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A STUDY OF CORRELATION BETWEEN METACOGNITIVE COMPETENCIES AND ATTITUDE TOWARDS SCIENCE AMONG SECONDARY SCHOOL STUDENTS

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ABSTRACT:
The paper aims to find correlations between metacognitive competencies and attitude towards among Secondary School Students in Mumbai. This study was conducted at a Secondary School offering the State Board syllabus in Mumbai. The researcher used the Metacognitive Awareness Inventory (Schraw, G., & Dennison, R.S. (1994) to measure metacognitive competencies. The researcher developed a self-rating, 4-point Likert scale to measure attitude towards Science. The results show that secondary school students are substantially high on metacognitive competencies and have a substantially significant positive attitude towards Science. There is a moderate positive linear relationship between metacognitive competencies and attitude towards Science of secondary school students. A Pearson correlation coefficient r of 0.468 indicates a moderate positive linear relationship between metacognitive competencies and attitude towards Science competencies among secondary students. Since the p-value <0.05, the correlation is statistically significant. The results show that the students with higher metacognitive competencies demonstrate a positive attitude towards Science.

Keywords: *Metacognitive Competencies, Metacognitive Awareness Scale, Attitude Towards Science, Secondary School Students.*

INTRODUCTION

The relationship between metacognition and science is immense. Metacognitive competencies provide the ways of learning, and a positive attitude towards Science increases curiosity and motivation to learn science and solve scientific problems. Learning depends upon an individual's desire to acquire knowledge and develop new perspectives. This desire stems from a very complex concept, namely attitude. Gordon Allport, defined attitude as "a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related." (Fazio R. 2009).

A combination of high metacognitive competencies and a positive attitude towards Science can contribute immensely to students' success in Science and Technology. Fostering metacognitive competencies while learning Science will make students lifelong learners capable of dealing with modern challenges. This study focuses on the correlation between metacognitive competencies and Attitude towards Science among Secondary School Students.

CONCEPTUAL FRAMEWORK

Metacognitive Competencies

Flavell (1979) defined metacognition as "knowledge that takes as its object or regulates any aspect of any cognitive endeavor"(p.906). The prefix 'meta' means 'about' the thing itself Metacognition is "thinking about thinking." Or "learning about learning" (Cambridge Assessment International Education, 2019). This refers to the "self-regulation" that effective learners exhibit, meaning they are aware of their learning process and can measure how efficiently they are learning as they study (Jaleel S & Premachandran. P 2016). The prefix 'meta' means 'about' the thing itself. So, metacognition is 'cognition about cognition', or 'thinking about one's thinking'. (Cambridge Assessment International Education, 2019).

Metacognition competencies have two dimensions: self-knowledge and self-regulation. (Cambridge Assessment International Education, 2019).

Self-Knowledge: Students who are metacognitively aware demonstrate self-knowledge. Students' thinking about the specific subject content. For example, I can easily remember tables; however I have trouble remembering capitals. Students know what strategies and conditions to use to facilitate learning.

Self-Regulation: refers to students' knowledge about the implementation of strategies and the ability to monitor the effectiveness of their strategies. For example- student knows to learn chemical equations, it is better to write and practice. For example use of mnemonics to remember to recall certain concepts.

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Attitude Towards Science

Attitude towards Science is an outcome of teaching and learning of Science. Attitude towards Science is a virtue that is reflected in a person's behaviour and actions towards Science. Attitude toward Science includes the "feelings, beliefs, and values held about an object that may be the enterprise of Science, school Science, and the impact of Science on society or scientists themselves" (Osborne et al., 2003, p.1053). Attitude is the response of students towards learning Science, that is, having a favourable or non-favourable attitude towards Science and scientists, interest or disinterest in Science activities, desire or desire to pursue Science for higher studies or in a career, and having enjoyment/boredom in Science learning experiences.

Review of Related Literature

1. Mellona J. and Angeles, H (2025) in their study on "Exploring The Relationship Between Attitudes Toward Science And Basic Process Skills Among Grade 12 STEM Students" employed a descriptive-correlational research design and gathered data from 76 Grade 12 STEM students through survey questionnaires. Their study revealed that students had very good attitudes toward Science due to Science confidence, enjoyment and utility. The inferential statistics revealed a highly significant positive relationship between Grade 12 STEM students' attitudes toward Science and basic process skills.

2. Willison J., Draper C., Fornarino L., Li M., Sabri T., Shi Y., & Zhao X. (2024) in their study on "Metacognitively ALERT in science: literature synthesis of a hierarchical framework for metacognition and preliminary evidence of its viability" emphasized that the development of student metacognition has the potential to provide some of the greatest learning gains in science education, even outstripping the contribution of general intelligence. They presented an integrative literature review of metacognition studies that draws together metacognitive knowledge and metacognitive skills into a hierarchical framework. As a preliminary test of its viability, the AMERT framework analysed interview data in which there was evidence of rich metacognitive thinking by students in the fourth, research-focused, year of a science degree.

3. Araes S., Apad P. et al. (2024) studied "Process Skills And Attitude Towards Science As The Contributing Factors In Cognitive Performance Among Special Science Class Students: A Quantitative Study" among Special Science Class students in High School, Philippines. There was a significant relationship and high correlation between process skills and cognitive performance, and a significant relationship for attitudes towards Science and cognitive performance. The overall level of process skills and attitude towards Science are contributing factors to cognitive performance among Special Science Class students was high.

4. Rivas S., Saiz C., & Ossa C. (2022), in their study on "Metacognitive strategies and development of critical thinking in higher education." Presented an intervention proposal to develop critical thinking and meta knowledge skills of showing whether instruction in critical thinking (ARDESOS-DIAPROVE) influences students' metacognitive processes. This study shows critical thinking increases with metacognitive processes.

5. A study by Tai R., Ryoo J. et al. (2022) titled "(Re-)Designing A Measure Of Student's Attitudes Toward Science: A Longitudinal Psychometric Approach," used a sample of 2016 self-reported responses from 6 and 7th grade students. This study of student's attitude towards Science potentially inform STEM education equity efforts on how instructional strategies and environments may differentially impact Science attitudes of subgroups of students.

6. Biscocho S. (2021) in the study "Metacognitive Knowledge, Skills And Attitude Of Science Technology And Society Students Across Programs", showed significant difference among the scores of students' metacognition according to course or programs. Metacognition was rated the highest among communication students (4.46) and lowest among management students (4.16). The overall mean metacognition (4.35) and the standard deviation (0.439) correspond that first-year students have metacognition. Furthermore, first-year students agree that they have metacognitive knowledge of (4.20), metacognitive skills of (4.07) and metacognitive attitudes of (4.03) in the course STS regardless of their programs.

Research Gap

This study aims to determine whether learning about learning and having self-regulation to use the learning strategies that work best and maximise success in Science fosters a positive attitude towards Science. There are various models and frameworks involving increased metacognitive competencies while learning Science. It is found to have a positive and moderate association between attitude toward Science and achievement in Science; however, if this is related to metacognitive competencies. This study aims to address a significant research gap by examining the attitude towards Science and metacognitive competencies among secondary school students in Mumbai. While past studies have explored these factors individually or in different contexts, no comprehensive research has investigated their relationship within this specific area. By including a specific sample of

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secondary school students, this study seeks to provide valuable insights into metacognitive competencies that correlate with attitude towards Science.

OBJECTIVES OF THE STUDY

The following were the objectives of the study;

1. To find out the metacognitive competencies of secondary school students.
2. To find out the attitude of secondary school students regarding Science.
3. To find out the relationship between the metacognitive competencies of secondary school students and their attitude towards Science.

Null Hypotheses

1. Metacognitive competencies of secondary school students are not significantly high.
2. There is no significant positive attitude among the secondary school students towards Science
3. There is no correlation between the metacognitive competencies of secondary school students and their attitude towards Science.

Research Methodology

The Descriptive Survey Method was used for the study. The subjects of the study were Grade IX students in a State Board School, Mumbai district, Maharashtra state, India.

Sample

A sample of 55 students from a State Board School in Mumbai District was selected by the purposive sampling method. The sample consisted of male and female Grade IX students.

Research Tools

The researcher used the Metacognitive Awareness Inventory (Schraw, G., & Dennison, R.S. (1994) to measure metacognitive competencies.

Tools were developed by the investigator to study the major objectives. The tools were validated for specificity and objectivity. The Likert scale used in the tools was 4-point where strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD). Each positive item on the instrument has values: SA = 4, A = 3, D = 2, and SD = 1. The score is reversed for negative items. The reliability coefficient was calculated for each of the tools and is as shown in Table 1.

Table 1: Reliability of the developed tools

Tools	Cronbach's alpha
4-point Likert Scale for Attitude Towards Science among secondary School students.	0.783

Analysis and Interpretation of Data

Descriptive Analysis for the scores of metacognitive competencies of Secondary school students and attitude towards Science.

Table 2: Descriptive statistics for the scores on metacognitive competencies and attitude towards Science.

	Sample Size (N)	Mean Score	Standard deviation	Skewness	Kurtosis
Metacognitive competencies	55	38.69	10.75	-0.11	-1.62
Attitude towards Science	55	75.73	12.95	0.12	-0.57

DISCUSSION

1. The mean score of metacognitive competencies was 38.69 with a standard deviation of 10.75. The negative skewness shows the distribution is left-skewed. Since the skewness value is 0.11, which is between -0.5 and 0.5, it is considered moderately skewed. The kurtosis value of 0.51, data is slightly leptokurtic. However since value is close to zero, data is considered normally distributed.
2. The mean score of attitude towards Science is 75.73 with a standard deviation of 112.95. The positive skewness shows the distribution is right-skewed. Since the skewness value is -0.57. However since value is close to zero, data is considered normally distributed.

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Inferential Analysis

Testing Hypothesis 1: Metacognitive competencies of secondary school students are not significantly high.

Calculation of the percentage mean score of metacognitive competencies among the Grade IX students

Percentage mean score = (Mean Score – Lowest Possible Score) x 100

(Highest Possible Score- Lowest Possible Score)

Table 3: Calculation of the percentage mean score of metacognitive competencies

Mean Score	38.69
Highest Possible Score	52
Lowest Possible Score	0
Percentage Mean score	74.41

Table 4: Interpretation of percentage Mean Score

Percentage Mean	Magnitude
0-20	Negligible
21-40	Low
41-60	Moderate
61-80	Substantial
81-100	Very High

The percentage mean score is substantial. The percentage mean score of metacognitive competencies among the grade IX students is found to be substantial. So the null hypothesis, "There is no significant positive opinion among the secondary school students regarding multidisciplinary approach", is rejected.

Inference: Secondary School students are substantially high on metacognitive competencies.

Testing Hypothesis 2: There is no significant positive attitude among the secondary school students towards Science.

Calculation of the percentage mean score of attitude towards Science among the Grade IX students

Percentage mean score = (Mean Score – Lowest Possible Score) x 100

(Highest Possible Score- Lowest Possible Score)

Table 5: Calculation of the percentage mean score of attitude towards Science

Mean Score	75.73
Highest Possible Score	108
Lowest Possible Score	27
Percentage Mean score	60.16

The percentage mean score is 60.16. The percentage mean score of attitude towards Science among the grade IX students is found to be substantial. So the null hypothesis, " Social competencies of the secondary school students are not significantly high", is rejected.

Inference: Secondary School students have a substantially significant positive attitude towards Science.

Testing Hypothesis 3: There is no correlation between the metacognitive competencies of secondary school students and their attitude towards Science.

Table 6: Pearson's Correlation between metacognitive competencies and attitude towards Science.

	Mean	Percentage mean score	r	t	P value		Remark
Metacognitive Competencies	38.69	74.41	0.468	3.86	One-tailed	0.0001	Moderate positive linear relationship
Attitude Towards Science	75.73	60.16			Two-tailed	0.0003	

From the table 6, it is observed that the mean scores for metacognitive competencies and attitude towards Science are 38.69 and 75.73. The calculated t-value is 3.86, which is more t than the table value of 2.01 at the 0.05 level of significance. This shows that there is significant relationship between metacognitive competencies and attitude towards Science of secondary school students. So the null hypothesis, "There is no

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correlation between the metacognitive competencies of secondary school students and their attitude towards Science." is rejected. A Pearson correlation coefficient r of 0.468 indicates a moderate positive relationship between metacognitive competencies and attitude towards Science among secondary students. Since one-tailed p-value is 0.0001 and two-tailed p-value is 0.0003 both p-values are less than 0.05, the correlation is statistically significant. The result shows that students who have high metacognitive competencies will demonstrate a positive attitude towards Science among secondary school students in Mumbai.

Inference: There is a moderate positive linear relationship between metacognitive competencies and attitude towards Science of secondary school students.

FINDINGS

The findings of the study are as follows;

1 Secondary School students are substantially high on metacognitive competencies.

2 Secondary School students have a substantially significant positive attitude towards Science.

3 There is a moderate positive linear relationship between metacognitive competencies and attitude towards Science of secondary school students.

CONCLUSION

Conclusions were drawn based on the results of the study. The findings of the study imply that students are substantially high on metacognitive competencies. That means they know what strategies and conditions work best for them while they are learning. Secondary School students have a substantially significant positive attitude towards Science. The findings of the study imply that students with higher metacognitive competencies demonstrate a positive attitude towards Science.

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