# RELATIONSHIP BETWEEN METACOGNITIVE AWARENESS AND ACADEMIC ACHIEVEMENT IN SCIENCE OF SECONDARY SCHOOL STUDENTS

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## ABSTRACT

***Context:*** *Metacognitive awareness enables an individual to become aware of thinking about own thinking. Science is a compulsory part of school education in India, the results of different boards reflects that a large part of students fail in science due to factors related to the learners, and metacognitive awareness has an important role in learning, so it is very important to study the relationship between metacognitive awareness and academic achievement in science. The aim of the paper is to study the significant difference in metacognitive awareness and academic achievement in science of secondary school students. It also focuses on the relationship between metacognitive awareness and academic achievement in science of secondary school students with age. Descriptive research methodology was used in this research A sample of 84 students was selected but 68 students participated and the sample was selected by purposive sampling technique from Govt. High School Sec- 20 D, Chandigarh, and a descriptive research methodology was used. Metacognitive awareness was measured by a metacognitive awareness inventory developed by Schraw and Dennison (1994), and academic achievement in science was measured by a science achievement scale developed by Shivani & Rani (2018). Kurtosis, skewness, Q-Q plots, Mean, SD, t-test, and Pearson's correlation were computed for the adopted sample. There were no significant differences in metacognitive awareness based on gender but reported significant differences based on locality. There were no significant differences in academic achievement in science based on gender and locality. It was also found that there was a mild positive relationship between metacognitive awareness and academic achievement in science.*

***Keywords:*** *Metacognitive Awareness, Knowledge of Cognition, Regulation of Cognition, Academic Achievement in Science, Gender, Locality.*

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## INTRODUCTION

John H. Flavell introduced the concept of metacognition, and it plays an important role in learning (Ochilova, 2021). Metacognition is cognition about cognition and it consists of four important components metacognitive knowledge, metacognitive experiences, goals or tasks, and actions or strategies (Flavell, 1979). Metacognitive awareness refers to knowing about own thinking and learning, it can be facilitated by introspection and self-evaluation, and facial expression recognition enables it to be visible in a collaborative context (Cini et al., 2023) and it consists of knowledge of cognition and regulation of cognition (Schraw & Dennison, 1994; & Kallio et al., 2018). Metacognitive knowledge is multidimensional, and metacognitive awareness can be constructed by promoting general awareness of the importance of metacognition, improving knowledge of cognition, improving regulation of cognition, and fostering environments (Schraw, 1998) and metacognitive-based learning propagates through identification, defining the problem, examining the solution, acting the strategy, the last look back, and evaluation to foster metacognitive awareness (Novia et al., 2018). Metacognitive awareness of reading strategies is assessed as global, problem-solving, and support reading strategies (Mokhtari & Reichard, 2002).Individuals differing in study profiles require different types of support for metacognitive awareness (Tuononen et al., 2023).

Academic achievement refers to the performance outcomes of a person in attaining the specific goals of the instructional environments in school, college, and university. It is a multifaceted construct and it includes various educational outcomes, in fact, the definition of academic achievement relies on the indicators used to measure it. It can be measured in terms of GPA (grade point average) or the SAT (Scholastic Assessment Test). It is based on the educational degrees one attains and influences one's further education and vocational career after completion of education (Steinmayr & Wirthwein, 2014).Academic causal factor, student causal factor, and learning milieu determine achievement in science (Paring et al., 2021).Parental involvement affects science achievement (Wang & Li, 2023), however, positive attitudes, higher prior knowledge of students and computer simulations result in higher academic achievement (Jere &Mpeta, 2024).Academic achievement and problem-solving ability were positively related, while examination anxiety and academic achievement

were negatively related (Bala & Shaafiu, 2016), academic achievement and study habits had a significant relationship (Singh & Mahipal, 2015). Metacognitive prompts with cooperative learning had positive effect on metacognitive awareness and EFL writing (Teng, 2022).

Self-confidence and grade point average affect metacognitive awareness (Bozgun & Akin-Kostereliogl u, 2023). The formative assessment instructional approach (Wafubwa & Csikos, 2022), and learning analytics-assisted recommendations and guidance feedback (Yilmaz, 2022) affect both metacognitive awareness and academic achievement.

Metacognitive awareness positively affects academic motivation (Huseyin, 2016), the ability to write explanatory text and other writing skills (Ramadhanti & Yanda, 2021), listening performance (Goh & Hu, 2014), academic performance (Nguyen et al. 2023), task performance in collaborative learning tasks (Cini et al., 2020), and understanding of the nature of science (Goren & Kaya, 2022).

## RATIONALE OF THE STUDY

Developing metacognitive awareness is an important component in teaching and learning, whether a learner knows what to study, how best to study it, or what has been learned makes the learners innovative and efficient (Wade & Reynolds, 1989). Self-regulation-based practices improve science learning (Schraw et al., 2006) and metacognitive interventions enhance academic performance in science (Famarin, 2024). Teachers generally use metacognitive strategies in science classrooms, and these can be incorporated by young teachers during their teaching practices to enhance science learning (Durukan et al., n. d.).Metacognitive skills affect science achievement (Al-Balushi et al., 2022) and metacognition is integrated into online science learning by awareness, using essential questions, planning, monitoring, evaluating, and reflecting. Individual differences affect learning and metacognition, so it is needed to conduct further research in this field (Maryani et al., 2022).

## SETTINGS AND DESIGN

In this study, descriptive research methodology, as a survey was used in secondary schools of Chandigarh to study metacognitive awareness and academic achievement in science.

## MATERIALS AND METHODS

The population consisted of all the students studying in secondary schools in Chandigarh. A sample of 84 students of the 9th class was selected from Govt. High School Sec-20 D, Chandigarh, by purposive sampling, and only 68 students participated in this research.

## OBJECTIVES

The following objectives were formulated in this study

1. To study the significant difference in metacognitive awareness of secondary school students.
2. To study the significant difference in academic achievement in science of secondary school students.
3. To study the relationship between metacognitive awareness and academic achievement in science of secondary school students.

## HYPOTHESES

The following hypotheses were formulated in this study

$H_{O1}$: There is no significant difference in metacognitive awareness of secondary school students.

$H_{A1}$: There is a significant difference in metacognitive awareness of secondary school students.

$H_{O2}$: There is no significant difference in academic achievement in science of secondary school students.

$H_{A2}$: There is a significant difference in academic achievement in science of secondary school students.

$H_{O3}$: There is no significant relationship between metacognitive awareness and academic achievement in science of secondary school students.

$H_{A3}$: There is a significant difference in academic achievement in science of secondary school students.

## STATISTICAL TOOLS USED IN THE STUDY

Metacognitive awareness inventory developed by Schraw and Dennison (1994),and achievement in science scale developed by Shivani and Rani (2018) were used to collect the research data.

### Statistical Techniques Used in the Study

Skewness and Kurtosis, Q-Q plots, Mean, SD, t-test, and Pearson's correlation analysis were used in this study.

### Data Analysis and Interpretation

**Section: I. Computation of Normality of Data.**

**Table No. 1: Normality of metacognitive awareness and academic achievement in science.**

| Variable | N | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Metacognitive Awareness | 68 | 196.54 | 16.69 | .119 | .291 | -.502 | .574 |
| Academic Achievement in Science | 68 | 21.20 | 3.30 | -.046 | .291 | -.789 | .574 |

From entries in the Table no. 1, it is found that the calculated values of metacognitive awareness of skewness and kurtosis were .119 and -.502, and calculated values of academic achievement in science of skewness and kurtosis were -.046 and -.789, which are in range (-1 to +1) for skewness and (-3 to +3) for kurtosis, these are insignificant, so the data is normally distributed.

Also, in figure 1 and figure 2, it is found that the data was near the straight line, and points are not much scattered, so data was found to be normal both for metacognitive awareness and academic achievement in science, so the parametric analysis was selected for differential analysis in this study.

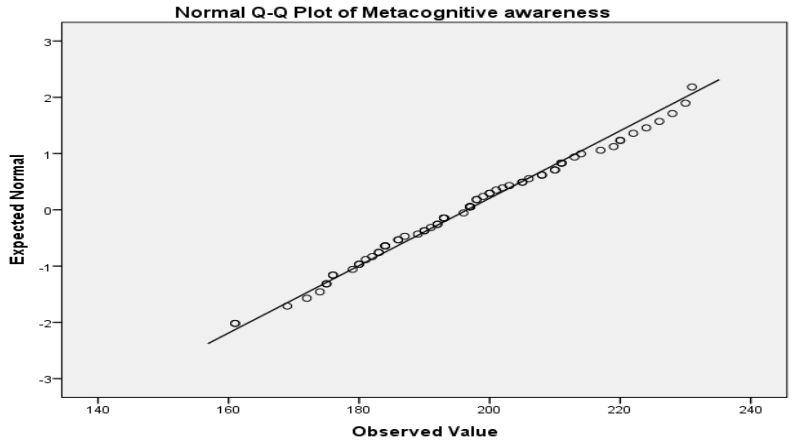


**Figure No. 1**

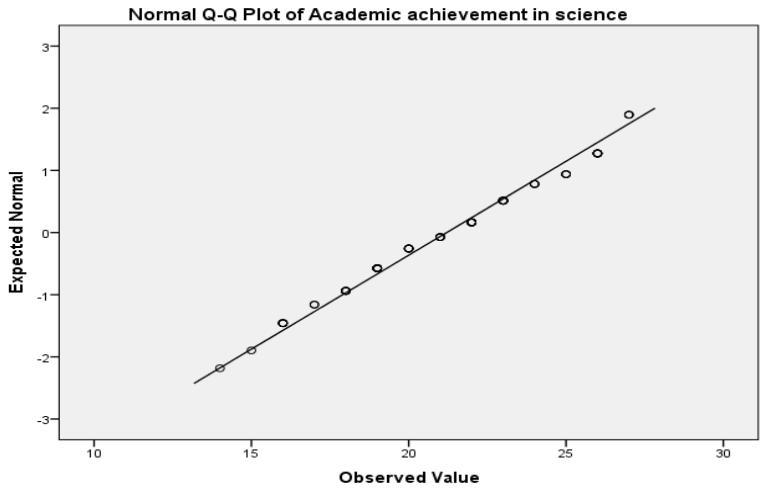


**Figure No. 2**

**Section: II. Differential analysis of metacognitive awareness and academic achievement in science.**

**a. Differential analysis of metacognitive awareness**

$H_{O1}$: There is no significant difference in metacognitive awareness of secondary school students.

$H_{O1.1}$: There is no significant difference in metacognitive awareness of secondary school students on gender basis.

$H_{O1.2}$: There is no significant difference in metacognitive awareness of secondary school students on locality basis.

**Table No. 2: Metacognitive Awareness of Secondary School Students on Gender Basis**

| Variable | Gender | N | Mean | Std. Deviation | t-value | Sig |
|---|---|---|---|---|---|---|
| Metacognitive Awareness | Male | 31 | 193.61 | 17.05 | 1.333 | .187 |
| | Female | 37 | 199.00 | 16.20 | | |

***Significance Level = 0.05 and df = 66**

It was found in Table no. 2, that the mean and SD of metacognitive awareness of male students were 193.61 and 17.05, and for female students were 199.00 and 16.20 respectively. The calculated t-value was 1.33 and lower than the table t-value = 1.96 at a level of significance 0.05 at df 66 however, p = .187> .05, so it was found statistically insignificant, hence there was no significant difference in metacognitive awareness of secondary school students. So, $H_{O1.1}$: There is no significant difference in metacognitive awareness of secondary school students on gender basis, is accepted.

**Table No. 3: Metacognitive Awareness of Secondary School Students on Locality Basis**

| Variable | Locality | N | Mean | Std. Deviation | t-value | Sig. |
|---|---|---|---|---|---|---|
| Metacognitive Awareness | Rural | 16 | 194.81 | 19.14 | 4.72 | .039 |
| | Urban | 52 | 197.07 | 16.03 | | |

***Significance Level = 0.05 and df = 66**

It was found in Table no. 3, that the mean and SD of metacognitive awareness of rural students were 194.81 and 19.14, and for urban students were 197.07 and 16.03 respectively. The calculated t-value was 4.72 and higher than the table t-value = 1.96 at a level of significance 0.05 at df 66 however, p = .039< .05, so it was found statistically significant, hence there was a significant difference in metacognitive awareness of secondary school

students. So, $H_{O1.2}$: There is no significant difference in metacognitive awareness of secondary school students on locality bases, is rejected.

Therefore, $H_{A1.2}$: There is a significant difference in metacognitive awareness of secondary school students on locality bases is accepted and the alternative hypothesis shifted towards urban students and described that urban students had a higher metacognitive awareness than the rural students.

**b. Differential analysis of academic achievement in science**

$H_{O2}$: There is no significant difference in academic achievement in science of secondary school students.

$H_{O2.1}$: There is no significant difference in academic achievement in science of secondary school students on gender basis.

$H_{O2.2}$: There is no significant difference in academic achievement in science of secondary school students on locality basis.

**Table No. 4: Differential analysis of academic achievement in science on a Gender basis**

| Variable | Gender | N | Mean | Std. Deviation | t-value | Sig. |
|---|---|---|---|---|---|---|
| Academic Achievement in Science | Male | 31 | 21.45 | 3.11 | .558 | .579 |
| | Female | 37 | 21.00 | 3.48 | | |

***Significance Level = 0.05 and df = 66**

It was found in Table no. 4, that the mean and SD of academic achievement in science of male students were 21.45 and 3.11, and for female students were 21.00 and 3.48 respectively. The calculated t-value was .558 and lower than the table t-value = 1.96 at a level of significance 0.05 at df 66 however, p = .579> .05, so was found statistically insignificant, hence there was no significant difference in academic achievement in science of secondary school students. So, $H_{O2.1}$: There is no significant difference in academic achievement in science of secondary school students on locality bases, is accepted.

**Table No. 5: Differential analysis of academic achievement in science on locality basis**

| Variable | Locality | N | Mean | Std. Deviation | t-value | Sig. |
|---|---|---|---|---|---|---|
| Academic Achievement in Science | Rural | 16 | 20.37 | 3.30 | .014 | 0.905 |
| | Urban | 52 | 21.46 | 3.29 | | |

***Significance Level = 0.05 and df = 66**

It was found in Table no. 5, that the mean and SD of academic achievement in science of rural students were 20.37 and 3.30, and for urban students were 21.46 and 3.29 respectively. The calculated t-value was .014 and lower than the table t-value = 1.96 at a level of significance 0.05 at df 66 however, p = .905> .05, so it was found statistically insignificant, hence there was no significant difference in academic achievement in science of secondary school students. So, $H_{O2.2}$: There is no significant difference in academic achievement in science of secondary school students on locality bases, is accepted.

**Section: III. Relationship between metacognitive awareness and academic achievement in science.**

$H_{O3}$: There is no significant relationship between metacognitive awareness and academic achievement in science of secondary school students.

**Table No. 6: Relationship between metacognitive awareness and academic achievement in science.**

| Variable | N | Pearson's r | Sig |
|---|---|---|---|
| Metacognitive awareness | 68 | 1 | 0.130 |
| Academic achievement in science | 68 | .185 | |

Entries in Table no 6, revealed that there is a mild positive relationship between metacognitive awareness and academic achievement in science. The calculated (r = .185, p =

0.130> .05), is found insignificant, so $H_{O3}$: There is no significant relationship between metacognitive awareness and academic achievement in science of secondary school students is accepted.

## DISCUSSION OF THE RESULTS

It was concluded that there were no significant differences in metacognitive awareness based on gender, but significant differences were reported based on locality. There were no significant differences in academic achievement in science based on gender and locality. It was also found that there was a mild positive relationship between metacognitive awareness and academic achievement in science. Our findings support the previous studies conducted by Young and Fry (2008), who reported that MAI is positively related to academic achievement. Memnuna and Akkaya (2009) found no significant difference in candidate teachers' metacognitive awareness on gender basis, but significant differences based on class levels. Butvilas et al. (2023) found no significant difference in subcomponents of metacognitive awareness on gender basis however; age and the field of study were related to sub-components of metacognitive awareness. Abdellah (2015) founda significant difference in metacognitive awareness of pre-service teachers and a positive relationship was reported between metacognitive awareness and academic achievement. Sawhney and Bansal (2015) reported significant differences in academic achievement of undergraduate students on gender basis, but no significant differences in metacognitive awareness on gender basis. However it was reported that academic achievement affects metacognitive awareness. Ozcakmak et al. (2021) reported no significant differences in metacognitive awareness based on gender, but significant differences in metacognitive awareness were reported based on age, and it was found that academic achievement affect metacognitive awareness. Cihanoglu (2012) reported no significant differences in metacognitive awareness based on gender, high school type graduated, type of education, and grade point averages. Turan et al. (2009) found no significant differences in metacognitive awareness based on gender, curricular language, or exposure, and there were no significant differences in SRLPS scores based on gender. Ozsoy and Gunindi (2011) reported no significant differences based on gender and type of school, but reported significant differences in metacognitive awareness based on prospective teacher's grade. There were no significant differences in academic achievement in science based on private school and government school and locality however, there were significant

difference in academic achievement in science on gender basis (Bourah& Soni 2016; & Lalrinmawia & Fanai 2020).

## EDUCATIONAL IMPLICATIONS

1. This study found a mild positive relationship between metacognitive awareness and academic achievement in science, so its findings can be used to improve learning outcomes in science for students.
2. This study found a significant effect of gender and locality on metacognitive awareness and academic achievement in science, so these variables must be kept in mind during teaching science classrooms.
3. These findings are useful for teachers, students, and researchers who are engaged in the related field of this research.

## SUGGESTIONS FOR FURTHER RESEARCH

1. The investigators can study metacognitive awareness and academic achievement in science based on other demographic variables.
2. The investigator can study the cause, why gender and locality had affected metacognitive awareness and academic achievement in science differently.
3. Further research can be conducted to study the relationship of metacognitive awareness with other variables.
4. The effect of metacognitive awareness on academic achievement in science can be studied in further studies.
5. The researcher can use other research tools to verify our findings.
6. The investigators can adopt a large sample size in further research.
7. The investigators can conduct similar research in other school subjects, and in higher or vocational institutions also

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