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**Research Article**

# Investigating the Interplay of Self-Regulated Learning, School Types and Gender on Metacognitive Abilities among Senior Secondary Students

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**ABSTRACT**

In this study, the researcher is investigating the influence of self-regulated learning, school types (government vs. private), and gender (male vs. female) on metacognitive abilities among senior secondary students. Self-regulated learning is categorized into high and low effectiveness, while school types and gender are considered as independent factors. Metacognitive abilities serve as the dependent variable. A descriptive survey approach is being employed, utilizing a multi-stage stratified random selection to choose 750 students as the sample. For this study, the researcher solely uses a Punita Govil-developed Metacognition Inventory (MCI) questionnaire (2011), and Gupta and Mehtani's (2017) Self-Regulated Learning Scale to gather the information. The primary effect of self-regulated learning, school type, and gender on metacognitive abilities among senior secondary school students is being identified as significant using a three-way ANOVA with a 2×2×2 factorial design to evaluate the data. The study finds that the metacognitive abilities of senior secondary school students do not significantly vary based on self-regulated learning levels, school types (public and private), gender differences, or the interaction between self-regulated learning and school types. The interaction between gender and self-regulated learning does not significantly benefit students. The relationship between public and private school types and gender has a significant impact on metacognitive abilities. However, no significant combination effect is found for gender, school types, or self-regulated learning on metacognitive abilities among senior secondary school students. The study suggests that the relationship between self-regulated learning, school types, and gender does not significantly impact metacognitive abilities.

**Index Words:** High Effective Self-Regulated Learning, Low Effective Self-Regulated Learning, Government and Private Schools, Male and Female

**Keywords:** Self-Regulated Learning, Metacognitive Abilities, Types of schools, Gender and Senior Secondary School Students

## 1.1 Introduction

Education experts have long been interested in the elements that go into students' metacognitive skills because they understand how important these skills are for both academic success and lifetime learning. The understanding and management of one's own cognitive processes, or metacognition, is essential for efficient learning and problem-solving. The goal of the current study is to investigate how gender, school type, and self-regulated learning interact to shape students' metacognitive capacities in senior secondary school. A variety of cognitive functions, including organising, observing, and assessing one's own learning, are included in metacognitive skills. The importance of metacognition in predicting academic performance, adaptive problem-solving, and the development of lifelong learning abilities has been highlighted by earlier studies (Flavell, 1979; Schraw & Dennison, 1994).

In order to engage in self-regulated learning (SRL), students must actively organise their tasks, establish goals, and reflect on their learning. Numerous studies have shown that metacognitive skills and self-regulated learning are positively correlated (Zimmerman, 1989; Pintrich, 2000). The objective of this research is to elucidate the complex correlation between students' metacognitive competency and their self-regulatory behaviours. The impact of distinct school types, including private, specialised, and public ones, on metacognitive skills has not received enough attention in the literature. Divergent metacognitive development may result from differences in the curricula, methods of instruction, and resources used by various school types. It is essential to look at these possible variations in order to comprehend the larger picture of schooling.
The question of whether gender influences cognitive ability has been discussed; some research indicates that male and female students may differ in their metacognitive abilities (Voyer & Voyer, 2014). On the other hand, little is known about the kind and scope of these variations. By analysing how gender may interact with self-regulated learning and school kinds to impact metacognitive abilities, this study seeks to further this conversation. Although the effects of gender, school types, and self-regulated learning on metacognition have been studied in individual studies, there is a dearth of thorough research that incorporates these variables. An in-depth analysis of main effects and possible interactions is possible with the mixed-methods ANOVA methodology, providing a more comprehensive knowledge of the intricate interactions between various factors. In conclusion, by investigating the combined effects of self-regulated learning, school kinds, and gender, this study seeks to expand our knowledge of metacognitive development among senior secondary school students. The findings of this study might influence curriculum development, instructional strategies, and treatments meant to improve students' metacognitive skills.

### 1.2 Literature review on metacognitive abilities and self-regulated learning

Metacognition and self-regulated learning are integral components of effective learning processes, each contributing uniquely to the enhancement of cognitive abilities and academic achievement. This literature review explores the interplay between metacognition and self-regulated learning, emphasizing their theoretical foundations, empirical evidence, and implications for educational practices.

#### ❖ Theoretical Frameworks

#### 1. Metacognition

According to Flavell (1979), metacognition is the process of reflecting on one's own thought processes. It includes both metacognitive regulation (control over cognitive processes) and metacognitive knowledge (awareness of cognitive processes).Metacognition, the awareness and control of one's cognitive processes, plays a crucial role in learning and academic achievement. Studies conducted among Indian undergraduate students (Sarkar &Patil, 2019; Gupta &Mathur, 2018) have highlighted gender differences in metacognitive awareness and strategies, suggesting that males and females may employ different approaches to learning and comprehension tasks. Linnen brink-Garcia, Tyson, and Patall (2008) examined the conditions under which achievement goal orientations contribute to academic achievement, emphasizing the importance of contextual factors and individual differences. Lips (2017) provided insights into the psychology of women, exploring how gender, culture, and ethnicity intersect to shape identity and behavior.
Marsh and Yeung (1998) conducted longitudinal studies on academic self-concept and achievement, revealing gender differences in the development of math and English constructs. Meyer and Woodruff (1997) explored the alignment between self-efficacy beliefs and performance outcomes, underscoring the role of self-perceptions in influencing behavior and achievement. The Organisation for Economic Co-operation and Development (OECD, 2019) disseminated findings from the Programme for International Student Assessment (PISA) 2018, offering valuable insights into the factors affecting students' lives and educational experiences. Pajares and Valiante (2001) investigated gender differences in writing motivation and achievement, examining the role of gender orientation in shaping academic outcomes.

#### 2. Self-Regulated Learning

Self-regulated learning, which has its roots in Zimmerman's (1990) model and social cognitive theory (Bandura, 1986), entails students actively controlling their motivation, behavior, and cognitive processes in order to meet academic objectives. Boekaerts (1997) introduced the concept of self-regulated learning, emphasizing its relevance for various stakeholders in education, including researchers, policymakers, educators, and students. Deci and Ryan (2000) explored the underlying motivations and determinants of goal pursuits, stressing the importance of intrinsic motivation and psychological needs satisfaction in fostering self-determined behavior. Pintrich (2000) discussed the significance of goal orientation in self-regulated learning, emphasizing its impact on motivation, engagement, and learning strategies. Pintrich and Schunk (2002) provided a comprehensive overview of motivation in education, integrating theoretical perspectives with empirical research to comprehend the multifaceted nature of motivational processes.

## ❖ Components of Metacognition and Self-Regulated Learning

### 1. Metacognitive Knowledge and Planning

Effective planning is associated with metacognitive knowledge, which encompasses awareness of one's own strengths and deficiencies in self-regulated learning (Efklides, 2008). Higher degrees of self-regulation are seen by students who are able to arrange their learning activities carefully.Dweck (2006) introduced the concept of mindset, elucidating how individuals' beliefs about intelligence and learning significantly impact their approach to challenges and learning tasks. Eccles (2011) discussed gendered educational and occupational choices, applying a model of achievement-related choices to comprehend gender differences in academic and career pursuits.

### 2. Monitoring and Evaluation in Self-Regulated Learning

Self-regulated learning heavily relies on metacognitive processes such as monitoring and assessment. The significance of self-monitoring to gauge progress and self-evaluation to ascertain the efficacy of tactics is emphasised by Zimmerman (1989).Schunk and Zimmerman (2008) analyzed motivation and self-regulated learning, presenting theoretical insights and practical strategies for enhancing academic success. Winne and Hadwin (1998) explored studying as a form of self-regulated learning, stressing the importance of metacognitive awareness and regulation in optimizing learning outcomes.
Zimmerman (2000) offered a social cognitive perspective on achieving self-regulation, highlighting the influence of cognitive, motivational, and social factors on students' ability to regulate their learning effectively.

## ❖ Empirical Studies

### 1. Positive Correlation between Metacognition and Self-Regulated Learning

Metacognitive abilities and self-regulated learning (SRL) are fundamental aspects of education, profoundly influencing students' academic performance and achievement. Anderman and Anderman (1999) delved into the social predictors of changes in students' achievement goal orientations, emphasizing the crucial role of social factors in shaping motivational beliefs and behaviors. Bandura (1997) highlighted the significance of self-efficacy beliefs in SRL, demonstrating how individuals' perceptions of their capabilities drive their learning processes and outcomes. Metacognition and self-regulated learning have been found to positively correlate in several research (Winne &Hadwin, 1998). Strong metacognitive abilities are associated with more successful self-regulated learning in students.The influence of school type on metacognitive abilities and self-regulated learning has also been investigated. Research conducted in various Indian regions, including Tamil Nadu (Murugan&Karunakaran, 2017), Mumbai (Kamat& Parikh, 2016), Delhi (Rajput & Singh, 2016), and Odisha (Das &Mohanty, 2018), suggests that different types of schools, such as government schools, private schools, and international schools, may provide varying levels of support for the development of metacognitive skills. Factors such as teacher-student ratios, teaching methodologies, and resource availability may contribute to these differences.Furthermore, studies have examined the relationship between self-regulated learning and metacognitive abilities among Indian school students (Sharma & Tiwari, 2019). Self-regulated learning involves the planning, monitoring, and evaluation of one's own learning process and has been found to be positively correlated with metacognitive abilities. Students who are more self-regulated tend to demonstrate higher levels of metacognitive awareness and effective learning strategies.

### 2. Reciprocal Relationship

According to research by Schellings and Van Hout-Wolters (2011), metacognitive abilities are improved by self-regulated learning activities and vice versa. The idea that self-regulated learning and metacognition complement one another is supported by this dynamic interaction.Additionally, gender differences in self-regulated learning and academic performance have been observed among Indian high school students (Mukherjee & Chatterjee, 2017; Agarwal &Verma, 2019). These studies suggest that males and females may exhibit varying levels of self-regulated learning behaviors, which could influence their academic outcomes.

## ❖ Educational Implications

### 1. Teaching Metacognitive Strategies for Self-Regulation

To improve self-regulation, educational interventions should emphasise the explicit teaching of metacognitive techniques (Pintrich, 2000). This might entail helping students plan, monitor, reflect on, and create goals for their learning. Else-Quest, Hyde, and Linn (2010) conducted a meta-analysis on cross-national patterns of gender differences in mathematics, revealing the intricate interplay of biological, social, and cultural factors influencing academic achievement. Hattie, Biggs, and Purdie (1996) conducted a meta-analysis on the effects

of learning skills interventions, demonstrating the efficacy of various instructional strategies in improving student learning outcomes.

### 2. Creating a Metacognitive and Self-Regulated Learning Environment

According to Efklides (2011), learning outcomes are enhanced in classroom contexts that promote metacognition and self-regulation. Teachers have the ability to create exercises that encourage students to consider their methods of learning and make objectives.

## 1.3 Research Questions:

**Q.1.** What are the main effects of self-regulated learning on metacognitive abilities among senior secondary school students?
**Q.2.** How do different school types (public and private) independently influence metacognitive abilities in senior secondary school students?
**Q.3.** What are the main effects of gender on metacognitive abilities among senior secondary school students?
**Q.4.** To what extent do self-regulated learning and school types interact in influencing metacognitive abilities?
**Q.5.** How do gender and self-regulated learning interact in shaping metacognitive abilities among senior secondary school students?
**Q.6.** What is the interaction between school types and gender in relation to metacognitive abilities?
**Q.7.** How do self-regulated learning, school types, and gender collectively influence metacognitive abilities among senior secondary school students?

## 1.4 Rationale of the Study:

The understanding of the complex and diverse nature of metacognitive development in senior secondary school pupils is the basis for the reasoning behind this study. According to Flavell (1979), metacognitive skills are essential for both academic achievement and lifelong learning. These skills include the ability to organise, monitor, and evaluate one's own learning. On the other hand, complex webs of interrelated factors influence these skills. Self-regulated learning (SRL), in which students actively control their cognitive processes, is essential to academic success. The inclusion of self-regulated learning (SRL) in the study is grounded in a body of research that shows a positive correlation between SRL and metacognitive skills (Zimmerman, 1989; Pintrich, 2000). For a complete picture, it is crucial to comprehend how self-regulated learning interacts with other factors to influence metacognitive abilities.

The diversity of educational experiences is influenced by variations in school types, such as public, private, and specialised institutions. The knowledge that various educational contexts may have distinct effects on metacognitive development forms the basis for the justification for researching school kinds. This fits well with the larger body of research that acknowledges the impact of contextual elements on cognitive and metacognitive functions (Schraw & Dennison, 1994). Gender disparities in metacognitive capacities may exist, and this is acknowledged by including gender as a variable (Voyer&Voyer, 2014). Studies have indicated that male and female students differ in their cognitive abilities. It is important to investigate these differences in order to address possible inequalities and create gender-sensitive teaching practices.

The reasoning for the study also considers how it can affect teaching methods. The investigation's findings may help educators and policymakers adjust their teaching strategies in light of students' gender, school type, and self-regulated learning behaviours. This is consistent with the overarching objective of enhancing learning outcomes and cultivating a more welcoming learning environment. A thorough study that goes beyond simple correlations is required, which is why a mixed-methods ANOVA technique was chosen. The statistical rigour that quantitative analysis offers makes it possible to identify primary effects and interactions between variables. Qualitative insights also contribute to the studies overall validity and reliability by providing a better grasp of contextual elements and aiding in the interpretation of quantitative findings.

The justification also arises from a vacuum in the literature, since research usually concentrates on individual elements instead of analysing their overall impact. By providing a more comprehensive knowledge of the metacognitive development of senior secondary school pupils, our research helps close this gap.

## 1.5Variables

Define the key variables:

- Independent Variables: Self-regulated learning, school types, gender
- Dependent Variable: Metacognitive abilities

### 1.6 Objectives of the Study

**Ob.1.** Assess the impact of self-regulated learning on metacognitive abilities among senior secondary school students.
**Ob.2.** Investigate how different school types (public and private) independently influence metacognitive abilities in senior secondary school students.
**Ob.3.** Analyze the main effect of gender on metacognitive abilities among senior secondary school students.
**Ob.4.** Examine the interaction between self-regulated learning and school types in shaping metacognitive abilities.
**Ob.5.** Explore the interaction between gender and self-regulated learning in influencing metacognitive abilities.
**Ob.6.** Investigate the interaction between school types and gender in relation to metacognitive abilities.
**Ob.7.** Assess how self-regulated learning, school types, and gender collectively influence metacognitive abilities among senior secondary school students.

### 1.7Hypotheses of the Study

**Ho1.** There is no significant difference in metacognitive abilities among senior secondary school students based on their levels of self-regulated learning.
**Ho2.** There is no significant difference in metacognitive abilities among senior secondary school students based on the type of school they attend (public and private,).
**Ho3.** There is no significant difference in metacognitive abilities between male and female senior secondary school students.
**Ho4.** The interaction between self-regulated learning and school types does not significantly influence metacognitive abilities among senior secondary school students.
**Ho5.** The interaction between gender and self-regulated learning does not significantly influence metacognitive abilities among senior secondary school students.
**Ho6.** The interaction between school types and gender does not significantly influence metacognitive abilities among senior secondary school students.
**Ho7.** There is no combined influence of self-regulated learning, school types, and gender on metacognitive abilities among senior secondary school students.

### 2.0 Methodology:

**Sample:** Ensure that the sample of senior secondary school students is varied and includes both genders and a range of school types.

**Instruments:**1. Punita Govil's Metacognition Inventory (MCI) was used to complete the current study. Thirty items make up the test battery. This tool evaluates the cognitive processes and cognitive control.
2. To assess the validity of a self-regulated learning scale, Dr. Madhu Gupta and Ms. Dimple Mehtani employed the Split-Half Method. They scored 1 for each negative response and 5-4 for Strongly Agree, Neutral, Disagree, and Strongly Disagree on a six-dimensional SE Scale. It was determined that the reliability coefficient (r) was 0.88, significant at the 0.1 level. There was a.503 to.596 correlation coefficient for the SRLS dimensions. The validity of the scale was evaluated as well. NOVA may be used to examine variations in metacognitive skills between genders, school types, and self-regulated learning levels.

**Procedure:**Conduct evaluations while maintaining a consistent methodology, and gather information on gender, school type, metacognitive skills, and self-regulated learning. To investigate any interaction effects as well as the primary effects of gender, school style, and self-regulated learning, uses ANOVA.

### 3.0 Data analysis and interpretation

### 3.1 Anova for 2x2x2 Factorial Designs for Metacognitive Abilities with respect to self-regulated learning, Types of Schools and Gender of Senior Secondary School Students

The main and interaction effects of gender, school style, and self-regulated learning on the metacognitive abilities of senior secondary school students were investigated using an ANOVA (2x2x2). This section presents the division of all independent variables into distinct subparts. For example, self-regulated learning (D) was divided into two categories: high effective self-regulated learning (D1) and low effective self-regulated learning (D2); school type (B) was further subdivided into government schools (B1) and private schools (B2); and gender (C) was separated into male (C1) and female (C2). The study's 2x2x2 ANOVA design is shown in Figure 3.1. For many sub-samples, the means and standard deviations are given as descriptive statistics in Table 3.1 and Figure 3.2. The analysis of variance (2x2x2) framework is described in Table 3.2. The relationship between

metacognitive abilities and nonpartisan attributes, including gender, school type, and self-regulated learning abilities, in senior secondary school students

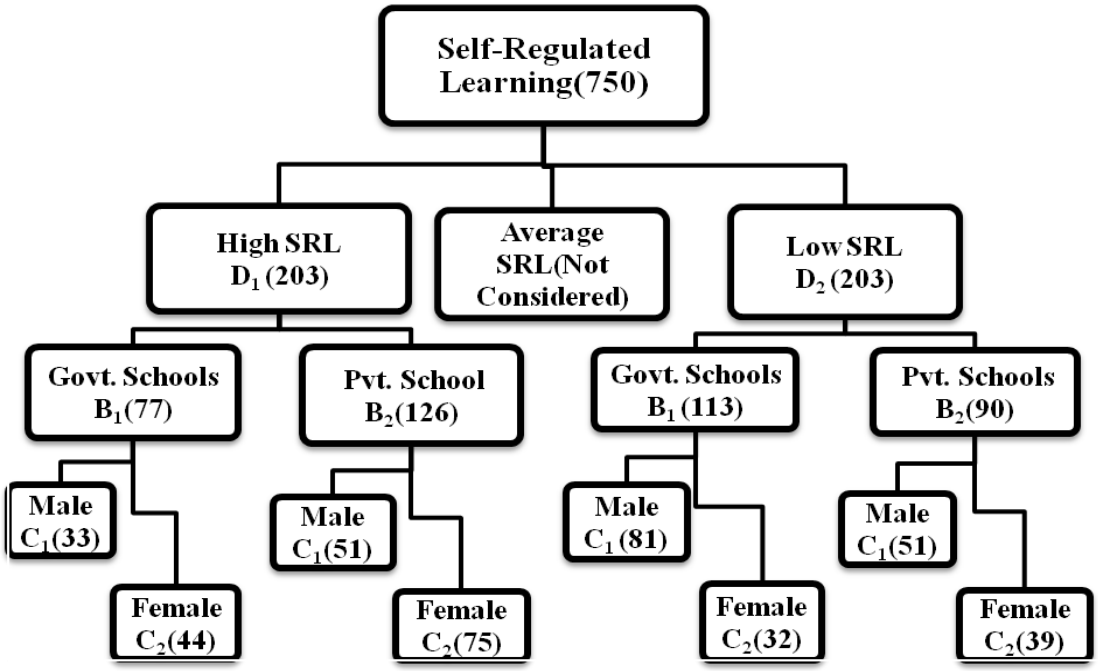


**Fig. 3.1 2x2x2 Factorial Designs for Effect of self-regulated learning, Types of Schools and Gender on Metacognitive Abilities of Senior Secondary School Students**

**Table: 3.1Mean's and $SD_S$ of sub-samples of 2 x 2 x 2 Design for Self-Regulated Learning, Types of Schools and Gender on Metacognitive Abilities of Senior Secondary School Students**

| Self-Regulated Learning (D) | Types of School (B) | Gender (C) | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| High Effective self-regulated learning (D1) | Govt. Schools Students (B1) | Male (C1) | 72.1515 | 17.82225 | 33 |
| | | Female (C2) | 65.6591 | 12.40207 | 44 |
| | Pvt. Schools Students (B2) | Male (C1) | 70.4902 | 17.07205 | 51 |
| | | Female (C2) | 68.5467 | 15.76028 | 75 |
| Low Effective self-regulated learning (D2) | Govt. Schools Students (B1) | Male (C1) | 82.0988 | 16.26930 | 81 |
| | | Female (C2) | 64.8750 | 14.74460 | 32 |
| | Pvt. Schools Students (B2) | Male (C1) | 92.7059 | 9.95047 | 51 |
| | | Female (C2) | 89.6410 | 7.77475 | 39 |

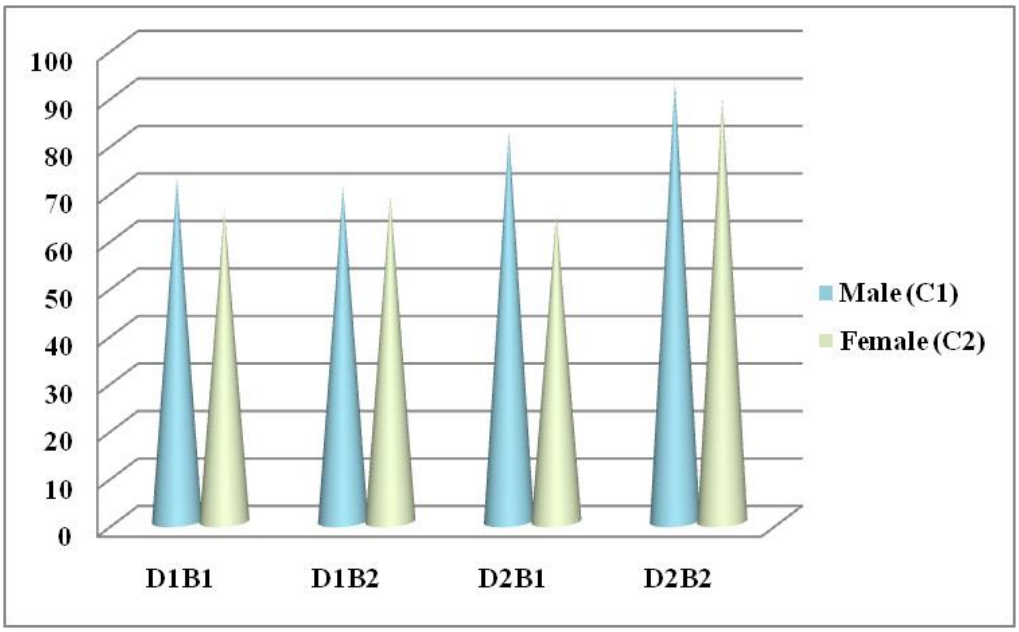


**Fig. 3.2: Mean Scores of (2x2x2) design for Metacognitive Abilities of Senior Secondary School Students with respect to Self-Regulated Learning, Types of Schools and Gender**

**Table: 3.2ANOVA for main effects on Metacognitive Abilities of Senior Secondary School Students in with respect to Self-Regulated Learning (D), Types of Schools (B ) and Gender (C)**

| Source of Variance | Sum of Squares (SS) | df | Mean Sum of Squares (MS) | f- ratios | Sig. level |
|---|---|---|---|---|---|
| **Main effects** | | | | | |
| D(self-regulated learning) | 15750.485 | 1 | 15750.485 | 73.842 | <.01 |
| B(Type of Schools) | 7662.433 | 1 | 7662.433 | 35.923 | <.01 |
| C(Gender) | 4719.826 | 1 | 4719.826 | 22.128 | <.01 |
| **Double interaction effects** | | | | | |
| D× B Interaction | 6669.925 | 1 | 6669.925 | 31.270 | <.01 |
| D×C Interaction | 803.621 | 1 | 803.621 | 3.768 | NS |
| B × C Interaction | 2002.001 | 1 | 2002.001 | 9.386 | 0.05 |
| **Triple Interaction Effects** | | | | | |
| D × B × C Interaction | 528.283 | 1 | 528.283 | 2.477 | NS |
| Between Cell | 84893.733 | 7 | 213.301 | - | - |
| With in cell | 2484522.000 | 398 | - | - | - |
| Total | 124241.369 | 405 | - | - | - |

### 3.2 Main effects of Self-Regulated Learning, Types of Schools and Gender on Metacognitive Abilities of Senior Secondary School Students

**Ho1.** There is no significant difference in metacognitive abilities among senior secondary school students based on their levels of self-regulated learning.

**Table: 3.3Comparison of High Effective Self-Regulated Learning ($D_1$) and Low Effective Self-Regulated Learning ($D_2$) on Metacognitive Abilities of Senior Secondary School Students**

| Group Compared | N | Mean | Std. Deviation | df | 't' Value | Level of Significance |
|---|---|---|---|---|---|---|
| High Effective Self-Regulated Learning(D1) | 203 | 68.9951 | 15.8393 | 404 | 9.1553 | 0.01 level |
| Low Effective Self-Regulated Learning(D2) | 203 | 83.4975 | 16.0775 | | | |

**Analysis:**From Table 3.3, it can be observed that the critical value on the t-table at a 0.05 level of significance is 1.97, and the 0.01 level of significance is 2.60.

**Interpretation:**According to the findings, hypotheses there is no significant difference in metacognitive abilities among senior secondary school students based on their levels of self-regulated learningare rejected.

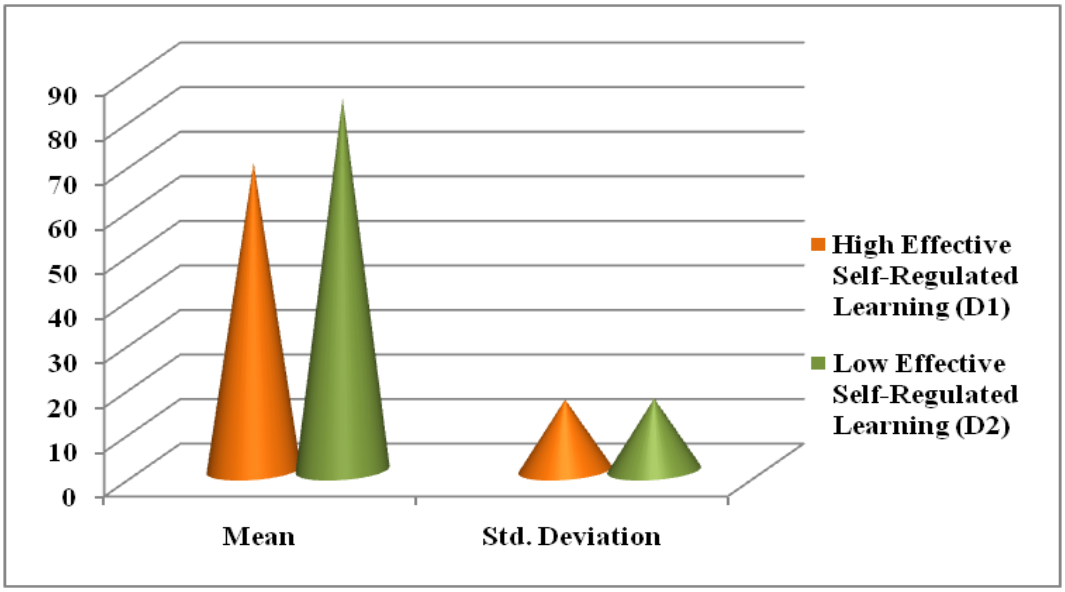


**Fig. 3.3: Mean Scores for Metacognitive Abilities of Senior Secondary School Students in relation to High Effective Self-Regulated Learning ($D_1$) and Low Effective Self-Regulated Learning ($D_2$)**

**Ho2.** There is no significant difference in metacognitive abilities among senior secondary school students based on the type of school they attend (public and private).

**Table: 3.4Comparison of Govt. Schools Students ($B_1$) and Pvt. Schools Students ($B_2$) on Metacognitive Abilities of Senior Secondary School Students**

| Group Compared | N | Mean | Std. Deviation | df | 't' Value | Level of Significance |
|---|---|---|---|---|---|---|
| Govt. Schools Students ($B_1$) | 190 | 73.6632 | 17.18595 | 404 | 2.8107 | 0.01 level |
| Pvt. Schools Students ($B_2$) | 216 | 78.5185 | 17.52552 | | | |

**Analysis:**From Table 3.4, it can be observed that the critical value on the t-table at a 0.05 level of significance is 1.97, and the 0.01 level of significance is 2.60.

**Interpretation:**According to the findings, hypotheses there is no significant difference in metacognitive abilities among senior secondary school students based on the type of school they attend (public and private)are rejected.

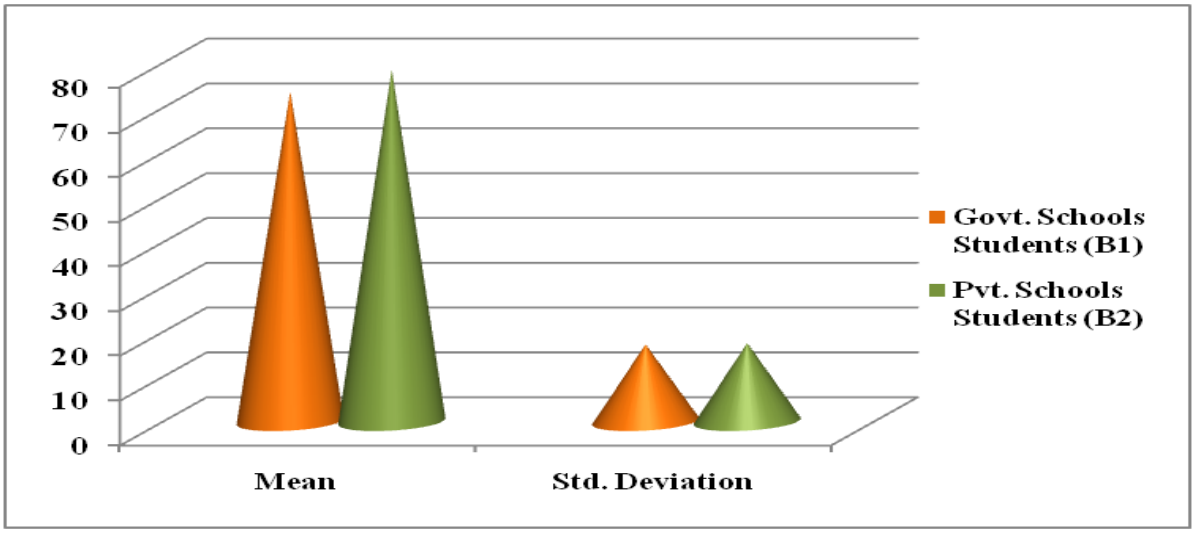


**Fig. 3.4: Mean Scores for Metacognitive Abilities of Senior Secondary School Students in relation to Govt. Schools Students ($B_1$) and Pvt. Schools Students ($B_2$)**

**Ho3.** There is no significant difference in metacognitive abilities between male and female senior secondary school students.

**Table: 3.5Comparison of Male ($C_1$) and Female ($C_2$) on Metacognitive Abilities of Senior Secondary School Students**

| Group Compared | N | Mean | Std. Deviation. | df | 't' Value | Level of Significance |
|---|---|---|---|---|---|---|
| Male ($C_1$) | 216 | 80.3426 | 17.53039 | 404 | 5.1825 | 0.01 level |
| Female ($C_2$) | 190 | 71.5895 | 16.33382 | | | |

**Analysis:**From Table 3.5, it can be observed that the critical value on the t-table at a 0.05 level of significance is 1.97, and the 0.01 level of significance is 2.60.

**Interpretation:**According to the findings, hypotheses there is no significant difference in metacognitive abilities between male and female senior secondary school students are rejected.

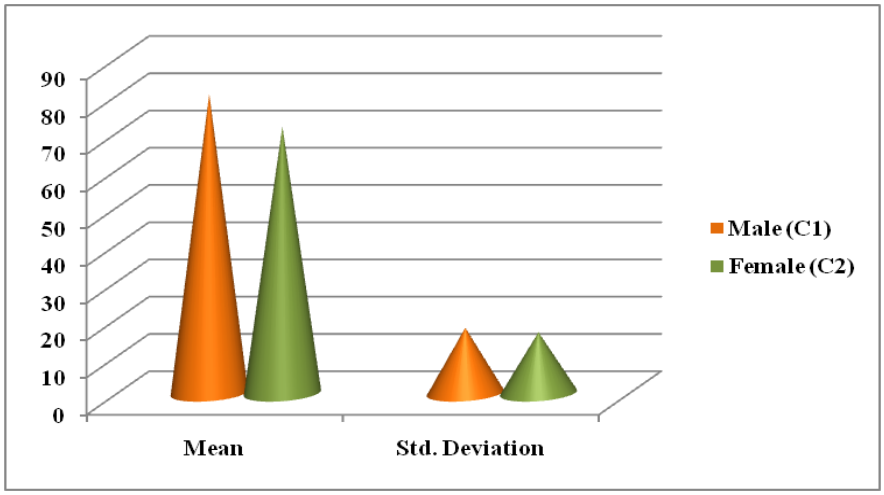


**Fig. 3.5: Mean Scores for Metacognitive Abilities of Senior Secondary School Students in relation to Male ($C_1$) and Female ($C_2$)**

### 3.3 Double interaction effects of Self-Regulated Learning, Types of Schools and Gender on Metacognitive Abilities of Senior Secondary School Students

**Ho4.** The interaction between self-regulated learning and school types does not significantly influence metacognitive abilities among senior secondary school students.

After analysing table 3.2, it can be concluded that self-regulated learning and school type (D x B) interact to influence metacognitive abilities because the F-ratio between the two variables is 31.270, which is significant at the 0.01 level. Thus, the study's "null hypothesis: There exists no significant interactional effect of Self-regulated learning and type of school on the metacognitive abilities of senior secondary school students" was dropped. Comparing the means and results of various participant groups was done using the t-test. Additionally, Table 3.6 displays the result.

**Table: 3.6Comparison of various groups ofSelf-Regulated Learning (D) × Types of Schools (B) on Metacognitive Abilities of Senior Secondary School Students**

| Sr. No | Group Compared | N | | Mean | | S.D. | | 't' Value |
|---|---|---|---|---|---|---|---|---|
| 1 | $D_1B_1$ vs. $D_1B_2$ | 77 | 126 | 68.441 | 69.333 | 15.206 | 16.264 | $0.3885^{NS}$ |
| 2 | $D_2B_1$ vs. $D_2B_2$ | 113 | 90 | 77.221 | 91.377 | 17.606 | 9.152 | $6.9174^{**}$ |
| 3 | $D_1B_1$ vs. $D_2B_1$ | 77 | 113 | 68.441 | 77.221 | 15.206 | 17.606 | $3.5627^{**}$ |
| 4 | $D_1B_1$ vs. $D_2B_2$ | 77 | 90 | 68.441 | 91.377 | 15.206 | 9.152 | $11.9966^{**}$ |
| 5 | $D_1B_2$ vs. $D_2B_1$ | 126 | 113 | 69.333 | 77.221 | 16.264 | 17.606 | $3.6001^{**}$ |
| 6 | $D_1B_2$ vs. $D_2B_2$ | 126 | 90 | 69.333 | 91.377 | 16.264 | 9.152 | $11.6077^{**}$ |

**** "Significant at 0.01 level; *Significant at 0.05 level; NS = Not Significant"**

$D_1$: High Effective Self-Regulated Learning D2: Low High Effective Self-Regulated Learning
$B_1$: Govt. Schools Students $B_2$:Pvt. Schools Students

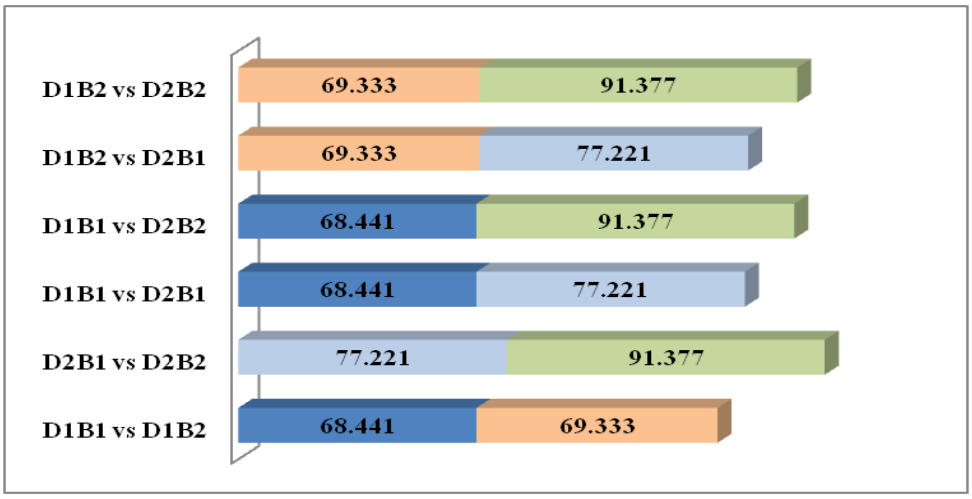


**Fig 3.6: Mean Scores for interaction Effect of Self-Regulated Learning (D) × Types of Schools (B) on Metacognitive Abilities of Senior Secondary School Students**

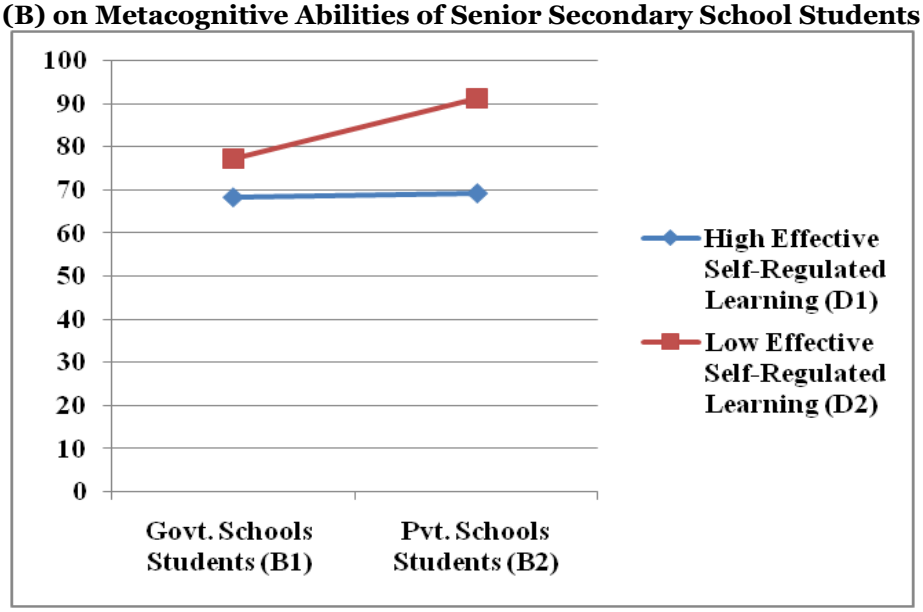


**Fig. 3.7: Interaction Effect of School Climate (A) × Types of Schools (B) on Metacognitive Abilities of Senior Secondary School Students**

**Ho5.** The interaction between gender and self-regulated learning does not significantly influence metacognitive abilities among senior secondary school students.
Table-3.2 shows that there is no significant interaction between gender and Self-regulated learning since the F-ratio (3.768) for this interaction is not judged significant. As a result, the null hypothesis "There exists no significant interactional effect of Self-regulated learning and Gender on the metacognitive abilities of senior secondary school students" remains true. As a result, it is feasible to conclude that pupils in senior secondary school have no discernable relationship between gender and Self-regulated learning in terms of their metacognitive abilities.

**Ho6.** The interaction between school types and gender does not significantly influence metacognitive abilities among senior secondary school students.
Table 3.2 may be reviewed to see that the F-ratio between gender (B x C) and kind of school is 9.386, which is significant at the 0.01 level and suggests that the two variables interact to affect metacognitive abilities. The study's "null hypothesis," which states that there is no significant interaction between gender and school type on students' metacognitive ability, was dropped as a result. To compare the means and scores of the various participant groups, the t-test was employed. Table 3.7displays the result as well.

**Table: 3.7Comparison of various groups of Types of Schools (B) × gender (C) on Metacognitive Abilities of Senior Secondary School Students**

| Sr. No | Group Compared | N | | Mean | | S.D. | | 't' Value |
|---|---|---|---|---|---|---|---|---|
| 1 | $B_1C_1$ vs $B_1C_2$ | 114 | 76 | 79.219 | 65.328 | 17.258 | 13.349 | 5.9313** |
| 2 | $B_2C_1$ vs $B_2C_2$ | 102 | 114 | 81.598 | 75.763 | 17.829 | 16.852 | 2.4718* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | $B_1C_1$ vs $B_2C_1$ | 114 | 102 | 79.219 | 81.598 | 13.349 | 17.829 | $0.9957^{NS}$ |
| 4 | $B_1C_1$ vs $B_2C_2$ | 114 | 114 | 79.219 | 75.763 | 13.349 | 16.852 | $1.5298^{NS}$ |
| 5 | $B_1C_2$ vs $B_2C_1$ | 76 | 102 | 65.328 | 81.598 | 17.258 | 17.829 | $6.1048^{**}$ |
| 6 | $B_1C_2$ vs $B_2C_2$ | 76 | 114 | 65.328 | 75.763 | 17.258 | 16.852 | $4.1413^{**}$ |

**** "Significant at 0.01 level; *Significant at 0.05 level; NS = Not Significant"**
**$B_1$: Govt. Schools Students $B_2$:Pvt. Schools Students $C_1$: Male Students $C_2$: Female Students**

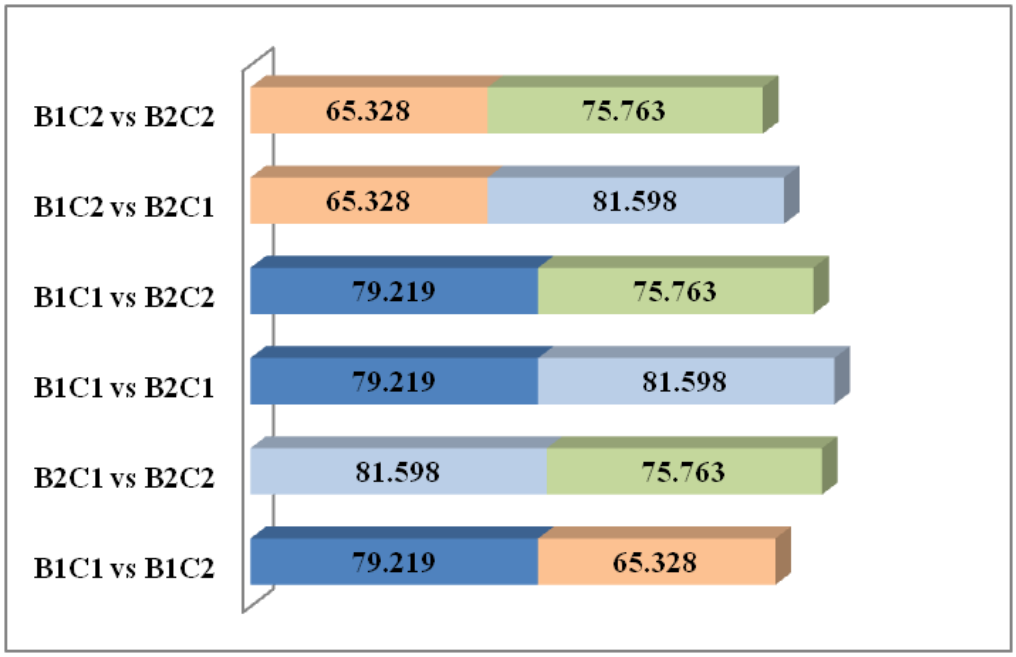


**Fig 3.8: Mean Scores for interaction Effect of Types of Schools (B) × Gender (C) on Metacognitive Abilities of Senior Secondary School Students**

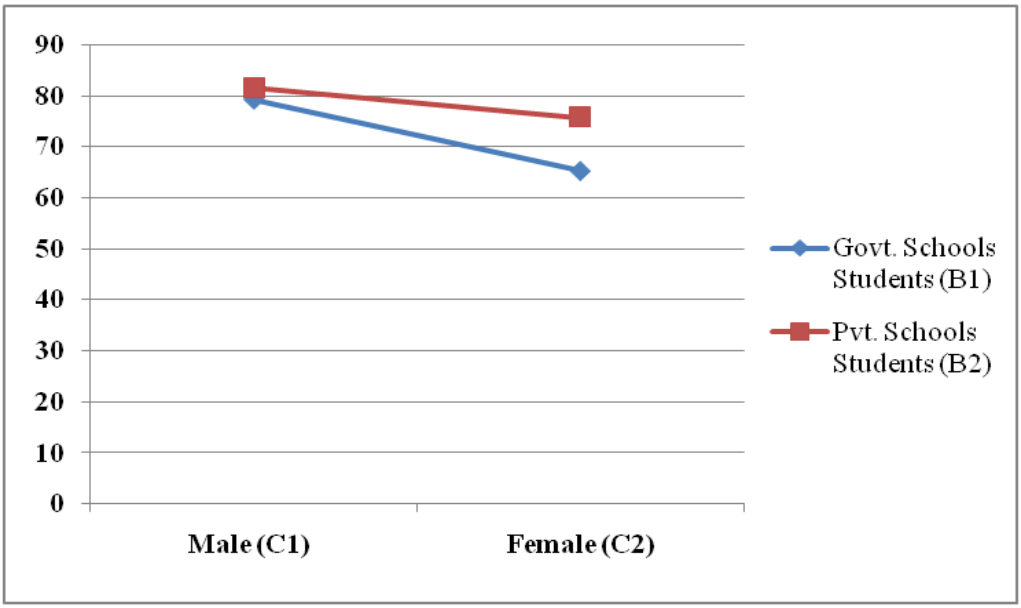


**Fig. 3.9: Interaction Effect of Types of Schools (B) × Gender (C) on Metacognitive Abilities of Senior Secondary School Students**

### 3.4 Triple interaction effect of Self-Regulated Learning, Types of Schools and Gender on Metacognitive Abilities of Senior Secondary School Students

**Ho7.** There is no combined influence of self-regulated learning, school types, and gender on metacognitive abilities among senior secondary school students.

The ANOVA analysis's Table 3.2 displays an f-value of 2.477, indicating that the interaction between (D x B X C) Self-regulated learning, school type, and gender had influence on students' metacognitive abilities in senior secondary school courses. The null hypothesis, which states that there exists no significant interaction effect of self-regulated learning, type of schools and gender over metacognitive abilities in senior secondary school students is accepted.

## 4.0 Discussion of Findings

### a. Main effects of Self-regulated learning (D)

**Ho1:**There exists no significant difference in metacognitive abilities among senior secondary school students based on their levels of Self-regulated learning.

"The hypothesis 'There exists no significant difference in metacognitive abilities among senior secondary school students based on their levels of self-regulated learning' is rejected at the 0.01 significance level. This finding aligns with Popoola et al. (2021), which suggested that metacognitive ability significantly predicts academic performance in mathematics among secondary school students."

### b. Main effects of Types of Schools (B)

**Ho.2:**There exists no significant difference in metacognitive abilities among senior secondary school students based on their levels of types of schools.

"The hypothesis 'There exists no significant difference in metacognitive abilities among senior secondary school students based on their levels of school types' is accepted as true. This finding aligns with some existing literature, such as the study by Kumar & Singh (2020), which found no significant differences in self-regulated learning among secondary school students across different types of schools. It indicates that the type of school may not significantly impact metacognitive abilities among students."

### c. Main effects of Gender (C)

**Ho3:** There exists no significant difference in metacognitive abilities among senior secondary school students based on their levels of gender.

The rejection of the hypothesis that "There is no significant difference in metacognitive abilities among senior secondary school students based on gender levels" is consistent with literature such as the study by Kaur (2017), suggesting potential gender differences in metacognitive abilities.

### a. Double interaction effects of Self-regulated learning and Types of Schools

**Ho4:** There exists no significant interactional effect of Self-regulated learning and types of school on the metacognitive abilities of senior secondary school students.

The rejection of the hypothesis that "There exists no significant interactional effect of Self-regulated learning and types of school on the metacognitive abilities of senior secondary school students" is consistent with findings from Gupta &Mehtani (2017), who explored academic achievement based on self-regulated learning and demographic variables, indicating potential interaction effects.

### b. Double interaction effects of Self-regulated learning and Gender

**Ho5:** There exists no significant interactional effect of Self-regulated learning and Gender on the metacognitive abilities of senior secondary school students

"The hypothesis 'There exists no significant interactional effect of Self-regulated learning and Gender on the metacognitive abilities of senior secondary school students' remains true. This finding aligns with some existing literature, such as the study by Ghazee& Islam (2021), which explored self-regulated learning skills among senior secondary school students without considering gender as an interaction factor."

### c. Double interaction effects of types of schools and gender

**Ho6:**There exists no significant interactional effect of types of schools and gender on the metacognitive abilities of senior secondary school students.

The rejection of the hypothesis that "There is no significant interaction between gender and school types on students' metacognitive ability" is consistent with literature such as the study by Kaur (2017), which investigated demographic factors including gender and type of school in relation to metacognition and critical thinking.

### Triple interaction effects of types of schools and gender

**Ho7:** There exists no significant interaction effect of Self-regulated learning, Types of Schools and Gender over metacognitive abilities in senior secondary school students

The rejection of the hypothesis that "There is no significant interaction effect of self-regulated learning, school types, and gender on metacognitive abilities in senior secondary school students" is consistent with findings from studies like Gupta &Mehtani (2017), which analyzed academic achievement based on self-regulated learning and demographic variables, suggesting potential interaction effects.

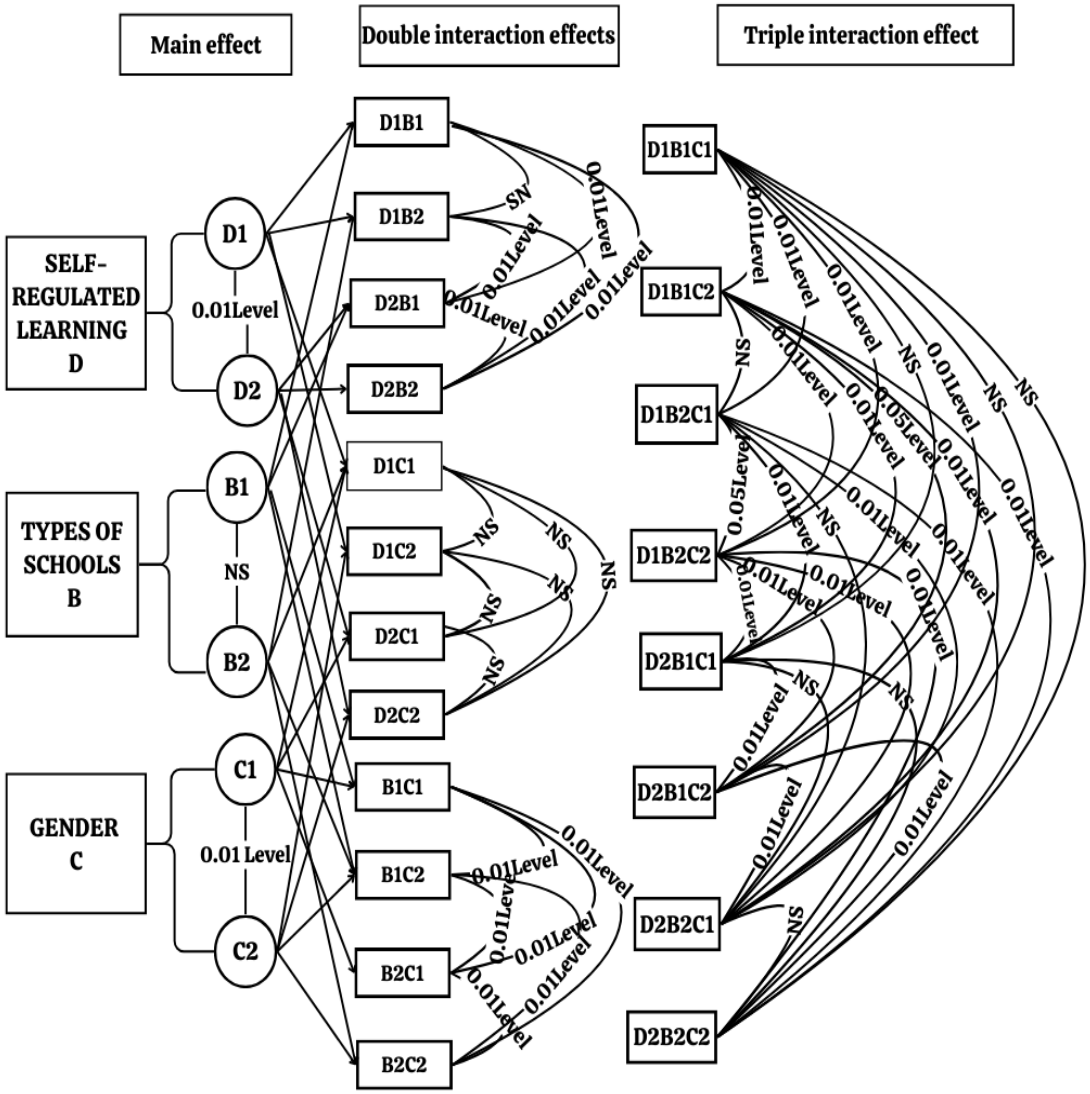


**Fig. 4.0 Interaction Effects of Self-regulated learning (D) × Types of Schools (B) × Gender (C) on metacognitive abilities of Senior Secondary School Students**

## 5.0 Educational Implication

The findings of the study have significant educational implications for fostering metacognitive abilities among senior secondary school students:

1. **Integration of Self-Regulated Learning Skills**: Educators should prioritize the integration of self-regulated learning skills into the curriculum. This involves explicitly teaching student's strategies for setting goals, monitoring their progress, and adapting their learning strategies based on their self-regulation levels (Arora &Bhagat, 2018).
2. **Tailoring Instruction to School Types**: While the type of school may not significantly impact metacognitive abilities, educators should consider contextual differences and tailor instructional approaches accordingly (Kumar & Singh, 2020). Strategies should be flexible to accommodate the diverse needs of students across different school environments.
3. **Gender-Sensitive Teaching Practices**: Given the potential gender differences in metacognitive abilities, educators should adopt gender-sensitive teaching practices. This involves creating an inclusive learning environment that addresses the unique needs and learning preferences of male and female students (Kaur, 2017; Mascardo et al., 2020).
4. **Promoting Collaborative Learning**: Educators should encourage collaborative learning environments where students can engage in peer discussions and reflection. Collaborative learning promotes metacognitive awareness and allows students to learn from each other's perspectives (Schellings & Van Hout-Wolters, 2011).
5. **Professional Development for Educators**: Teachers should receive professional development opportunities to enhance their understanding of metacognitive strategies and how to effectively incorporate

them into their teaching practices (Schraw & Dennison, 1994). Continuous training ensures that educators are equipped with the necessary skills to support students' metacognitive development.

6. **Parental Involvement**: Educators should actively involve parents in supporting students' metacognitive development. Providing parents with resources and guidance on how to reinforce metacognitive strategies at home can further enhance students' learning outcomes (Schellings & Van Hout-Wolters, 2011).

By implementing these educational implications, schools can create a supportive learning environment that fosters the development of metacognitive abilities among senior secondary school students, ultimately enhancing their academic success and overall learning experience.

## 6.0 Recommendations for Future Research

Examination of the hypotheses and findings sheds light on the intricate connections between self-regulated learning, school types, gender, and metacognitive abilities among senior secondary school students. Moving forward, there are several avenues for future research.

Longitudinal studies are recommended to track the development of metacognitive abilities over time and explore how factors such as self-regulated learning, school types, and gender contribute to this process (Popoola et al., 2021). By following students longitudinally, researchers can gain a deeper understanding of the trajectory of metacognitive skills throughout secondary education.

Qualitative research methodologies should complement quantitative analyses to provide richer insights into the underlying mechanisms influencing metacognitive abilities. Qualitative studies can illuminate students' perspectives, experiences, and strategies related to self-regulated learning (Flavell, 1979).

Cultural considerations should be taken into account, prompting investigations into cultural differences in metacognitive abilities and self-regulated learning practices among senior secondary school students. Cross-cultural comparisons would enhance our understanding of culturally specific factors shaping metacognitive skills (Voyer&Voyer, 2014).

Intervention studies are crucial for designing and evaluating programs aimed at enhancing self-regulated learning and metacognitive abilities. Rigorous experimental designs are needed to assess the effectiveness of interventions and their impact on academic performance (Efklides, 2008).

Teacher training programs should be explored as a means to support students' metacognitive development. Investigating how teachers can be better equipped to promote self-regulated learning skills through professional development initiatives is essential (Schellings& Van Hout-Wolters, 2011).

Additionally, the integration of technology in education warrants further investigation. Research should focus on designing technology-supported interventions to foster self-regulated learning and metacognitive skills among students (Zimmerman, 1989).

Gender-sensitive approaches are recommended to address potential differences in learning preferences and strategies between male and female students. Tailored interventions can be designed to meet the specific needs of each gender group (Voyer&Voyer, 2014).

Parental involvement should also be examined in relation to students' self-regulated learning behaviors and metacognitive development. Research could explore how parents can be engaged as partners in supporting their children's metacognitive growth (Schraw & Dennison, 1994).

Lastly, research findings should inform educational policies and practices aimed at creating supportive learning environments conducive to the development of metacognitive skills. Policy implications should be considered to ensure that all students have access to resources that facilitate their metacognitive development (Zimmerman, 1990).

By addressing these areas in future research, scholars can deepen our understanding of the complex interplay between self-regulated learning, school contexts, gender, and metacognitive abilities among senior secondary school students, ultimately contributing to more effective educational practices and student outcomes.

## 7.0 Suggestions

- Incorporate professional development initiatives to improve educators' comprehension of metacognition and self-regulated learning, empowering them to provide encouraging learning environments.
- In order to incorporate self-regulated learning techniques and activities that enhance metacognitive skills into the curriculum for various school types, work together with curriculum developers.
- Promote inclusive policies in schools that take into account and meet the needs of a diverse student body, creating an atmosphere in which all children may succeed.

## 8.0 Conclusion

The study on metacognitive abilities among senior secondary school students offers significant insights into the interplay of various factors influencing cognitive processes in educational settings. The findings suggest that while individual aspects like self-regulated learning and gender may not independently impact

metacognitive abilities significantly, the type of school attended and the relationship between gender and school type appear to have notable effects. Specifically, the study indicates that variations in self-regulated learning levels did not significantly affect metacognitive abilities among students. Moreover, there were no discernible differences in metacognitive abilities between students attending public and private schools, nor between male and female students. However, the study highlights the importance of considering the interaction between gender and school type, which appears to significantly influence metacognitive abilities. Overall, these findings underscore the complexity of factors contributing to metacognitive development in students and suggest avenues for further investigation to fully understand these dynamics and their implications for educational practice.

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