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Analysis of Metacognitive Awareness in Relation to Achievement in Mathematics in Secondary School Students

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Abstract
Metacognition, defined as "thinking about one's own thinking," encompasses reflection on knowledge and self-regulation of learning processes, both integral to learning and development. This study examines the impact of metacognition on mathematics achievement among secondary school students.Using a combination of descriptive surveys and comparative correlation methods, we investigated the relationship between metacognition and mathematics achievement in a sample of 100 secondary science students selected randomly. Data were collected using the Cognitive Awareness Inventory developed by Schraw and Dennison (1994), which assesses various aspects of metacognitive awareness.Our findings indicate a significant positive correlation between metacognition and mathematics achievement. Furthermore, gender was found to have no significant impact on mathematics achievement in terms of metacognitive awareness.These results contribute to our understanding of the importance of metacognition in academic achievement, particularly in the context of mathematics education. Educators and policymakers may benefit from considering the role of metacognitive strategies in promoting student success in mathematics.

Keywords: Metacognition, Metacognition Awareness, Achievement in Mathematics, Secondary School Student

INTRODUCTION

In the realm of education, understanding the intricate relationship between metacognitive awareness and academic achievement has emerged as a focal point of research. Particularly within the domain of mathematics, where cognitive prowess plays a pivotal role, the exploration of metacognition offers valuable insights into student learning and performance. This research delves into the dynamic interplay between metacognitive awareness and achievement in mathematics among secondary school students. Metacognition, defined as the reflective understanding of one's own cognitive processes, holds immense potential for enhancing learning outcomes. By illuminating the extent to which students comprehend, monitor, and regulate their mathematical thinking, we aim to discern its impact on academic success.Secondary school students stand at a critical juncture in their educational journey, grappling with complex mathematical concepts while developing their metacognitive skills. Yet, despite its acknowledged importance, the precise nature of the relationship between metacognitive awareness and mathematical achievement remains underexplored, particularly within this demographic.This research endeavors to bridge this gap by employing a comprehensive methodology that integrates quantitative

analysis with qualitative insights. Through surveys, assessments, and interviews, we seek to ascertain the level of metacognitive awareness among secondary school students and its correlation with their mathematical performance.By shedding light on the nexus between metacognitive processes and mathematical achievement, this study not only advances theoretical understanding but also offers practical implications for educators and policymakers. Ultimately, our findings aim to inform targeted interventions and instructional strategies aimed at fostering metacognitive development and optimizing mathematical learning outcomes in secondary education settings

REVIEW OF RELATED LITERATURE

The term "Literature," within the realm of research, encapsulates information gathered pertaining to the subject or discipline under investigation, spanning theoretical, practical, and research studies (Aswal, 2001). Aswal's study explored the relationship between intelligence and mathematics achievement across various socioeconomic status levels, revealing a significant correlation between the two variables among different socioeconomic strata.

Chen (2001) delved into the factor structures influencing mathematics achievement, emphasizing the significance of home environment and attitudes towards mathematics. Similarly, Diseth (2003) examined the academic performance of adolescent boys and girls, finding no discernible disparity in academic achievement between intellectually superior and very superior students of both genders at the secondary level.

Prakash (2003) investigated the impact of temperament and memory on mathematics achievement among intermediate students, highlighting the positive correlation between certain temperamental traits and mathematical proficiency in girls.

Kramarski and Mevarech (2003) conducted a study on the effects of metacognitive training on mathematical reasoning and metacognitive skills among eighth-grade students, showcasing the benefits of metacognitive instruction in enhancing mathematical abilities and reasoning skills.

Albert (2004**)** explored the relationship between cognitive style, gender, intelligence quotient, and academic achievement among high school students, identifying a significant albeit modest correlation between cognitive style and academic performance.

Diaz (2015) examined the efficacy of metacognitive strategies in assisting young learners with vocabulary acquisition difficulties, demonstrating the positive impact of metacognitive strategy training on vocabulary learning skills. Jagals et al. (2016) investigated metacognitive awareness and reflection for problem-solving in mathematics, elucidating the role of metacognitive skills in facilitating mathematics problem-solving abilities.

Kaur et al. (2018) studied the interplay among metacognition, learning environment, self-regulation, and adolescent academic achievement, revealing the significant positive contributions of metacognition, self-regulation, and perceptions of the learning environment to academic success.

Bagci and Unvern (2019) examined the effect of metacognitive awareness of reading strategies on self-efficacy perception in reading comprehension among secondary school students, underscoring the positive association between metacognitive awareness of reading strategies and self-efficacy perception in reading comprehension among eighth-grade students.

RATIONALE FOR THE STUDY

The literature reviewed indicates a substantial body of research exploring Achievement in Mathematics in

relation to various variables and factors. While there exists a notable volume of studies on Achievement in Mathematics and Metacognition Awareness, the majority of these investigations tend to focus on other selected psychological variables and factors. Notably, the specific relationship between metacognitive awareness and achievement in mathematics has not been adequately addressed in prior research, leading to a noticeable gap in understanding.

Motivated by this gap, the present researcher recognized the importance of examining the relationship between Metacognitive Awareness among secondary school students and their Achievement in Mathematics. This study distinguishes itself from previous research efforts in several key aspects, including the geographical area under study, the demographic characteristics of the population, the sample composition, and the dimensions of analysis. As such, this study represents a unique contribution to the existing literature, offering fresh insights into the interplay between metacognitive processes and mathematical achievement among secondary school students.

STATEMENT OF THE PROBLEM

"In light of the existing gap in research literature regarding the relationship between metacognitive awareness and achievement in mathematics among secondary school students, this study aims to investigate the extent to which metacognitive awareness influences mathematical achievement. Specifically, the research seeks to address the following questions:

1. What is the level of achievement in mathematics among secondary school students??
2. What is the level of metacognitive awareness among secondary school students
3. Is there a significant relationship between metacognitive awareness and achievement in mathematics among secondary school students?
4. To what extent do demographic factors (e.g., age, gender) influence the relationship between metacognitive awareness and achievement in mathematics?

By addressing these questions, the research endeavors to provide valuable insights into the role of metacognitive processes in shaping mathematical achievement among secondary school students, thereby contributing to the existing body of knowledge in the field of educational psychology.

OBJECTIVES OF THE STUDY

The objectives of the study can be outlined as follows:

1. To evaluate the academic achievement in mathematics among secondary school students.
2. To assess the level of metacognitive awareness among secondary school students.
3. To explore the influence of demographic factors (such as age, gender, and academic background) on the relationship between metacognitive awareness and achievement in mathematics.
4. To investigate the relationship between metacognitive awareness and achievement in mathematics among secondary school students.
5. To identify potential areas for intervention and enhancement of metacognitive skills to improve mathematical achievement among secondary school students.
6. To contribute to the existing body of knowledge in educational psychology by providing empirical evidence on the relationship between metacognitive processes and academic achievement in mathematics among secondary school students.

HYPOTHESES OF THE STUDY

1. Null Hypothesis (H0):There is no significant difference between boys and girls with respect to their achievement in mathematics
2. Null Hypothesis (H0): There is no significant difference between boys and girls in relation to their metacognitive awareness
3. Null Hypothesis (H0): There is no significant relationship between metacognitive awareness and achievement in mathematics among secondary school students.

LIMITATION OF THE STUDY

As per the data availability and convenience of research, the present study is exclusively delimited to all secondary science students of the Angul district only. The study design is delimited to the descriptive survey method; similarly, the sampling technique is delimited to simple random sampling with a sample size of 100 students.

METHODOLOGY

The methodology used in this study is as follows:

a. The primary objective of this study was to assess the levels of metacognitive awareness and achievement among secondary students in relation to mathematics. To compare the metacognitive awareness and achievement levels between male and female secondary students, a descriptive survey method was employed. Additionally, to explore the influence of gender interaction, a 2*3 Factorial Design was utilized

b. Participants: All secondary science students studying at different secondary schools in Angul district constituted the population of this study. In the present study, a sample random sampling technique was used to select 100 secondary science students from 5 govt secondary schools as a sample. The following table depicts the distribution of samples in the present study.

Table 1. List of schools used for the selection of samples and sample distribution.

SI	NAME OF THE SCHOOL	NUMBER OF STUDENTS		
		BOYS	GIRLS	TOTAL
01	Angul Higher Secondary School	10	10	20
02	Dav Public School, Angul	10	10	20
03	Kendriya vidyala, Angul	10	10	20
04	Rotary Public School, Angul	10	10	20
05	Govt. Town Higher Secondary School, Angul	10	10	20
TOTAL		50	50	100

TOOLS USED IN THIS STUDY

This study attempts to investigate achievement in mathematics of secondary school students in relation to their meta cognitive awareness. The following tools were used to collect data on the above variables.

- Academic score card for the half-yearly examination
- Meta cognitive awareness inventory developed by Schraw et al. Dennisaon, R.S. (1994).

STATISTICAL TECHNIQUE USED.

Statistical techniques are necessary to understand general trends and group characteristics from various individual characters. In this study, the researcher used the following statistical devices for analysis and interpretation: To determine the level of metacognitive awareness and achievement in mathematics, the mean, standard deviation, and percentage were used. For comparative analysis of the level of metacognitive awareness and achievement in mathematics of secondary school students, the researcher used mean, standard deviation, standard deviation error, and t-test. Correlation analysis of metacognitive awareness and achievement in mathematics was performed using Pearson product moment correlation.

DATA ANALYSIS AND RESULT

The collected data were analyzed properly, and the results are discussed below.

Table 2. Score of achievements of secondary school students in mathematics with mean and standard deviation.

CATEGORY	NO. OF STUDENT	MEAN	SD	MEAN TOTAL	SD TOTAL
Boys	50	66.58	14.207	64.955	14.309
Girls	50	63.33	13.981		

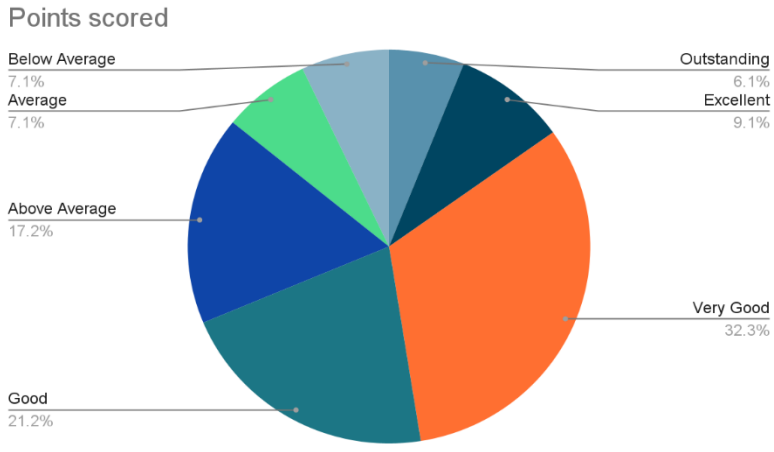
From Table 2, it is observed that boys have a mean score of 66.58 with a standard deviation of 14.207 and girls have a mean score of 63.33 with a standard deviation of 13.981 with regard to their achievement in mathematics. In total, their mean score was 64.955 with a standard deviation of 14.309. As the mean score was between 60 and 70, secondary school students had "good" achievement in mathematics.

To make it clearer, the researcher analyzed the achievement of secondary school students in terms of percentage.

Table 3. Achievement of secondary school students in percentage with respect to gender

GRADE	A1	A2	B1	B2	C	D	E	TOTAL
No. of boys (in %)	8	10	32	20	18	8	4	100%
No. of girls (in %)	4	8	34	22	16	6	10	100%

Table 3. Shows the grade-wise percentage of boys and girls. Achievement scores in mathematics are divided into 7 grades named A1, A2, B1, B2, C, D, and E, which represent outstanding, excellent, very good, good, above average, average, and below average r scores, respectively.



Distribution of Scores Among Boys and Girl

From the table, it is observed that 8% of boys and 4% of girls have outstanding scores. 10% of boys and 8% of girls have excellent scores. 32% of boys and 34% of girls have excellent scores. 20% of boys and 22% of girls have good scores. 18% of boys and 16% of girls have above average scores. 8% of boys and 6% of girls have average scores. 4% of boys and 10% of girls have below average scores. So, most of the boys and girls have excellent and good scores.

Descriptive analysis of the level of metacognitive awareness of secondary school students was performed using mean, standard deviation, and percentage, which are given in the following tables.

Table 4. Mean and standard deviation of the score of secondary school students in the metacognitive awareness inventory

CATEGORY	MEAN	SD	MEAN TOTAL	SD TOTAL
Boys	34.64	6.611	34.5	6.812
Girls	33.46	6.957		

From table 4, boys have a mean score of 34.64 with a standard deviation of 6.11 and girls have a mean score of 33.46 with a standard deviation of 6.957 in the metacognitive awareness inventory. In general, secondary students had a mean score of 34.5 with a standard deviation of 6.812 . It lay between 26 and 43. Therefore, secondary school students have average metacognitive awareness.

Percentage analysis of metacognitive awareness of secondary school students was performed by the researcher, which is given in the following chart. To achieve the third objective, the researcher had the first hypothesis “There is no significant difference between boys and girls with respect to achievement in mathematics.

Table 5. Mean difference in achievement in mathematics between boys and girls

GENDER	N	MEAN	SD	SED	T-VALUE	SIGNIFICANCE
BOYS	50	66.58	14.207	2.81	1.03	Not significant at .05 level
GIRLS	50	63.33	13.981			

To determine the significant difference in Achievement in Mathematics based on gender, the mean, standard deviation, and t- values were computed. The mean values of the boys and girls students were found to be 66.58 and 63.33, respectively, and the t-value was 1.03. The obtained t-value of 1.03 is smaller than the table value at the 0.05 level of significance. Hence, the null hypothesis is accepted, and it is concluded that there is no significant difference in Achievement in Mathematics between boys and girls.

The fourth objective of the study was achieved by testing the null hypothesis “There is no significant difference between boys and girls in relation to their meta cognitive awareness.” The results are given in the following table.

Table 6 Mean difference in metacognitive awareness between boys and girls

GENDER	N	MEAN	SD	SED	T-VALUE	SIGNIFICANCE
BOYS	50	34.64	6.611	1.357	0.869	Not significant at 0.05 level
GIRLS	50	33.46	6.957			

To determine the significant difference in metacognitive awareness based on gender, the mean, standard deviation, and t-value were calculated. The mean values of the boys and girls students were found to be

34.64 and 33.46, respectively, and the t-value was 0.869. The obtained t-value 0.869 is smaller than the table value at the 0.05 level of significance. Hence, the null hypothesis is accepted, and it is concluded that there is no significant difference in meta cognitive awareness between boys and girls.

To achieve the fifth objective of the study, the researcher tested the null hypothesis "There is no significant relationship between metacognitive awareness and achievement in mathematics of secondary school students. The Pearson product-moment correlation was computed to assess the relationship between achievement in mathematics and metacognitive awareness. The results of the analysis are given in Table 1.

Table 7 Relationship between achievements in mathematics and metacognitive awareness

VARIABLE	N	R -VALUE	CORRELATION
Metacognitive awareness	100	0.415	Positive correlation
Achievement in Mathematics	100		

It is found that the R-value is 0.415 positive. Therefore, metacognitive awareness and achievement in mathematics are positively correlated. Hence, the null hypothesis is rejected, and it is concluded that there is a significant positive relationship between Achievement in Mathematics and Metacognitive Awareness.

MAJOR FINDINGS

The following main findings appeared as an outcome of this investigation:

1. It was found that most secondary school students have an average level of metacognitive awareness.
2. Most Secondary school students have good academic performance.
3. There was no significant difference in the metacognitive awareness of secondary school students with respect to their gender.
4. There was no significant difference in the achievement in mathematics of secondary school students with respect to gender.
5. A positive relationship exists between metacognitive awareness and the academic achievement of secondary school students.

SUGGESTION FOR FURTHER RESEARCH

The following suggestions may be considered for future research:

1. This study was confined to only five schools in the Angul district. This study may be conducted at the regional, state, and national levels.
2. Similar studies may be conducted with higher secondary students and college students. Studies may be conducted at various school levels.
3. The metacognitive awareness and achievement of boys and girls between and within the school can be compared.
4. This study was conducted with one subsample as gender. Further study can be conducted by considering other sub variables and intervening factors.
5. The researcher felt that studies conducted on metacognitive awareness and achievement in mathematics are very few and have contradictory findings. There exists a research gap that must be addressed. The researcher in this study tried to

CONCLUSION

The study examining metacognitive awareness and mathematics achievement among secondary school students in the Angul district, utilizing a sample size of 100, has revealed a noteworthy positive correlation between metacognitive awareness and performance in mathematics. Distinguished by its unique dimensions, extensive scope, and distinct findings, this research contributes original insights to the existing body of literature. Notably, the study's findings hold promise in addressing the contemporary challenges within secondary education. By recognizing the pivotal role of metacognitive awareness, educators and policymakers can strategically tailor activities, curriculum, and instructional strategies to cultivate and augment metacognitive skills among secondary school students. Thus, this study offers valuable implications for shaping the future trajectory of secondary education, ultimately fostering improved academic outcomes and student success.

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