



Metacognitive Skills as Predictors of Science Academic Success Among Senior High School Students

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Abstract

This study examined the relationship between metacognitive skills and science academic achievement among Senior High School students at a certain school in Misamis Occidental, Philippines, during the School Year 2025-2026. Specifically, the study assessed students' metacognitive skills in terms of planning, monitoring, and evaluating, and identified which component best predicts science academic achievement. A quantitative descriptive-correlational research design was employed involving 203 Grade 11 students selected through simple random sampling. Data were gathered using the Metacognitive Awareness Inventory (MAI) and students' science grades. Results revealed that students demonstrated a high level of metacognitive skills and an outstanding level of science academic achievement. Findings further showed that overall metacognitive skills had no significant relationship with science academic achievement. However, monitoring metacognitive skill showed a significant relationship and emerged as the best predictor of students' science academic success. The study highlights the importance of strengthening students' monitoring skills to improve academic performance in science.

Keywords

Evaluating Skill, Metacognitive Skills, Monitoring Skill, Planning Skill, Science Academic Success, Senior High School Students

1. Introduction

Science education at the senior high school level aims to develop students' higher-order thinking skills, particularly in analysing, evaluating, and solving complex problems. Despite this goal, many students continue to experience difficulties in understanding scientific concepts, which often results in low academic performance. One contributing factor to this issue is the lack of effective learning strategies, particularly in regulating one's own thinking processes. This highlights the importance of metacognitive skills in improving students' academic outcomes.

Metacognitive skills refer to learners' ability to plan, monitor, and evaluate their own learning processes. Recent studies have emphasized the significant role of metacognition in enhancing academic achievement. For instance, Yilmaz and Keser (2017) found that metacognitive support in learning environments significantly improves students' academic performance and engagement. Similarly, Huertas et al. (2017) reported that metacognitive scaffolding positively influences students' learning achievement, particularly in structured and guided learning environments.



Moreover, Vettori et al. (2018) revealed that metacognitive skills are strongly associated with students' academic outcomes, highlighting that learners who possess higher levels of metacognitive awareness tend to achieve better academic results. In the same vein, Tian et al. (2018) demonstrated that metacognitive knowledge significantly contributes to students' performance within a self-regulated learning framework. These findings suggest that metacognition plays a crucial role in facilitating deeper understanding and effective learning.

In addition, Endah et al. (2018) emphasized that the use of metacognitive learning strategies enhances students' academic achievement and self-concept, indicating that students who are aware of their cognitive processes are more confident and capable in their learning. Similarly, Gaylon and Dales (2017) found that metacognitive strategies significantly improve students' academic achievement and engagement, further supporting the importance of metacognition in educational settings.

Despite the growing body of international research supporting the relationship between metacognitive skills and academic achievement, there remains a limited number of local studies focusing on senior high school students in public secondary schools, particularly in Misamis Occidental National High School. This indicates a gap in the literature, especially in understanding how metacognitive skills influence science academic achievement within the local educational context.

Therefore, this study aims to examine the relationship between metacognitive skills and science academic achievement among Senior High School students during the school year 2025-2026. Specifically, it aims to answer the following queries: 1. What is the level of students' metacognitive skills in terms of planning, monitoring, and evaluating? 2. What is the level of students' science academic achievement? 3. Is there a significant relationship between students' overall metacognitive skills and the components in terms of planning, monitoring, and evaluating, and their science academic achievement? 4. Which component of metacognitive skills best predicts students' science academic achievement?

2. Methods

This study employed a quantitative descriptive-correlational research design to examine the relationship between metacognitive skills and academic achievement in science of 203 Grade 11 students using simple random sampling at a certain school in Misamis Occidental, during the school year 2025-2026. It utilized the Metacognitive Awareness Inventory (MAI) developed and standardized by Schraw, G., & Dennison, R.S. (1994). It was administered through a survey questionnaire using Google forms where the respondents checked the scale indicating their judgment on each item. The MAI is a self-report questionnaire consisting of 52 items. Only the metacognitive skills part was used in terms of planning with 7 items, monitoring with 10 items, and evaluation with 6 items. Responses on the inventory are recorded on a 5-point Likert scale, ranging from one (1) representing "never" to five (5) indicating "always." A higher weighted mean suggests a strong or high level of metacognitive awareness, while a lower weighted mean suggests a weak or low level of metacognitive awareness. Before collecting the data, a letter to grant permission to conduct research was sent to the office of the superintendent of the division and forwarded to the office of the school head. Once permission was granted, coordination with the respective teachers for the data collection followed.

The data collected was tallied, collated, and tabulated using Microsoft Excel and JASP, a free, open-source software program for statistical analysis. The descriptive aspect of the design will be used to determine the levels of students' metacognitive skills and academic achievement, while the correlational aspect will be used to identify the relationship between these variables. Descriptive



statistics, specifically the mean and standard deviation, were used to describe levels of variables, the metacognitive skills in terms of planning, monitoring, and evaluating, and the science academic achievement. The Pearson “r” correlation test was used to determine the relationship between metacognitive skills and science academic achievement among Senior High School students. The multiple regression analysis was used to identify predictors for science academic success among senior high school students in terms of planning, monitoring, and evaluating.

3. Results and Discussion

3.1. Level of Students’ Metacognitive Skills in terms of Planning, Monitoring, and Evaluating.

Table 1. Level of Students’ Metacognitive Skills in Terms of Planning

No.	Indicators	Mean	SD	Interpretation
(4.)	I pace myself while learning in order to have enough time.	3.68	0.91	High
(6.)	I think about what I really need to learn before I begin a task.	4.17	0.91	High
(8.)	I set specific goals before I begin a task.	3.89	0.98	High
(22.)	I ask myself questions about the material before I begin.	3.75	1.01	High
(23.)	I think of several ways to solve a problem and choose the best one.	4.16	0.90	High
(42.)	I read instructions carefully before I begin a task.	4.33	0.84	Very High
(45.)	I organize my time to best accomplish my goals.	3.67	1.00	High
	Overall	3.95	0.27	High

Mean Range. 1.00 – 1.80 (Very Low); 1.81 – 2.60 (Low); 2.61 – 3.40 (Moderate); 3.41 – 4.20 (High); 4.21 – 5.00 (Very High)

Table 1 shows the level of students’ metacognitive skills in terms of planning has an overall weighted mean of 3.95, with a standard deviation of 0.27, interpreted as *High*. The item with the highest mean is *Item 42* with the statement “I read instructions carefully before I begin a task.” (*mean* = 4.33), with a standard deviation of 0.84, interpreted as *Very High*. Meanwhile, all other items are interpreted as *High*, where *Item 45* has the lowest mean of 3.67, with a standard deviation of 1.00.

The results imply that the students possess strong planning skills, particularly in preparing themselves cognitively before performing academic tasks. This means that learners can set goals, identify strategies, and organize learning activities to improve academic performance. Such findings support the Metacognitive Theory of Flavell (1979), which emphasizes that planning is a critical component of metacognitive regulation that helps learners’ control and direct their learning processes. The findings are consistent with the study of Yilmaz and Keser (2017), who found that metacognitive support enhances students’ academic performance and engagement because learners become more strategic



and organized in accomplishing tasks. Similarly, Zimmerman (2002) explained that learners who actively plan their learning activities are more capable of becoming self-regulated learners and achieving academic success.

Table 2. Level of Students’ Metacognitive Skills in Terms of Monitoring

No.	Indicators	Mean	SD	Interpretation
(1.)	I ask myself periodically if I am meeting my goals.	3.89	0.91	High
(2.)	I consider several alternatives to a problem before I answer.	3.96	0.85	High
(11.)	I ask myself if I have considered all options when solving a problem.	3.90	0.91	High
(21.)	I periodically review to help me understand important relationships.	3.79	0.94	High
(28.)	I find myself analyzing the usefulness of strategies while I study.	3.78	0.94	High
(39.)	I try to translate new information into my own words.	4.09	1.03	High
(41.)	I use the organizational structure of the text to help me learn.	3.77	0.96	High
(43.)	I ask myself if what I'm reading is related to what I already know.	4.23	0.86	Very High
(47.)	I try to break studying down into smaller steps.	3.73	1.02	High
(48.)	I focus on overall meaning rather than specifics.	3.62	0.93	High
	Overall	3.88	0.18	High

Mean Range. 1.00 – 1.80 (Very Low); 1.81 – 2.60 (Low); 2.61 – 3.40 (Moderate); 3.41 – 4.20 (High); 4.21 – 5.00 (Very High)

Table 2 presents the level of students’ metacognitive skills in terms of monitoring, which reflects an overall weighted mean of 3.88, with a standard deviation of 0.18, interpreted as *High*. The item with the highest mean is *Item 43* with the statement “I ask myself if what I’m reading is related to what I already know.” (*mean* = 4.23) with a standard deviation of 0.86. Meanwhile, the rest of the items are interpreted as *High*, where *Item 42*, with the statement “I focus on overall meaning rather than specifics.” gets the lowest mean of 3.62 with a standard deviation of 0.93.

The findings imply that students can assess their progress and understanding during learning activities. Monitoring skills allow learners to identify whether strategies are effective and whether adjustments are needed to improve comprehension. According to Flavell (1979), monitoring is a critical aspect of metacognitive regulation because it enables learners to oversee and control their cognitive performance. The results are supported by Huertas et al. (2017), who emphasized that metacognitive scaffolding improves students’ learning achievement because learners become more aware of their



understanding and learning progress. Likewise, Tian et al. (2018) found that metacognitive knowledge significantly contributes to students' academic performance within a self-regulated learning framework.

Table 3. Level of Students' Metacognitive Skills in Terms of Evaluating

No.	Indicators	Mean	SD	Interpretation
(7.)	I know how well I did once I finish a test.	3.53	1.00	High
(19.)	I ask myself if there was an easier way to do things after I finish a task.	4.06	0.95	High
(24.)	I summarize what I've learned after I finish.	3.73	0.97	High
(36.)	I ask myself how well I accomplish my goals once I'm finished.	3.92	0.86	High
(38.)	I ask myself if I have considered all options after I solve a problem.	3.69	0.96	High
(50.)	I ask myself if I learned as much as I could have once I finish a task.	3.76	0.94	High
	Overall	3.78	0.19	High

Mean Range. 1.00 – 1.80 (Very Low); 1.81 – 2.60 (Low); 2.61 – 3.40 (Moderate); 3.41 – 4.20 (High); 4.21 – 5.00 (Very High)

Table 3 shows the level of students' metacognitive skills in terms of evaluating, which reflects an overall weighted mean of 3.78, with a standard deviation of 0.19, interpreted as *High*. All the items are interpreted as *High*, where the highest mean 4.06 with a standard deviation of 0.95 is *Item 19*, with the statement "I ask myself if there was an easier way to do things after I finish a task." Meanwhile, the item with the lowest mean is *Item 7* with the statement "I know how well I did once I finish a test." (*mean* = 3.53) with a standard deviation of 1.00.

The findings suggest that students demonstrate reflective thinking after completing academic tasks. Evaluating skills helps learners identify strengths and weaknesses in their learning processes and improve future performance. This supports Flavell's (1979) assertion that evaluation is a critical component of metacognition because it allows learners to reflect on and assess their cognitive performance. The findings are consistent with the study of Endah et al. (2018), who reported that metacognitive learning strategies enhance students' academic achievement and self-concept. Similarly, Gaylo and Dales (2017) found that students who use metacognitive strategies become more engaged and effective in their learning activities.

Table 4 - Summary of the Level of Students' Metacognitive Skills

No	Indicators	Mean	SD	Interpretation
1.	Planning	3.95	0.27	High
2.	Monitoring	3.88	0.18	High



3. Evaluating	3.78	0.19	High
Overall	3.87	0.21	High

Table 4 presents the level of students' metacognitive skills in terms of planning, monitoring, and evaluating, which reflects an overall weighted mean of 3.87, with a standard deviation of 0.21, interpreted as *High*. The indicator with the highest mean is *Item 1* (Planning) at 3.19, with a standard deviation of 0.27, interpreted as *High*. Meanwhile, the indicator with the lowest mean is *Item 3* (Evaluating) at 3.78, with a standard deviation of 0.19, interpreted as *High*.

The findings indicate that students generally possess strong metacognitive skills that help them regulate their learning processes effectively. Students can plan to learn strategies, monitor their understanding, and evaluate their academic performance. These skills contribute to improved comprehension and academic success in science subjects. The findings support the Metacognitive Theory of Flavell (1979) and the Self-Regulated Learning Theory of Zimmerman (2002), which explain that learners who are aware of and capable of regulating their thinking processes are more likely to achieve better academic outcomes. The results further support the idea that metacognitive skills are essential for meaningful learning and problem-solving. Practically, these findings imply that science teachers should continue integrating metacognitive activities such as reflective questioning, self-monitoring exercises, and strategic planning tasks into classroom instruction. Such practices may strengthen students' independent learning abilities and improve their science academic achievement.

3.2. Level of Students' Science Academic Achievement.

Table 5 - Level of Students' Science Academic Achievement

Test	Mean	SD	Interpretation
Final Grade	93.71%	4.17	Outstanding

n = 203 students. DepEd Performance Descriptors. Below 75% (Did Not Meet Expectations/ Failed); 75% - 79% (Fairly Satisfactory); 80% - 84% (Satisfactory); 85% - 89% (Very Satisfactory); 90% - 100% (Outstanding)

Table 5 presents the level of students' science academic achievement, which reflects an overall weighted mean of 93.71% with a standard deviation of 4.17, interpreted as *Outstanding*. This indicates that the students performed very well in their science subjects and demonstrated mastery of the required competencies.

The findings imply that students possess strong academic abilities in science, which may be influenced by effective learning strategies and positive study habits. Their outstanding performance suggests that students can understand and apply scientific concepts successfully. The findings support the study of Vettori et al. (2018), who found that metacognitive skills significantly influence students' academic outcomes. Likewise, Tian et al. (2018) emphasized that metacognitive knowledge contributes positively to students' performance within self-regulated learning environments.

3.3. Test of Relationship between students' overall metacognitive skills and the components in terms of planning, monitoring, and evaluating, and their science academic achievement.



Table 6. Test of Relationship between Metacognitive Skills and Science Academic Achievement of the Students

Variables	Pearson r	Interpretation	p-value	Interpretation
Metacognitive Skills and Science Academic Achievement	.132	No Linear Relationship	.060	No Significant Relationship
<i>Note. Pearson r:</i>	$0 - \pm 0.29$	=		<i>No Linear Relationship</i>
	$\pm 0.30 - \pm 0.49$	=		<i>Weak Linear Relationship</i>
	$\pm 0.50 - \pm 0.69$	=		<i>Moderate Linear Relationship</i>
	$\pm 0.70 - \pm 0.99$	=		<i>Strong Linear Relationship</i>
	± 1	=		<i>Perfect Linear Relationship</i>

Table 6 shows the computed Pearson r value of .132 indicates no linear relationship between the variables. Furthermore, the obtained p-value of .060 is greater than the 0.05 level of significance, indicating no significant relationship.

The findings imply that although students possess high metacognitive skills, these skills do not significantly influence their science academic achievement. This may suggest that other factors such as motivation, teaching strategies, learning environment, and prior knowledge also contribute to academic performance. The findings partially contradict the theories of Flavell (1979) and Zimmerman (2002), which emphasize that metacognitive skills contribute to academic achievement. However, the results may indicate that metacognitive skills alone are insufficient predictors of academic success when considered collectively. The findings also differ from the studies of Yilmaz and Keser (2017) and Vettori et al. (2018), who reported significant relationships between metacognition and academic achievement. Nevertheless, the results suggest that specific dimensions of metacognition may have stronger effects than others.

Table 7. Test of Relationship between Metacognitive Skills in terms of Planning and Science Academic Achievement of the Students

Variables	Pearson r	Interpretation	p-value	Interpretation
Metacognitive Skills in Planning and Science Academic Achievement	.119	No Linear Relationship	.090	No Significant Relationship
<i>Note. Pearson r:</i>	$0 - \pm 0.29$	=		<i>No Linear Relationship</i>
	$\pm 0.30 - \pm 0.49$	=		<i>Weak Linear Relationship</i>
	$\pm 0.50 - \pm 0.69$	=		<i>Moderate Linear Relationship</i>
	$\pm 0.70 - \pm 0.99$	=		<i>Strong Linear Relationship</i>
	± 1	=		<i>Perfect Linear Relationship</i>



Table 7 shows the computed Pearson r value of .119 indicates no linear relationship between the variables. Moreover, the obtained p-value of .090 is greater than the 0.05 level of significance, indicating no significant relationship. The findings imply that planning skills alone may not directly influence students' science academic achievement. Although students frequently engage in planning activities, these may not automatically result in higher academic performance unless effectively implemented during learning tasks.

The findings differ from Zimmerman's (2002) Self-Regulated Learning Theory, which emphasizes the importance of planning in academic success. Similarly, the findings are inconsistent with Yilmaz and Keser (2017), who found that planning and metacognitive support contribute positively to academic achievement.

Table 8. Test of Relationship between Metacognitive Skills in terms of Monitoring and Science Academic Achievement of the Students

Variables	Pearson r	Interpretation	p-value	Interpretation
Metacognitive Skills in Monitoring and Science Academic Achievement	.168	No Linear Relationship	.017	With Significant Relationship
<i>Note.</i>	<i>Pearson r:</i>	$0 - \pm 0.29$	=	<i>No Linear Relationship</i>
		$\pm 0.30 - \pm 0.49$	=	<i>Weak Linear Relationship</i>
		$\pm 0.50 - \pm 0.69$	=	<i>Moderate Linear Relationship</i>
		$\pm 0.70 - \pm 0.99$	=	<i>Strong Linear Relationship</i>
		± 1	=	<i>Perfect Linear Relationship</i>

Table 8 shows the computed Pearson r value of .168 indicates no linear relationship between the variables. However, the obtained p-value of .017 is less than the 0.05 level of significance, indicating a significant relationship. The findings imply that monitoring skills significantly influence students' science academic achievement. Students who frequently monitor their understanding, review their progress, and evaluate their learning strategies tend to perform better academically.

The findings support Flavell's (1979) Metacognitive Theory, which explains that monitoring enables learners to regulate their cognitive processes effectively. Likewise, the findings are consistent with Tian et al. (2018), who found that metacognitive monitoring contributes positively to students' performance in self-regulated learning environments. Huertas et al. (2017) also emphasized that monitoring strategies improve students' achievement through increased awareness of learning progress.

Table 9. Test of Relationship between Metacognitive Skills in terms of Evaluating and Science Academic Achievement of the Students

Variables	Pearson r	Interpretation	p-value	Interpretation
Metacognitive Skills in Evaluating and Science	.055	No Linear Relationship	.432	No Significant Relationship



Academic Achievement

Note.	Pearson r:	0 – ± 0.29	=	No Linear Relationship
		± 0.30 – ± 0.49	=	Weak Linear Relationship
		± 0.50 – ± 0.69	=	Moderate Linear Relationship
		± 0.70 – ± 0.99	=	Strong Linear Relationship
		± 1	=	Perfect Linear Relationship

Table 9 shows the computed Pearson r value of .055, which indicates no linear relationship between the variables. In addition, the obtained p-value of .432 is greater than the 0.05 level of significance, indicating no significant relationship. The findings imply that evaluating skills alone may not significantly influence students’ science academic achievement. Although students reflect on their performance after completing tasks, these reflective activities may not directly translate into improved academic outcomes.

The findings differ from the studies of Endah et al. (2018) and Gaylo and Dales (2017), who found that evaluating and reflective learning strategies enhance academic achievement and engagement. Nevertheless, the findings suggest that evaluation skills may become more effective when combined with other metacognitive strategies.

3.4. Determining Predictors of Students’ Science Academic Achievement.

Table 10. Regression Analysis for Determining Predictors of Students’ Science Academic Success

Model	R	R ²	Adjusted R ²	F-value	p-value
1	.168 ^a	.028	.023	5.822	.017 ^a

a. Predictors: (Constant), Monitoring Metacognitive Skill

Table 10 presents the regression analysis for determining predictors of students’ science academic success, where findings reveal an R value of .168 and an R² value of .028, indicating that monitoring metacognitive skill explains 2.8% of the variance in students’ science academic achievement. Furthermore, the obtained p-value of .017 is less than the 0.05 level of significance, indicating that monitoring skill is a significant predictor of science academic achievement.

The findings imply that students who actively monitor their understanding and learning progress are more likely to achieve better academic performance in science. Although the percentage of explained variance is relatively low, monitoring remains a crucial factor in academic success. The findings support Zimmerman’s (2002) Self-Regulated Learning Theory, which explains that self-monitoring helps learners regulate and improve their academic performance. Likewise, Tian et al. (2018) emphasized that metacognitive monitoring significantly contributes to academic achievement in self-regulated learning environments.

Table 11. Statistics Associated with the Predictors of Students’ Science Academic Success in the Multiple Regression Analysis

Model	Unstandardized	Standardized	t
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		Coefficients		Coefficients	p-value
		B	SE		
1	(Constant)	89.013	1.968		45.237 < .001
	Monitoring Metacognitive Skills	1.211	.502	.168	2.413 .017

a. Dependent Variable: Science Academic Achievement

Table 11 presents the statistics associated with the predictors of students' science academic success in the multiple regression analysis, where the findings revealed that monitoring metacognitive skills obtained a beta coefficient of .168 with a p-value of .017, indicating that monitoring significantly predicts science academic achievement.

The regression coefficient further indicates that for every one-unit increase in monitoring metacognitive skills, science academic achievement increases by 1.211 units. This suggests that students who regularly assess their understanding and learning progress tend to achieve better academic performance. The findings support the Metacognitive Theory of Flavell (1979), which emphasizes the importance of monitoring in regulating learning processes. The findings are also consistent with Huertas et al. (2017), who reported that monitoring and metacognitive scaffolding improve learning achievement. Similarly, Tian et al. (2018) highlighted the significant contribution of monitoring skills to academic success within self-regulated learning.

4. Conclusion

The study concluded that the senior high school students demonstrated a high level of metacognitive skills in terms of planning, monitoring, and evaluating, as well as an outstanding level of science academic achievement. These findings indicate that students possess the ability to regulate their learning processes and apply strategies that support academic performance in science.

The findings further revealed that overall metacognitive skills did not show a significant relationship with science academic achievement. Likewise, planning and evaluating metacognitive skills were not significantly related to students' academic performance. However, monitoring metacognitive skill was found to have a significant relationship with science academic achievement and emerged as the best predictor of academic success in science. This suggests that students who actively monitor their understanding, assess their progress, and connect prior knowledge with new learning tend to perform better academically.

The findings support the Metacognitive Theory of Flavell (1979), which emphasizes the importance of regulating cognitive processes during learning. The results also align with Zimmerman's (2002) Self-Regulated Learning Theory, which explains that self-monitoring contributes to improved academic performance. Furthermore, the findings are consistent with the studies of Huertas et al. (2017) and Tian et al. (2018), who reported that metacognitive monitoring positively influences students' learning achievement and academic performance.

Therefore, the study concludes that monitoring metacognitive skills plays a significant role in enhancing science academic achievement among senior high school students. Developing students' monitoring abilities may help improve their learning performance and encourage more effective and independent learning practices.

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