Integration of Indigenous Knowledge and Peer Relationship as Predicators of Metacognitive Science Learning among Junior High School Students

MELODY M. CLERIGO
Graduate School
Holy Cross of Davao College, Inc.
https://orcid.org/0009-0004-8466-4345

ROGAR R. GARCIA, EdD
Master Teacher II, Department of Education – Division of Davao City,
F. Bangoy National High School
https://orcid.org/009-0001-5947-0184

Abstract — Metacognitive science learning remains weak. This study examined metacognitive science learning through the integration of indigenous knowledge and peer relationship as predictors. Through predictive research design, the study surveyed 236 respondents selected via universal sampling. The data were analyzed using multiple linear regression. Results showed that metacognitive science learning is very strongly (81.7%) predicted by indigenous knowledge integration and peer relationship, supporting Sociocultural Theory. School leaders may adopt sociocultural practices to enhance metacognitive science learning. Future research may examine additional variables, use qualitative approaches, and factor-analytic validation to explain remaining variance in metacognitive science learning.

Keywords: Integration of indigenous knowledge, peer relationship, predictors of metacognitive science learning, junior high school students

I. INTRODUCTION

Metacognitive learning in science education remains a persistent global challenge, as many students continue to demonstrate limited ability to regulate their thinking during scientific tasks. This problem is particularly evident in students' difficulty transferring metacognitive skills across different science contexts, indicating fragile and inconsistent use of planning, monitoring, and evaluation strategies (Sadykova et al., 2024). Recent studies consistently report that students often engage weakly in metacognitive processes during science learning, reflecting superficial monitoring of understanding and limited self-regulation (Stanton et al., 2021). Such deficiencies in metacognitive learning constrain students' capacity to regulate learning effectively and apply knowledge across contexts, reinforcing the seriousness of poor metacognitive learning as an ongoing concern in science education (Bal & Doğanay, 2022).

Globally, research continues to indicate that students exhibit poor metacognitive learning in science, particularly reflected in low proficiency in monitoring and evaluation processes. These weaknesses suggest that many learners struggle to track their understanding, assess the effectiveness of learning strategies, and regulate their thinking during scientific tasks. Evidence from a recent study in Turkey revealed that most high school students were classified at a novice level of metacognition, indicating limited use of planning, monitoring, and evaluation strategies in science learning (Dulger & Ogan-Bekiroglu, 2025). Similarly, findings from Indonesia showed that junior high school students demonstrated low metacognitive learning across all measured indicators, pointing to consistently underdeveloped metacognitive skills in science classrooms (Almubarokah et al., 2025).

In the Philippine context, evidence from international large-scale assessments indicates persistent weaknesses in students' metacognitive learning in science, as Filipino students scored below the global average in scientific literacy in PISA, reflecting limited ability to plan, monitor, and evaluate their own learning processes in the subject (Famarin, 2024). Complementary evidence shows that students demonstrate limited functional metacognitive learning, particularly in applying and regulating their understanding during academic tasks (Diriposun, 2024). At the local level, similar patterns are observed in the Davao Region, where students show minimal progression in metacognitive learning over time, as reflected in classroom observations and regional assessments (Zhong et al., 2025; Alonzo & Custodio, 2023).

Poor metacognitive learning in science remains a critical and unresolved concern, as it undermines students' ability to plan, monitor, and evaluate their understanding—processes essential for scientific reasoning, problem-solving, and conceptual clarity (Willison et al., 2024). When these metacognitive skills are weak, students are less able to regulate their learning during complex scientific tasks, leading to superficial understanding and persistent misconceptions. This concern is reinforced by international assessment results showing that Filipino learners consistently perform below global benchmarks in scientific literacy, indicating that deficiencies in science learning are rooted not only in content acquisition but in underdeveloped metacognitive skills (OECD, 2023). Collectively, these patterns highlight the need to address poor metacognitive learning as a central concern in science education rather than a secondary instructional issue.

This study aligns with Sustainable Development Goal (SDG) 4 (Quality Education) by advancing inclusive, high-quality science instruction through culturally responsive pedagogy that integrates indigenous knowledge and peer collaboration. It supports national education priorities, particularly the Department of Education's mandate under DepEd Order No. 32, s. 2015, by providing empirical evidence to guide the development of culturally grounded science learning materials.

Moreover, the study contributes to the decolonization of science education by affirming the value of local knowledge systems and sociocultural interaction in fostering students' engagement and metacognitive development. The findings offer practical implications for teachers and schools in designing inquiry-based instruction anchored in learners' experiences, while supporting Indigenous learners' cultural identities and promoting equitable access to meaningful and relevant science education

Statement of the Problem

The purpose of this study is to determine the influence of Indigenous Knowledge and peer relationships as predictors of students' metacognitive science learning.

Specifically, it was aimed to determine:

1. the levels of integration of indigenous knowledge in science instruction in terms of cultural relevance, indigenous scientific explanation, classroom application; peer relationship in terms of intimacy, popularity, trust, insightfulness; students' metacognitive science learning in terms of knowledge about cognition, and regulation of cognition;

2. the significant correlations between the Integration of Indigenous Knowledge and students' metacognitive science learning; Peer Relationship and students' metacognitive science learning; and

3. the significance of the predictive model for student metacognitive science learning using indigenous knowledge and peer relationship as predictors.

Hypotheses

The following hypotheses will be tested at the 0.05 level of significance:

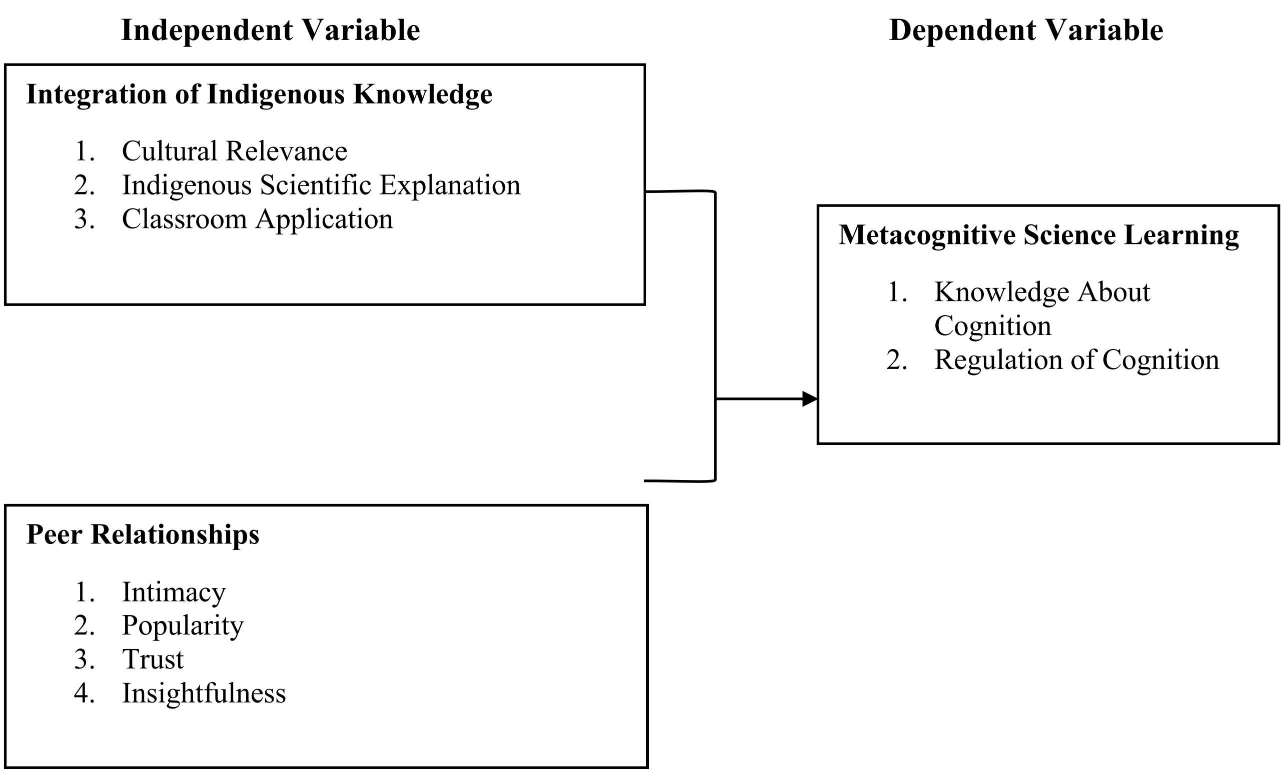
H_{01}: **There is** no significant relationship between the level of Integration of Indigenous Knowledge and students' metacognitive science learning; the significant relationship between the level of Peer Relationship and students' metacognitive science learning.

H_{02}: The predictive model for student metacognitive science learning using indigenous knowledge and peer relationship as predictors is not significant.

Theoretical and Conceptual Framework

This study is anchored on **Sociocultural Theory, primarily developed by Lev Vygotsky (1978),** which posits that cognitive development is a collaborative, social process heavily influenced by culture and social interactions. According to Sociocultural Theory, metacognitive development occurs through social interaction and guided collaboration, as learners achieve higher cognitive functions with the support of peers and cultural resources, highlighting the importance of social and cultural contexts in learning.

In this study, indigenous knowledge integration, indicated by cultural relevance (Gay, 2010), indigenous scientific explanation (Aikenhead & Michell, 2011), and classroom application (Battiste, 2013), captures learning facilitated by cultural tools that ground science concepts in students' everyday contexts. Peer relationship, reflected in intimacy, popularity, trust, and insightfulness (Aydoğdu, 2021), represents learning through social interaction, collaboration, and shared regulation within the Zone of Proximal Development. Metacognitive science learning, indicated by knowledge of cognition and regulation of cognition (Flavell, 1979; Schraw & Dennison, 1994), represents the internalization of higher-order thinking skills. Together, these constructs align with Sociocultural Theory, which emphasizes that metacognitive development occurs through culturally grounded instruction and meaningful peer interaction (Matindike & Ramdhany, 2025; Shive, 2025). In other words, all the components of the theory are used in this study. Thus, this study is fully anchored on the theory.



II. METHODOLOGY

This study employed predictive research design. Such design aims to forecast or estimate outcomes based on one or more predictor variables. It focuses on identifying relationships that enable the anticipation of outcomes, rather than limiting analysis to the description or explanation of phenomena. It extends explanatory research by placing greater emphasis on prediction informed by both theory and empirical evidence (van Witteloostuijn et al., 2022).

The study was conducted in selected public secondary schools under Cluster XVI of Davao City, Region XI. These schools were selected based on administrative approval, and their implementation of contextualized science instruction in line with the Department of Education's K to 12 Curriculum Framework. The schools serve learners from diverse ethnolinguistic communities and integrate Indigenous Knowledge Systems and peer-based learning into classroom practices, providing a culturally rich and socially interactive setting appropriate for examining the predictive roles of indigenous knowledge integration and peer relationship in metacognitive science learning.

The participants of this study consisted of 236 junior high school students from Labo NHS (n=58), Butay NHS (n=83), and Kiman anao IS (n=95), public secondary schools in Cluster XVI, Davao City, who were exposed to the integration of Indigenous Knowledge Systems (IKS) in science instruction and were enrolled in the school year 2025-2026. These students were selected as they possess relevant learning experiences and observable peer relationships, enabling them to provide reliable data for examining metacognitive science learning, which were essential in determining how cultural relevance and peer interaction contribute to students' ability to plan, monitor, and evaluate their learning.

This study employed universal sampling technique, wherein all members of the target population who met the inclusion criteria were included as participants. This approach was appropriate given the manageable population size, ensuring complete representation, adequate sample size, and minimized sampling bias, thereby strengthening the accuracy and reliability of the findings (Etikan & Bala, 2017).

Moreover, it employed a survey method to collect quantitative data using structured questionnaires, allowing for efficient and standardized data collection (Creswell, 2018).

To measure the study variables, three adapted instruments using a 4-point Likert scale were utilized. All these questionnaires were adapted, modified, and were contextualized for public junior high schools in Davao City, validated by experts, and pilot-tested. The Indigenous Knowledge Integration Questionnaire (IKIQ) adapted from Gwekwerere and Madziwa (2021) consists of 12 items measuring cultural relevance, indigenous scientific explanation, and classroom application (Cronbach's alpha α = 0.82). The Peer Relationship Scale for Adolescents (PRS) adapted from Aydoğdu (2021) contains 15 items across intimacy, popularity, trust, and insightfulness, showing high reliability (Cronbach's alpha α = 0.94). The Metacognitive Awareness Inventory (MAI) adapted from Schraw and Dennison (1994) includes 52 items measuring knowledge and regulation of cognition and has demonstrated strong reliability (Cronbach's alpha α = 0.97).

This study employed the following data analysis technique: descriptive statistics, correlation analysis, and multiple linear regression analysis. Descriptive data analysis, specifically mean and standard deviation, were used to describe the levels of the variables, while correlation and regression analyses were applied to determine relationships and predictive strength among variables (Kim & Mallory, 2023).

The following scale was used to interpret the level of variables:

Scale	**Level**	**Indigenous Knowledge Integration**	**Peer Relationship**	**Metacognitive Science Learning**
1.00 - 1.74	Very Low	Very Weak	Very Weak	Very Weak
1.75 - 2.49	Low	Weak	Weak	Weak
2.50 - 3.74	High	Strong	Strong	Strong
3.75 - 4.00	Very High	Very Strong	Very Strong	Very Strong

Standard Deviation Value of Ranges and Interpretation

SD Value Range of Interpretation

0.00 – 0.50	Very low variability/responses are very consistent
0.51 – 1.00	Low variability / responses are relatively consistent
1.01 – 1.50	Moderate variability/responses vary significantly
1.51 – 2.00	High variability/responses vary significantly
Above 2.00	Very high variability/responses are highly dispersed

Correlation analysis was employed to examine the strength and direction of relationships among the variables without implying causation, using Pearson's r as the statistical index (Schober et al., 2023).

For the interpretation scale of r-value, the following scheme is used as proposed by Guilford (1956):

Computed r	Descriptive Interpretation
+/- 1.00	Perfect correlation
Between +/- 0.75 – +/- 0.99	High correlation
Between +/- 0.51 – +/- 0.74	Moderately high correlation
Between +/- 0.31 – +/- 0.50	Moderately low correlation
Between +/- 0.01 – +/- 0.30	Low correlation
0.00	No correlation

Multiple regression analysis was applied to determine the degree of influence and predictive strength. The strength of the beta (β) coefficients was interpreted using the guidelines proposed by Cohen (1988) and Hair et al. (2019).

β Value Range	**Predictive Strength**
±0.00 – ±0.09	Very Weak
±0.10 – ±0.29	Weak
±0.30 – ±0.49	Moderate
±0.50 – ±0.69	Strong
±0.70 and above	Very Strong

This study, the Influence of Indigenous Knowledge and Peer Relationship on Students' Metacognitive Science Learning, involving Junior High School students from far and remote areas and was conducted in accordance with ethical guidelines approved by the Department of Education and the Holy Cross of Davao College – Society for Moral Integrity and Legal Ethics (HCDC-SMILE). Since the participants were minors, both their assent and their parents' or guardians' consent were obtained prior to participation. The study posed minimal risk and was coordinated with school staff to avoid disrupting classes, while all personal data were protected in compliance with the Data Privacy Act of 2012. Participant selection was fair, and all materials used were respectful of local culture and traditions.

III. RESULTS

Table 1 are the descriptive statistical results of the study including the variables involved namely, indigenous knowledge integration, peer relationship, and metacognitive science learning with their respective indicators. Likewise, the number of samples, standard deviation, mean and descriptive level specifically corresponding with each of the variables are found in the table.

TABLE 1
DESCRIPTIVE STATISTICS (N = 236)

Variables	Number of Samples (N)	Standard Deviation	Mean	Descriptive Level
Indigenous knowledge integration	**236**	**0.56**	**3.27**	**High**
Cultural relevance		*0.59*	*3.29*	*High*
Indigenous scientific explanation		*0.59*	*3.27*	*High*
Classroom application		*0.50*	*3.26*	*High*
Peer relationship	**236**	**0.59**	**3.27**	**High**
Intimacy		*0.49*	*3.24*	*High*
Popularity		*0.54*	*3,28*	*High*
Trust		*0.83*	*3,32*	*High*
Insightfulness		*0.51*	*3.25*	*High*
Metacognitive science learning	**236**	**0.46**	**3.22**	**High**
Knowledge of cognition		*0.47*	*3.23*	*High*
Regulation of cognition		*0.44*	*3.21*	*High*

Specifically, the indigenous knowledge integration variable obtained a mean score of 3.27, described as high level, which indicates a strong level of integration among students. All indicators under this variable were likewise rated high. The standard deviation of 0.56 indicates low variability, suggesting a relatively consistent pattern of responses across participants. Similarly, the peer relationship variable obtained a mean score of 3.27, also described as high level, which indicate respondents demonstrate strong peer relationship. All indicators under this variable were likewise rated high. The standard deviation of 0.59 indicates low variability, reflecting relatively consistent responses. Finally, metacognitive science learning variable also reached a mean of 3.22, described as high level, indicating strong use of metacognition in their science learning. All indicators were likewise rated high. The corresponding standard deviation of 0.46 indicates very low variability, further suggesting relatively consistent responses.

These findings indicate that the students are well-exposed to culturally relevant teaching and maintain supportive social bonds, which likely coincide with their high engagement in metacognitive processes.

Table 2 presents the correlational results. It includes the predictive and criterion variables, the r-values, p-values, decisions on the null hypothesis, and corresponding interpretations.

TABLE 2
CORRELATIONAL TABLE (N =236)

Variables	**Metacognitive Science Learning**			
	r-value	p-value	Decision on *Ho*	Interpretation
Indigenous knowledge integration	0.837	0.000	Reject H_o	High significant correlation
Peer relationship	0.890	0.000	Reject H_o	High significant correlation

Level of Significance: 0.05

Decision Rule: Reject Ho if p < 0.05

As shown in the table, the correlation of Indigenous knowledge integration and metacognitive science learning variables obtained a p-value of 0.000, which is less than the 0.05 degree of confidence. Hence, the null hypothesis was rejected. This indicates that the correlation is highly significant. Moreover, the r-value of 0.84 indicates that the correlation is high, implying that the higher levels of metacognitive science learning are associated with higher levels of indigenous knowledge integration. As indigenous knowledge integration changes, the metacognitive science learning also changes.

Similarly, the relationship of peer relationship and metacognitive science learning variables obtained a p-value of 0.000, which is less than the 0.05 degree of confidence. Hence, the null hypothesis was likewise rejected. This indicates that the correlation is high significant. Moreover, the r-value of 0.89 indicates high significant correlation, suggesting the increase in metacognitive science learning, is associated to the increase peer relationship.

Both indigenous knowledge integration and peer relationship displayed high and significant associations with metacognitive science learning. Comparatively, peer relationship demonstrates slightly higher correlation coefficient, suggesting a stronger statistical association within the model.

Table 3 presents the results of the multiple linear regression analysis, including the unstandardized coefficients (B), standard errors, standardized coefficients (β), t-values, p-values, and corresponding decisions.

TABLE 3
REGRESSION TABLE (N = 236)

	Metacognitive Science Learning ($\hat{y}$)						
Variables	Unstandardized Coefficient		Standardized Sig Coefficient	T		Decision on H_o	Interpretation
	B	Std. Error	B				
Constant	0.219	0.09	—			—	—
Indigenous knowledge integration	0.261	0.05	0.30	5.66	0.000	Reject H_0	Positive significant influence
Peer relationship	0.657	0.05	0.64	12.20	0.000	Reject H_0	Positive significant influence

Model Summary:
$R = 0.904$ | $R^2 = 0.817$ | Adjusted $R^2 = 0.815$ | $F = 38.6$ | $p = 0.000$
Level of Significance: *0.05*
Decision Rule: *Reject H_0 if $p < 0.05$*

Predictive Model: MSL = 0.219 + 0.261(IKI) + 0.657(PR)

It specifically shows the predictive model for student metacognitive science learning using indigenous knowledge integration and peer relationship as predictors is MSL = 0.219 + 0.261(IKI) + 0.657(PR). The model summary also reveals an F=38.6, with corresponding p-value of 0.000 that is less than the 0.05 level of significance. This leads to the rejection of null hypothesis, indicating that the overall regression model for metacognitive science learning is significant. The model further emphasizes that the criterion is forecasted by changes in the predictors.

Furthermore, the result shows an R value of 0.90 and an adjusted R^2 value of 0.82, indicating that the model very strongly (81.7%) predicts metacognitive science learning.

Summary of Findings

Based on statistical results, it specifically was found thatnIndigenous knowledge integration and peer relationship both have a high, positive and statistically significant correlation with metacognitive science learning. The model to predict metacognitive science learning using indigenous knowledge integration and peer relationship is significant.

IV. DISCUSSION

Correlation of Indigenous Knowledge Integration and Peer Relationship with Metacognitive Science Learning

The result of the present study shows high significant correlation between indigenous knowledge integration and metacognitive science learning, suggesting that students' metacognitive engagement in science is closely aligned with culturally grounded instruction. This finding supports the claim of Rasmawan et al. (2025), explaining that integrating indigenous knowledge into science lessons is significantly associated with students' reflective awareness and monitoring of understanding. Likewise, this current finding matches the idea of McKinley & Stewart (2022), asserting that the inclusion of local and cultural knowledge systems is closely related to learners' metacognitive awareness and engagement in meaning-making processes

However, this result differs from the findings of Dulger and Ogan-Bekiroglu (2024), stating that although students demonstrated awareness of metacognitive strategies, their engagement in regulation and reflection did not consistently align with instructional contextualization. These differences may reflect variations in construct operationalization and instructional emphasis.

Moreover, peer relationship also shows high significant correlation with metacognitive science learning. This finding affirms Wen and Castek (2023), who emphasized that peer dialogue and collaborative engagement are significantly related to students' opportunities to articulate reasoning and reflect on understanding. Furthermore, it supports the assertion of Katsantonis and McLellan (2023), reporting that shared regulation during group learning tasks is associated with higher engagement in metacognitive processes.

In contrast, the present result contradicts Lin, Hsieh, and Huang (2024), who reported that peer interaction did not consistently correspond with metacognitive engagement across learning tasks, suggesting that such associations may depend on classroom structure and task design. These studies indicate that the relationship between peer interaction and metacognitive engagement may be context-dependent and shaped by instructional conditions.

Metacognitive Science Learning as Influence and Predicted by Indigenous Knowledge Integration and Peer Relationship

The regression result reveals that both indigenous knowledge integration and peer relationship significantly predict metacognitive science learning, with peer relationship emerging as the stronger predictor. This finding supports Katsantonis and McLellan (2023), who reported that shared regulation during peer interaction is closely associated with students' metacognitive engagement in classroom learning. In addition, the current finding affirms de Beer et al. (2022), who found significant associations between indigenous knowledge integration and students' reflective engagement when science instruction is situated within familiar cultural contexts. This pattern aligns with recent findings indicating that culturally relevant curricula are most effective when implemented alongside collaborative learning structures that actively engage students in dialogue and reflection (Wen & Castek, 2023).

However, the recent finding negates the study of (Bang & Medin, 2020), emphasizing that culturally grounded and collaborative learning experiences do not inherently elicit metacognitive engagement unless reflection on thinking processes is intentionally embedded. These discrepancies may be attributed to differences in educational settings, constructs measured, and methodological approaches.

Conclusion

In conclusion, forecasting metacognitive science learning using integration of indigenous knowledge and peer relationship as predictors is significant. This conclusion supports Sociocultural Theory, positing that cognitive development is a collaborative, social process heavily influenced by culture and social interactions. It explains that metacognitive development occurs through social interaction and guided collaboration, as learners achieve higher cognitive functions with the support of peers and cultural resources, highlighting the importance of social and cultural contexts in learning.

Recommendations

Based on conclusion, future study may examine additional variables to account the remaining 18.3% variance in the metacognitive science learning. Qualitative approaches may be pursued to explore sociocultural influences on metacognition. Exploratory factor-analytic studies may be appropriate to validate sociocultural learning instruments. Lastly, school leaders may utilize these findings to strengthen metacognitive science learning among junior high school students by systematically integrating sociocultural elements such as peer interaction, and indigenous knowledge into classroom practices.

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