
Influence of Self-Regulation and Metacognitive Awareness on the Academic Resilience Among Science, Technology, and Engineering Students

ALMIRA S. LATIP

Teacher I, Department of Education – Division of Davao City,
Daniel R. Aguinaldo National High School
<https://orcid.org/0009-0005-3751-9839>

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 — Increasing concern on students' low academic resilience highlights its critical role in overcoming academic adversities. This study determined the significant influence of self-regulation and metacognitive awareness on academic resilience among junior high school STE students. Utilizing descriptive-correlational design and multiple regression analysis with 218 STE students, findings revealed that both self-regulation and metacognitive awareness significantly influence academic resilience, collectively explaining 59% of its variance. The results affirm the Self-Determination Theory, though with limitations in the dimension of relatedness. Future quantitative studies may incorporate additional variables to explain the remaining variance in academic resilience. Educational institutions are encouraged to integrate structured self-regulation and metacognitive awareness strategies into STE pedagogy to strengthen students' academic resilience.

Keywords — *Self-regulation, metacognitive awareness, academic resilience, STE students*

I. INTRODUCTION

Global prevalence of low academic resilience is evident among higher education students (Chua et al., 2023). This claim aligns with Bagdžiūnienė et al.'s (2025) observation that academic resilience is crucial in helping students to effectively overcome academic challenges and in laying a strong foundation for their future success. Academic resilience is not only essential for achieving strong academic outcomes but also for cultivating an attitude necessary to navigate real-world challenges (Mohan and Kaur, 2021).

Previous international studies have explored academic resilience among students. In Korea, there was a drastic drop in academic resilience among nursing students when education was delivered using non-face-to-face classes (Lee and Jang, 2022). In South Africa, undergraduate medical students with dysfunctional strategies were seen to have low academic resilience (Van der Merwe et al., 2020). Moreover, in Brazil, academic resilience is evidently challenged among higher education students, who face significant stress and adversity primarily from competing professional and family demands, as well as the loss of loved ones (de Oliveira Durso et al., 2021).

In the Philippines, a study by Berdida and Grande (2022) revealed that nursing students tend to exhibit a decline in academic resilience as they advance through their college education. Similarly, Samoy et al. (2025) reported that male college students had lower academic resilience than female students during the shift to online learning.

Low academic resilience leads to poor academic performance and increased risk of student dropout (Radhamani and Kalaivani, 2021). Thus, academic resilience is a critical attribute in today's crisis-prone world (Uicheng and Chobphon, 2024). Collectively, the cited literature underscores an urgent need to address academic resilience among students. Moreover, a notable research gap exists regarding the limited studies on academic resilience among school-aged population particularly in junior high school, as most researches have focused on the higher education students. This gap, along with the limitation of research exploring how self-regulation and metacognitive awareness influence students' academic resilience are exactly what motivated the pursuit of this study.

By examining self-regulation and metacognitive awareness, the study contributes to strengthening STE learners' academic resilience, which is essential for advancing inclusive and equitable education under SDG 4, nurturing creative problem-solvers for global challenges, and guiding institutions in developing supportive teaching approaches.

The main purpose of the study was to determine the influence of self-regulation and metacognitive awareness on the academic resilience of STE learners. Specifically, it aims to determine: the level of students' self-regulation in terms of intrinsic motivation: to know, intrinsic motivation: self-development, identified regulation, introjected positive regulation, introjected negative regulation, external regulation: general, and external regulation: teacher; the level of metacognitive awareness in terms of declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, and evaluation; and the level of academic resilience in terms of perseverance, reflecting and adaptive help-seeking, and negative affect and emotional response; the significant relationship between self-regulation, metacognitive awareness and academic resilience; and the significant distinct and combined influence of self-regulation and metacognitive awareness on the academic resilience among STE students. This study was anchored on Self-Determination Theory (SDT) by Edward Deci and Richard Ryan (1985).

II. METHODOLOGY

This study utilized a non-experimental, quantitative research design utilizing descriptive-correlational approach. Non-experimental research involves studying variables as they occur naturally without any intervention or manipulation of an independent variable (Price et al., 2015). Descriptive research design is used to systematically describe the characteristics of a particular population or setting as they naturally occur (Sileyew, 2020). In addition, correlational research examines the relationship among variables without manipulation (Creswell, 2012). This design is most appropriate for this study as it describes the levels of self-regulation, metacognitive awareness, and academic resilience. Subsequently, correlational design was used to explore the relationships between self-regulation, metacognitive awareness, and academic resilience.

This study was conducted in a Cluster 2 public junior high school within the Division of Davao City, which offers the Science, Technology, and Engineering (STE) curriculum. This

school was selected due to its reputation for providing quality education through the STE curriculum and its classification as “very large” among public high schools.

The researcher utilized universal sampling and involved 218 respondents. Universal sampling includes every member of the population, which is appropriate for descriptive-correlational studies as it enhances representativeness and improves the precision on the relationships between variables (Lemboye, 2019; Lau & Kuziemy, 2017). The criteria on selecting the respondents include the following: (a) only students who are officially enrolled in the STE program for the school year 2025-2026; (b) Grade 7 to Grade 10 students aged 12-17 years and (c) who provided informed consent assent. The exclusion criteria are the following: a) students who were absent during the collection of data, and b) students who were not able to completely answer the questionnaire.

There were three adapted and modified questionnaires used in this study, namely, the Self-Regulation Questionnaire (SRQ-A), Metacognitive Awareness Inventory, and Academic Resilience Scale. The first instrument, developed by Gordeeva et al. (2020), measures the students’ self-regulation and captures their degree of autonomy. The second questionnaire, originally developed by Tak et al. (2022), measures the learners’ metacognitive awareness or their ability to understand their own thinking and learning processes. The third instrument, developed by Cassidy (2016), measures the students’ ability to navigate challenges and setbacks despite academic adversity.

All three questionnaires were adapted, modified, and validated to suit the background of the respondents and the objectives of the study. Each utilized a Likert-scale with specific indicators describing respondents’ current conditions. Moreover, they were subjected to reliability testing, and all items obtained a Cronbach’s alpha above 0.90, confirming the high reliability of these tools.

The matrix (summary table) presented below shows the statistical tools corresponding to each statement of the problem in this study, along with the specific purpose for which each statistical tool is used.

<i>Statement of the Problem</i>	<i>Statistical Tool</i>	<i>Purpose/Use</i>
Levels of the three respective variables	Descriptive Statistics (Mean, SD)	Determine levels of self-regulation, metacognitive awareness, and academic resilience
Significance of the correlation between the independent and dependent variables	Pearson Product–Moment Correlation	Test significance and strength of relationships among variables
Significance of the degree of influence of independent variables to the dependent variable	Regression Analysis	Assess degree of influence of self-regulation and metacognitive awareness on academic resilience

Presented below is the matrix that outlines the scale, descriptive level, and corresponding interpretation assigned to each variable involved in this study. This measure is used particularly in describing the levels of self-regulation, metacognitive awareness, and academic resilience.

<i>Scale</i>	<i>Level</i>	<i>Interpretation for Self-Regulation</i>	<i>Interpretation for Metacognitive Awareness</i>	<i>Interpretation for Academic Resilience</i>
3.26 – 4.00	Very High	The student's self-regulation is excellent.	The student's metacognitive awareness is excellent.	The student's academic resilience is excellent.
2.50 – 3.25	High	The student's self-regulation is good.	The student's metacognitive awareness is good.	The student's academic resilience is good.
1.75 – 2.49	Low	The student's self-regulation is poor.	The student's metacognitive awareness is poor.	The student's academic resilience is poor.
1.00 – 1.74	Very Low	The student's self-regulation is very poor.	The student's metacognitive awareness is very poor.	The student's academic resilience is very poor.

For the interpretation scale of r-value, the following scheme is used:

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

The correlation interpretation scale used in this study was a commonly used descriptive guide for interpreting Pearson's r-values.

The study adhered to strict ethical standards in conducting research involving STE learners. Before data collection, parent's informed consent and assent were obtained from all respondents

to ensure voluntary participation and the confidentiality of their responses. The research instruments were subjected to validation and reliability testing to establish the accuracy and trustworthiness of the findings. Formal permissions from the Department of Education—at the division, cluster, and school levels—were secured to authorize the conduct of the study. In addition, the research proposal was reviewed and approved by the Society of Moral Integrity and Legal Ethics (SMILE) to guarantee compliance with ethical, legal, and moral research principles.

III. RESULTS AND DISCUSSION

Table 1 presents the descriptive statistics for the levels of the study. Included in the table are the variables involved namely, self-regulation, metacognitive awareness, and academic resilience with their respective indicators. It also includes the number of respondents, standard deviations, computed means and the corresponding descriptive levels.

TABLE 1
DESCRIPTIVE STATISTICS (N = 218)

Variables	Standard Deviation	Mean	Descriptive Level
Self-regulation	0.39	3.06	High
Intrinsic Motivation: To Know	0.56	2.85	High
Intrinsic Motivation: Self-Development	0.54	3.04	High
Identified Regulation	0.48	3.01	High
Introjected Positive Regulation	0.55	3.14	High
Introjected Negative Regulation	0.53	3.02	High
External Regulation: General	0.49	3.25	High
External Regulation: Teacher	0.50	3.13	High
Metacognitive Awareness	0.39	3.11	High
Declarative Knowledge	0.53	2.99	High
Procedural Knowledge	0.49	3.19	High
Conditional Knowledge	0.51	3.12	High
Planning	0.53	3.10	High
Monitoring	0.49	3.13	High
Evaluation	0.47	3.14	High

Academic Resilience	0.41	3.12	High
Perseverance	0.43	3.20	High
Reflecting and Adaptive Help-Seeking	0.48	3.11	High
Negative Affect and Emotional Response	0.53	3.05	High

Specifically, Table 1 shows that the self-regulation variable obtained the mean score of 3.06 (SD=0.39) described as high. Further, this mean score suggests that the STE students have a good self-regulation. The table also shows that all the indicators obtained high means: external regulation: general (3.25), introjected positive regulation (3.14), external motivation: teacher (3.13), intrinsic motivation: self-development (3.04), introjected negative regulation (3.02), identified regulation (3.01), and intrinsic motivation: to know (2.85). These findings collectively highlight that students exhibit consistent self-regulation across different dimensions, with external regulation emerging as the strongest indicator. The consistently high mean scores across all indicators suggest that STE students possess strong self-regulatory capacities, with external regulation (general) emerging as the most influential dimension. This implies that while students are capable of managing their own motivation and learning strategies, they remain highly responsive to structured guidance and external expectations.

Moreover, Table 1 presents an overall mean score of 3.11 (SD=0.39) for metacognitive awareness which is described as high. This mean score indicates that the respondents' metacognitive awareness is good. All the indicators show high means with procedural knowledge the highest (3.19), followed by evaluation (3.14), monitoring (3.13), conditional knowledge (3.12), planning (3.10), and declarative knowledge (2.99). These results suggest that learners are proficient in applying strategies and methods to accomplish tasks, as well as in evaluating and monitoring their progress.

Finally, Table 1 further shows that the overall mean score of 3.12 (SD=0.41) for academic resilience is high. This implies that the STE students have good academic resilience. As shown in Table 1, all the indicators of academic resilience obtained high means with perseverance the highest (3.20), followed by reflecting and adaptive help-seeking (3.11), and negative affect and emotional response (3.05). This suggests that learners are capable of sustaining effort and commitment even in the face of academic challenges. The relatively high scores in reflecting and adaptive help-seeking (M = 3.11) further imply that students are willing to adjust strategies and

seek support when necessary, while the indicator, negative affect and emotional response ($M = 3.05$), highlights their ability to manage stress and regulate emotions effectively.

These findings are supported by Igbuhay et al. (2024), who reported high levels of self-regulation among senior high school students, particularly in evaluating information, initiating change, and implementing plans. Similarly, Özden and Özmen (2023) identified moderately high metacognitive awareness in a sample of 390 high school students, which was positively associated with self-confidence and academic performance. Moreover, Carroza-Pacheco et al. (2025), in their analysis of 609 Spanish secondary students, found that resilience dimensions—especially internal resources and identity–self-esteem—significantly predicted high academic performance.

Table 2 shows the correlational results between the independent variables — self-regulation and metacognitive awareness — and the dependent variable, academic resilience. In addition, the table presents the corresponding r -values, p -values, the decision on the hypothesis, and the corresponding interpretation.

TABLE 2
CORRELATION TABLE (N=218)

Variables	Academic Resilience			
	r-value	p-value	Decision on H0	Interpretation
Self-regulation	0.58	<.001	Reject H0	Moderate Positive, Significant
Metacognitive Awareness	0.76	<.001	Reject H0	High Positive, Significant

Level of Significance: 0.05

Decision Rule: Reject H_0 if $p < 0.05$

The correlation analysis in Table 2 revealed statistically significant positive relationship between the independent variables and academic resilience. Self-regulation demonstrated a moderate positive correlation with academic resilience ($r=0.58$, $p<.001$), indicating that students with stronger self-regulatory abilities tend to exhibit greater perseverance and adaptability in academic contexts. Similarly, metacognitive awareness showed a high positive and statistically

significant correlation with academic resilience ($r=0.76$, $p<.001$), suggesting that students who are more aware of their own thinking processes are better equipped to sustain resilience when faced with academic challenges. Since both relationships were significant at 0.05 level, the null hypotheses were rejected, confirming that self-regulation and metacognitive awareness are meaningfully associated with academic resilience. This significant association between self-regulation and metacognitive awareness with academic resilience implies that strengthening students' ability to monitor and control their learning processes can enhance their capacity to adapt and thrive in challenging academic contexts.

These findings align with Mousavi et al. (2024), who revealed that female secondary students showed a significant positive Pearson correlation between learning self-regulation and academic resilience, with self-regulation contributing 5.70% to resilience variance after controlling for motivation. Similarly, Herdiana et al. (2024), in a study of 211 biology students at a senior high school in Indonesia, revealed a strong correlation between metacognitive skills and academic resilience, with metacognition contributing 62.7% to resilience variance.

Table 3 presents the regression analysis showing that self-regulation and metacognitive awareness significantly influence the STE students' academic resilience. With R^2 of 0.59 ($p<.001$), the model indicates that these two factors account for 59% of the total variance in STE students' academic resilience.

TABLE 3
REGRESSION TABLE (N=218)

	Academic Resilience						
	Unstandardized Coefficients		Standardized Coefficients				
Variables	B	Std. Error	Beta	t	Sig.	Decision on H_0	Interpretation

(Constant)	0.48	0.15	—	3.12	0.002	—	—
Self-regulation	0.15	0.05	0.14	2.51	0.013	Reject	Positive Significant Influence
Metacognitive Awareness	0.70	0.06	0.67	11.66	<.001	Reject	Positive Significant Influence

R = 0.77 | R² = 0.59 | F = 160 | p = <.001

Level of Significance: 0.05

Decision Rule: Reject H₀ if p < 0.05

The regression analysis revealed that the independent variables significantly explained variations in academic resilience ($R^2 = 0.59$, $p < .001$), indicating that 59% of the variance in academic resilience is accounted for by self-regulation and metacognitive awareness. The overall model demonstrated a strong relationship between the independent variables and academic resilience ($R=0.77$), and the regression model was statistically significant ($F=160$, $p<.001$), leading to the rejection of the null hypotheses.

The unstandardized coefficient for self-regulation ($B = 0.15$, $\beta = 0.14$, $p = .013$) indicates that higher levels of self-regulatory skills are associated with increased academic resilience, though its influence is relatively modest. In contrast, metacognitive awareness exerted a stronger positive and statistically significant influence on academic resilience ($B = 0.70$, $\beta = 0.67$, $p < .001$), suggesting that students with greater metacognitive awareness are substantially more likely to demonstrate perseverance, adaptability, and emotional regulation in academic setting. Since both self-regulation and metacognitive awareness were statistically significant, their null hypotheses were rejected. These findings confirm that while both self-regulation and metacognitive awareness significantly influence academic resilience, metacognitive awareness exerts greater influence on academic resilience. This implies that fostering students' metacognitive awareness alongside self-regulatory skills can meaningfully impact their ability to adapt, persevere, and thrive in challenging academic contexts.

These findings support Ataii et al. (2021), who demonstrated that self-regulation directly predicts academic resilience, with perceived competence mediating this relationship. In addition, Gina et al. (2024) reported a strong correlation between metacognitive skills and academic

resilience, showing that metacognitive awareness significantly contributes to students' ability to adapt and persevere in academic contexts.

Summary of Findings

The levels of self-regulation, metacognitive awareness, and academic resilience of STE students were generally high. Self-regulation and Metacognitive Awareness significantly correlate with Academic Resilience. Self-regulation has a positive (14%) significant influence on Academic Resilience while Metacognitive Awareness has a positive (67%) significant influence on Academic Resilience. Self-regulation and Metacognitive Awareness have a positive (59%) significant combined influence on Academic Resilience among STE students.

Self-regulation, Metacognitive Awareness, and Academic Resilience Descriptions

The findings indicate that STE students demonstrate high level of self-regulation in terms of intrinsic motivation: to know, intrinsic motivation: self-development, identified regulation, introjected positive regulation, introjected negative regulation, external regulation: general, and external regulation: teacher. This result aligns with Bene et al. (2021), who reported that STEM students exhibit higher self-regulation than non-STEM students. Likewise, it supports the study of Nakhostin-Khayyat et al. (2024) which highlighted that self-regulation particularly identified and introjected regulation is strengthened by motivational factors.

The study further revealed high metacognitive awareness among STE students. This is consistent with Cabasa and Pañares (2025), who found that students who exhibit awareness of their metacognitive skills also recognize strategies such as planning, reflective practices, and mental scripting. This result also supports Ontog (2024), who reported high level of metacognitive awareness among Grade 12 STEM students, noting that when students regulate their cognition, they continuously refine and keep an eye on their learning while developing self-awareness.

Moreover, the results indicate that STE students possess high academic resilience. This observation is consistent with the finding of Grigorescu (2025), who found that students with high levels of resilience, perseverance, and emotional balance are better equipped to overcome academic challenges through planning, collaboration, and support systems involving family, peers, and teachers. Similarly, the present findings resonate with Bagdžiūnienė (2025), whose research in European universities noted that students with high academic resilience benefit from study resources and self-efficacy, which in turn lead to greater engagement and well-being.

Self-regulation and Metacognitive Awareness, and the Academic Resilience Correlation

The finding that self-regulation and academic resilience have a moderate positive correlation aligns with Mahama et al. (2023), who observed that students who actively self-regulate during school-related activities are likely to withstand academic adversities. Similarly, this result supports the findings of Nakhostin-Khayyat et al. (2024), which highlighted that students who effectively regulate their thoughts, emotions, and behaviors when facing academic or life challenges are more likely to demonstrate adaptable thinking and flexible problem-solving which are hallmarks of academic resilience.

The study also revealed that metacognitive awareness and academic resilience have high positive correlation. This finding conforms with Kumar (2025), who found a significant and positive relationship between metacognition and academic resilience among private senior secondary school students.

Academic Resilience as Influenced by Self-Regulation and Metacognitive Awareness

The finding of this study, which shows that self-regulation significantly influences academic resilience, is consistent with those of Mahama et al. (2023). Their research found that students with self-regulated learning abilities are able to learn from their mistakes and develop tolerance towards negative situations. Moreover, the result shows that metacognitive awareness significantly influences academic resilience. This finding supports Baniani and Davoodi (2021), who reported that metacognitive beliefs significantly predict students' academic resilience and

found that cognitive trust and cognitive awareness have the most significant role in students' academic resilience.

Anchored on Self-Determination Theory (Deci and Ryan, 1985), this study demonstrates that the positive and significant influence of self-regulation and metacognitive awareness on academic resilience of STE students affirms the theory's central claim that when learner's needs for autonomy and competence are supported, their capacity for resilience is enhanced. In this context, self-regulation and metacognitive awareness function as mechanisms that sustain motivation, enabling students to adapt effectively to academic challenges and persist in the face of setbacks.

IV. CONCLUSION

The results of this study indicate that self-regulation and metacognitive awareness significantly contribute to the academic resilience of STE students, aligning with Deci and Ryan's Self-Determination Theory. Specifically, these mechanisms fulfill learners' psychological needs for autonomy and competence, which are central to sustaining motivation and persistence. While relatedness is acknowledged as part of the broader theory, this study highlights autonomy and competence as the primary drivers of resilience, showing that when students regulate their learning and reflect on their cognitive processes, they are better equipped to overcome academic challenges and thrive in demanding educational contexts.

V. RECOMMENDATIONS

Based on the conclusion, this study recommends integrating structured self-regulation and metacognitive awareness strategies into STE pedagogy to enhance academic resilience among students. Such integration promotes learner autonomy, persistence, and adaptability, thereby contributing to inclusive and quality education in line with SDG 4. Future studies may incorporate additional variables, such as relatedness within the Self-Determination Theory framework, to explain the remaining variance in academic resilience. Expanding the scope across diverse contexts and larger sample sizes will strengthen the generalizability of findings.

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