Mediating Effect of Classroom Climate in the Relationship Between Academic Adaptability and Student Science Engagement

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ABSTRACT

Student science engagement is declining. The significance of the mediating effect of classroom climate on the correlation between academic adaptability student science engagement was examined. Using predictive research design, involving 200 students selected through simple random sampling, and analyzing the data using Mediation analysis, the result showed classroom climate partially and moderately mediates the link between academic adaptability and student science engagement, supporting Social Cognitive Theory. Future studies should explore additional variables and qualitative insights to explain the remaining variance, while educational leaders should strengthen classroom climate programs to further enhance the effect of academic adaptability on student science engagement.

Keywords: Classroom climate, academic adaptability, student science engagement, mediating effect

INTRODUCTION

Student engagement is widely regarded as a critical indicator of students' involvement in learning processes and their sustained participation in academic activities. However, numerous international studies report a continuing decline in students' interest, participation, and active involvement in science learning, raising concerns about the effectiveness of science education in fostering meaningful learning experiences (Fredricks et al., 2004; Potvin & Hasni, 2014).

Evidence from international large-scale assessments further underscores the seriousness of this problem. Results from the Programme for International Student Assessment (PISA) consistently reveal low levels of student engagement and proficiency in science across many countries, indicating that a substantial proportion of learners struggle to meaningfully engage with scientific concepts and practices (OECD, 2019). These findings highlight a global pattern of disengagement that threatens the development of scientific literacy necessary for participation in an increasingly science-driven world. The problem of student engagement in science is also evident in both developed and developing contexts. Research conducted in countries such as the United States, the United Kingdom, Australia, and Canada documents persistent disengagement in science classrooms, reflected in declining interest, reduced participation, and limited persistence in science-related learning pathways (Martin et al., 2022; Lyons et al., 2021).

In the Philippine context, the issue of student engagement in science is particularly pronounced. International assessment results place Filipino students among the lowest performers signaling serious challenges in sustaining engagement with science learning at the secondary level (OECD, 2019). This pattern of low engagement has significant implications for students' academic trajectories and the nation's capacity to develop a scientifically literate population. Despite the growing body of international evidence documenting declining student engagement in science, there remains a need for context-specific research that deepens understanding of how this problem manifests within local educational settings. Addressing this gap is essential, as persistent disengagement in science education continues to undermine learning outcomes and long-term participation in STEM-related fields.

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Significance of the Study

This study is significant as it addresses the persistent issue of poor student science engagement, contributing to the attainment of Sustainable Development Goal 4, which emphasizes inclusive, equitable, and quality education for all learners. By providing insights into improving classroom climate practices, the study supports the creation of structured and supportive learning environments that respond to learner needs. In the Philippine context, the findings align with the national goal of education, which aims to deliver accessible, inclusive, and learner-centered quality education that promotes holistic development among students.

Statement of the Problem

The objective of this was to determine the significance of the mediating effect of classroom climate on the correlation between academic adaptability and science engagement as perceived by the junior high school students. Specifically, it aimed to pursue the following objectives:

1. To determine the levels of classroom climate in terms of physical environment, teacher-students interaction, peer relationship, and teacher orientation toward learning; academic adaptability in terms of self-learning, information utilization, environmental choice, goal orientation, and coping withs tress; and students' science engagement in terms of engagement of science lessons and tasks, science learning involvement, and science effort and preparation;
2. To determine the significance of the correlation between classroom climate, academic adaptability, and the students' science engagement.
3. To determine the significance of the direct effect of academic adaptability on sci engagement, controlling for classroom climate.
4. To determine the significance of indirect effect of academic adaptability on sci engagement, through classroom climate
5. To determine the significance of the total effect on academic adaptability on science engagement.

Hypotheses

The research hypotheses were tested at a 0.05 level of significance.

Ho1: Academic adaptability, and classroom climate do not significantly correlate with students' science engagement.

Ho2: The direct effect of Academic adaptability on Students science engagement, controlling for classroom climate is not significant.

Ho3: The indirect effect of Academic adaptability on Students science engagement, through classroom climate is not significant

Ho4: The total effect of Academic adaptability on Students science engagement.

THEORETICAL AND CONCEPTUAL FRAMEWORK

This study is theoretically grounded in Bandura's Social Cognitive Theory (SCT), which conceptualizes learning as the result of reciprocal interactions among personal factors, behavior, and environmental influences (Bandura, 1986). Within this framework, academic adaptability represents a personal factor reflecting students' self-regulatory capacities and perceived ability to manage academic challenges, closely aligned with Bandura's notion of self-efficacy (Bandura, 1997).

In this study, the academic adaptability indicated by self-learning, information utilization, environmental choice, goal orientation, and coping with stress stands for the personal factors as stated in the theory. Likewise, the classroom climate variable indicated by physical environment, teacher-student interaction, peer relationship, and teacher's orientation toward learning is associated with environmental influences highlighted in the theory.

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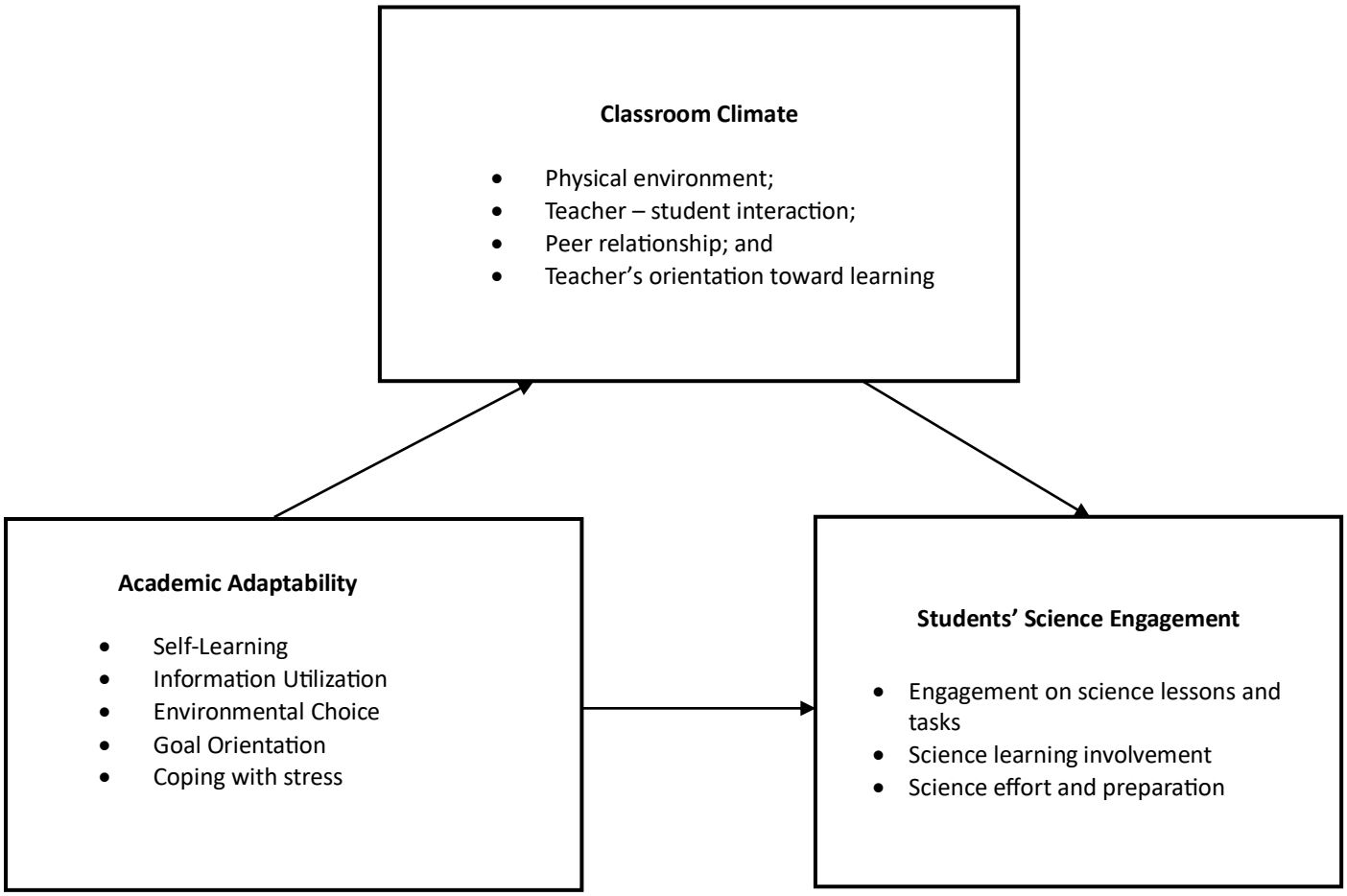
Lastly, student science engagement indicated by engagement on science lessons and tasks, science learning involvement, and science effort and preparation relate with behavior that is explained with the theory.

CONCEPTUAL FRAMEWORK

Figure 1. Conceptual Framework of the Study



Method

This study utilized predictive research design. Predictive research design is a research approach that integrates forecasting of future outcomes into the scientific study, adding prediction as a complement to traditional retrospective explanation by using existing theories and data to anticipate what is likely to occur rather than only explaining what has already happened. It is applied when the research goal is forward-looking—such as testing how well theories or models predict future phenomena or outcomes—and is especially useful in areas where decision-making depends on expected trends or behaviors. Among its advantages are that it broadens the methodological toolkit of research by enabling scholars to evaluate and compare competing theoretical predictions, enhances relevance to practical decision contexts, and encourages stronger tests of theory by assessing predictive accuracy rather than relying solely on past explanation (van Witteloostuijn et al., 2022).

This study was conducted at public secondary schools in Cluster 14, Division of Davao City, chosen for its diverse student population with varying socioeconomic backgrounds and academic abilities. As a highly urbanized center in Mindanao, the city hosts numerous public and private schools that implement varied teaching approaches and educational programs aligned with national standards. Its multicultural environment and accessibility to different types of learners provide a rich context for examining educational practices, instructional strategies, and student engagement. These characteristics make Davao City a relevant and meaningful setting for research in the field of education.

The study included 200 participants, selected based on the following **inclusion** criteria: (1) current enrollment in Grades 10, (2) enrollment in at least one science-related course, (3) attendance at a school within the Division

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of Davao City, and (4) provision of written informed consent (with parental/guardian consent for minors). Students will be excluded if they (1) are not currently enrolled, (2) have irregular attendance, (3) are in alternative education programs such as special education or individualized learning plans, or (4) decline to provide consent, either personally or through their parents/legal guardians.

Random sampling method was employed in selecting the participants, ensuring an unbiased and representative sample. This approach is commonly used in research, particularly when time, resources, and participant accessibility are limited (Thomas, 2020). It allows for efficient and cost-effective data collection by selecting readily available participants, making it well-suited for exploratory research.

This study utilized a survey technique in gathering data. A quantitative method used to collect data from a group of respondents through questionnaires or interviews to describe attitudes, opinions, behaviors, or characteristics of a population. It is applied when researchers need to gather standardized information from a relatively large group efficiently, especially in studies involving perceptions, experiences, or social trends. Its advantages include cost-effectiveness, ability to collect large amounts of data quickly, ease of analysis through structured responses, and generalizability of findings when properly sampled, making it widely used in social science and educational research (Story & Tait, 2022).

To gather the data, the study utilized three adapted questionnaires for academic adaptability, classroom environment, and student science engagement with a total of 57 items. Adapted version of classroom climate scale by Vallejos et all (2018) which measures with Cronbach's α =0.847, academic adaptability scale by Zhang et al. (2019) which, (Cronbach's α = 0.872) and Students' Science Engagement Scale (SSES) by T. Baraquia (2019) with Cronbach's α = 0.895. These instruments were adapted, modified, and validated to suit the respondents and the objectives of the study, and a Likert scale was used to measure each variable, with reliability testing indicating that all instruments used were highly reliable.

The study employed three data analysis techniques, namely descriptive analysis, correlation, and mediation analysis. Descriptive analysis was used to summarize and present data through measures such as means, and standard deviations to clearly describe the characteristics of the dataset without making causal inferences; it is valued for its simplicity, clarity, and effectiveness in organizing large data (Mishra et al., 2022). Correlational analysis examined the strength and direction of relationships between variables without manipulation, making it useful for identifying patterns and associations in natural settings and providing a basis for prediction. It utilizes Pearson r as statistical tool(Schober et al., 2021). Meanwhile, mediation data analysis was utilized to explain how or why an independent variable affects a dependent variable through a mediator, offering deeper insights into underlying mechanisms and enhancing theory development. It utilizes estimated Beta (Hayes, 2022).

The following table contains the range of means, descriptive level, and interpretation of each variable. Specifically, it measures the descriptive levels of academic adaptability, classroom environment, and student science engagement.

Range of Means	Description	Academic Adaptability	Classroom Climate	Student Science Engagement
3.26 - 4.00	Very High	Very good	Very Good	Very Good
2.50 – 3.25	High	Good	Good	Good
1.75 - 2.49	Low	Poor	Poor	Poor
1.00 – 1.74	Very Low	Very Poor	Very Poor	Very Poor

The following is the Standard Deviation Value Interpretation:

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Range	Description	Interpretation
SD ≤ 0.50	Highly consistent responses	Strong and uniform responses
SD = 0.51 -1.00	Moderately Consistent Responses	Acceptable consistency
SD = 1.01 – 1.50	Low consistency Responses	Differing views or experiences
SD > 1.50	Very Low Consistency Responses	High variability and lack of consensus

The study used a standard descriptive guide for interpreting the Pearson R-value based on Guildford (1956). The following scale was applied.

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 standard measure for the interpretation of the strength of the mediation is as follows:

Proportion Mediated	*Strength of Mediation*
< 0.20	Weak Mediation
0.20 – 0.50	Moderate Mediation
> 0.50	Strong Mediation

Ethical Considerations

This study adhered to established ethical standards and protocols. Informed consent was obtained by explaining the study to participants and securing their signed agreement, ensuring that participation was entirely voluntary. Confidentiality was maintained by not requiring participants to write their names and by securely storing all collected data. Respect for institutions was observed by formally requesting permission from the Department of Education, Division of Davao City, and research rigor was ensured through the review and approval of the research proposal. Ethical clearance was secured from the Holy Cross of Davao College – Society for Moral Integrity and Legal Ethics (HCDC-SMILE).

RESULTS AND DISCUSSION

In this chapter are the descriptive, correlation, and mediation tabular presentations, along with the corresponding analysis and interpretation of the statistical results. This chapter ends with a summary of findings.

Descriptive Results

Table 1 presents the descriptive statistics of the study variables, including classroom climate, academic adaptability, and science engagement among the respondents (N = 200). It also includes the standard deviation, mean, and corresponding descriptive level.

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Table 1: Descriptive Statistics (n = 200)

Variables	Number of Samples (N)	Standard Deviation	Mean	Descriptive Level
Classroom Climate	**200**	**0.33**	**3.30**	**Very High**
Physical Environment	*200*	*0..43*	*3.25*	*High*
Teacher - student interaction	*200*	*0.39*	*3.25*	*High*
Peer Relationship	*200*	*0.45*	*3.38*	*Very High*
Teacher's Orientation Towards Learning	*200*	*0.42*	*3.33*	*Very High*
Academic Adaptability	**200**	**0.36**	**3.41**	**Very High**
Collaboration	*200*	*0.47*	*3.21*	*High*
Critical Thinking	*200*	*0.42*	*3.52*	*Very High*
Environmental Choice	*200*	*0.44*	*3.52*	*Very High*
Goal Orientation	*200*	*0.47*	*3.41*	*Very High*
Coping of Stress	*200*	*0.41*	*3.40*	*Very High*
Science Engagement	**200**	**0.36**	**3.39**	**Very High**
Engagement on Science Lessons and Tasks	*200*	*0.41*	*3.42*	*Very High*
Science Learning Involvement	*200*	*0.44*	*3.35*	*Very High*
Science Effort and Preparation	*200*	*0.47*	*3.42*	*Very High*

The table shows that science engagement has a mean of 3.39, described as very high, indicating strong engagement among respondents. All its indicators are very high, with a standard deviation of 0.36, showing consistent responses. Academic adaptability has a mean of 3.41, also very high, with mostly very high indicators and one high indicator, and a standard deviation of 0.36, indicating uniform responses. Meanwhile, classroom climate has a mean of 3.30, described as very high, but with two indicators rated high and the rest very high. It has a standard deviation of 0.33, also showing consistency, though with slightly more variation compared to the other variables. Overall, science engagement and academic adaptability show very strong and consistent positive perceptions, while classroom climate remains positive but slightly less uniform.

Correlation Results

Table 2 is correlation table. It contains the determinant, mediator, and criterion variables. Likewise, it could contain the R-value, p-value, decision on null hypothesis, and interpretation.

Table 2: Correlation Table (n=200)

Variables	**Science Engagement**			
	r-value	*p-value*	*Decision on H0*	*Interpretation*
Classroom Climate	0.56	<.001	Reject *H0*	Moderate positive, significant correlation
Academic Adaptability	0.63	<.001	Reject *H0*	Moderate positive, significant correlation

Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$

The table shows that classroom climate and science engagement have a significant relationship, with a p-value of 0.001, which is lower than the 0.05 level of significance. Thus, the null hypothesis was rejected. The r-value of 0.56 indicates a moderately positive correlation, meaning that changes in classroom climate are associated with changes in science engagement. Similarly, academic adaptability and science engagement also show a significant relationship, with a p-value of 0.001. The null hypothesis was rejected, and the r-value of 0.63 indicates a moderately high positive correlation. Overall, both classroom climate and academic adaptability are positively related to science engagement, with academic adaptability showing a stronger association.

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Mediation Results

Table 3 is mediation table. It contains path effect, estimate beta, standard error, Z-value, p-value, decision on null hypothesis, and interpretations.

Table 3. Mediation Table (n = 200)

Label	*Path / Effect*	*Estimate (B)*	*SE*	*Z-value*	*p-value*	*Decision on H_o*	*Interpretation*
A	Academic Adaptability → Classroom Climate	0.53	0.04	10.90	<.001	Reject H_0	Significant
B	Classroom Climate → Science Engagement	0.33	0.07	4.33	<.001	Reject H_0	Significant
c'	Academic Adaptability→ Science Engagement (Direct Effect)	0.46	0.06	7.12	<.001	Reject H_0	Significant
a × b	Indirect Effect (Mediation)	0.17	0.04	4.08	<.001	Reject H_0	Significant
c (Total Effect)	Academic Adaptability→ Science Engagement (Total)	0.64	0.04	12.88	<.001	Reject H_0	Significant

Level of Significance: 0.05
Decision Rule: Reject H_o if $p < 0.05$
% Mediation: Direct – 72.6%; Indirect – 27.4%

The table shows that the direct effect of academic adaptability on science engagement, while controlling for classroom climate, is significant, with an estimated beta of 0.46 and a p-value of 0.001, leading to the rejection of the null hypothesis. The indirect effect of academic adaptability on science engagement through classroom climate is also significant, with an estimated beta of 0.17 and a p-value of 0. 001. Lastly, the total effect of academic adaptability on science engagement is significant, with an estimated beta of 0.64 and a p-value of 0.001. Overall, academic adaptability significantly influences science engagement both directly and indirectly through classroom climate, resulting in a stronger combined effect.

Summary of Findings

Based on statistical results, it specifically was found that:

1. Academic adaptability and classroom climate significantly correlate with Student Science Engagement.
2. The direct effect Academic adaptability on student science engagement controlling for classroom climate, is significant.
3. The indirect effect Academic adaptability on student science engagement through classroom climate, is significant.
4. The total effect of Academic adaptability and classroom climate is significant.

DISCUSSION

Academic Adaptability, Classroom Climate and Science Engagement

The finding of the study stating that the Academic adaptability and classroom climate significantly correlate with Student Science Engagement supports the study of Ma et al. (2024) stating that classroom climate positively predicted student engagement, and that this relationship was also carried indirectly through achievement goal orientation. Although the context was EFL rather than science, the mechanism is strongly parallel to your result because it shows that classroom climate works both directly and indirectly in shaping engagement. Likewise, this current finding corroborates with Purnomo et al. (2024) who found that adaptability had a significant positive direct effect on student engagement and also an indirect effect through self-regulation among elementary students in online mathematics learning.

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In contrary, this current finding contradicts the study of Yang and Liang (2025**)**, explaining that although classroom social climate positively predicted student engagement overall**,** some proposed pathways were not significant, specifically the links between classroom social climate and foreign language classroom anxiety and between foreign language classroom anxiety and student engagement. Yang and Liang study was conducted in China the current finding was more appropriate in the Philippine context. A 2024 study found that a supportive classroom climate significantly and positively influences student engagement, reinforcing the idea that environmental conditions within the classroom are critical drivers of active participation and learning involvement.

Academic Adaptability, Classroom Climate, and Science Engagement Correlation

Recent research has consistently demonstrated that classroom climate is significantly associated with student engagement. Ma et al. (2024) reported that a supportive classroom climate characterized by positive peer relationships and teacher support significantly predicts student engagement, motivation, and academic outcomes. Similarly, Grazia and Molinari (2023) found that students' perceptions of school and classroom climate are positively associated with emotional and behavioral engagement, highlighting the importance of interpersonal and instructional environments in promoting active learning. These findings are supported by the present study, which revealed a moderate, significant positive correlation between classroom climate and science engagement, indicating that students who perceive a more supportive, conducive classroom environment tend to exhibit higher levels of engagement in science learning.

Academic adaptability has also been identified as a key factor influencing student engagement and academic performance. Wang et al. (2024) reported that students with higher levels of self-regulation and adaptive learning behaviors demonstrate significantly greater learning engagement and academic success. Likewise, Martin et al. (2022) emphasized that adaptability plays a crucial role in students' capacity to respond to academic challenges, thereby enhancing engagement and persistence in learning tasks. These findings align with the current study, which found a moderate and significant positive correlation between academic adaptability and science engagement. This suggests that students who are better at adjusting their learning strategies and academic behaviors are more likely to be actively engaged in science learning activities. The significant relationships between classroom climate, academic adaptability, and science engagement suggest that supportive learning environments and adaptive student behaviors work together to promote student involvement in science learning activities.

Academic Adaptability and Science Engagement Correlation as Mediated Classroom Climate

Recent studies have reported that classroom climate plays a significant mediating role in shaping students' engagement and academic outcomes supports Grazia and Molinari (2023) who found that classroom climate indirectly influences student engagement through emotional and motivational processes, highlighting the role of classroom context in transmitting the effects of individual student characteristics to learning outcomes. Similarly, the current finding also agrees with Ma et al. (2024) who demonstrated that classroom climate interacts with motivational factors and significantly predicts student engagement, suggesting that classroom environment serves as a mechanism through which personal learning attributes affect engagement.

In contrary, a recent study challenges the assumption that classroom climate consistently functions as a strong predictor or mediator of student engagement. Liang et al. (2025) found that while classroom social climate is related to engagement, it is not a necessary condition**,** meaning that student engagement can still occur even in the absence of a strong or supportive classroom climate. However, this finding contradicts the perspective of Grazia and Molinari (2023) and Ma et al. (2024), as it suggests that classroom climate may not always act as a critical mechanism in shaping engagement, and that other individual or contextual factors can independently sustain student engagement.

CONCLUSION

Based on the findings, it is concluded that classroom climate moderately (25.6) and partially mediates the correlation between academic adaptability and student science engagement. Hence, the Social Cognitive theory

positing that learning is the result of reciprocal interactions among personal factors, behavior, and environmental influences, was fully affirmed.

RECOMMENDATIONS

Based on the conclusion, the following are recommended:

1. Further research may utilize other variables not covered in the study to account the remaining 73.5 variance in the strength of the mediation between academic adaptability and student science engagement.
2. Qualitative research maybe conducted to generate themes that maybe utilize as potential mediator.
3. Educational leaders may initiate programs relevant classroom climate to enhance the effect academic adaptability on student science engagement.

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