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Teacher-Student Relationship as a Mediator Between Culturally Responsive Classroom Climate and Science Engagement Among Senior High School Students

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Abstract: This study primarily examined whether teacher-student relationship significantly mediates the relationship between culturally responsive classroom climate and science engagement among senior high school students in Tagum City. Employing a quantitative, descriptive-correlational design, the study utilized stratified and simple random sampling to select 330 students from three public secondary schools in Tagum City. The study used three adapted questionnaires: the Culturally Responsive Classroom Climate Scale, the Student–Teacher Relationship Scale, and the Students' Science Engagement Scale. All instruments underwent panel validation and pilot testing to ensure content validity, reliability, and contextual appropriateness prior to data collection. The analysis employed mean, standard deviation, Pearson product moment correlation, and mediation analysis. The results show that respondents rated culturally responsive classroom climate and science engagement at very high levels, while teacher student relationship was rated high. The analysis revealed significant relationships between culturally responsive classroom climate and science engagement, between culturally responsive classroom climate and teacher student relationship, and between teacher-student relationship and science engagement. Mediation analysis further confirmed that teacher-student relationship partially mediates the relationship between culturally responsive classroom climate and science engagement. These findings suggest that while a culturally responsive climate is vital, fostering strong relational bonds between teachers and students is essential for maximizing science engagement in diverse classrooms.

Keywords: Science education, mediation analysis, culturally responsive classroom climate, teacher-student relationship, science engagement, senior high school students, Tagum City, Philippines

I. INTRODUCTION

Student engagement reflects the motivation of students to learn and invest time and effort in their academic work and is crucial for achievement. In science classrooms, engagement remains low [115]. About 50% of secondary students are chronically disengaged [142] and the Philippines ranked 78th out of 79 countries in the 2018 OECD PISA, indicating low science literacy [124]. Filipino students show very low engagement in science partly because traditional teaching methods fail to connect with diverse student experiences, leading to disengagement and inequity [180].

International studies suggest cultural norms, content-heavy teaching, high-stakes exams, poor teacher-student relationships, and low-quality learning activities contribute to disengagement [97]. In the Philippines only 35% of junior high students in Calbayog City report engagement, 45% of college students in Northwestern Mindanao are highly engaged and many learners in Misamis Oriental show low affective and cognitive

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engagement under lecture-based instruction [103] [45][139]. Low enjoyment, perceived irrelevance, language barriers, and lack of cultural representation further reduce engagement, as seen in Manila, Bangsamoro, and Lumad schools in Bukidnon [108] [189] [46]. Local data in Davao de Oro indicate 60% of students are disengaged and 55% minimally engaged while in Tagum City many Grades 10 students achieved only fair grades [166] [112].

Despite extensive research, little is known about how culturally responsive classroom climates and teacher-student relationships shape engagement in secondary science education [12]. Most studies focus on teachers' perspectives or isolated practices and neglect students' experiences, particularly in indigenous or underrepresented communities. Few studies examine the mediating role of teacher-student relationships, leaving relational mechanisms unclear. This study examines the relationship between culturally responsive classroom climate and science engagement and tests the mediating role of teacher-student relationships. The findings provide insight into how relational dynamics link culturally responsive practices to engagement and offer evidence to guide curriculum development, instructional improvement, and culturally inclusive science policies.

II. MATERIALS AND METHODS

This study employed a quantitative descriptive–correlational design with mediation analysis to examine the relationships among culturally responsive classroom climate, teacher–student relationship, and science engagement, including the mediating role of teacher–student relationship. The participants were 330 Grade 11 and 12 students enrolled in School Year 2025–2026 from three major public senior high schools in Tagum City, Davao del Norte, Philippines, selected from a total population of 2,332 students using the RaoSoft sample size calculator at a 95% confidence level and 5% margin of error. A two-tier sampling procedure was applied, utilizing stratified random sampling by school followed by simple random sampling within each stratum. Data were collected using three validated and adapted instruments: the Culturally Responsive Classroom Climate Scale (CRCCS; $\alpha = 0.884$), the Student Version of the Teacher–Student Relationship Inventory (S-TSRI; $\alpha = 0.875$), and the Students' Science Engagement Scale (SSES; $\alpha = 0.927$), all measured using a 5-point Likert scale. The instruments underwent expert validation and pilot testing prior to administration. Ethical approval was secured from the institutional Research Ethics Committee, and informed consent and assent were obtained from participants and parents of minors. Questionnaires were administered face-to-face and completed within 90 minutes. Data were encoded in password-protected files and analyzed using SPSS in consultation with a statistician. Statistical analyses included mean and standard deviation to determine variable levels, Pearson product–moment correlation to assess relationships, and the Sobel test to examine mediation effects. All data were anonymized, treated confidentially, and stored securely in compliance with the Philippine Data Privacy Act of 2012.

III. RESULTS AND DISCUSSION

Table 1

Extent of Culturally Responsive Classroom Climate of the SHS students in terms of Diverse Language

Items	SD	Mean	Descriptive Equivalent
My teacher allows students to express themselves in their preferred or native language.	0.79	4.36	Very High
My teacher supports students who choose to use their preferred or native language when answering questions.	0.83	4.21	Very High
My teacher allows students to use their native language in class during small discussions.	0.77	4.31	Very High
My teacher uses language that I can understand.	0.76	4.49	Very High
My teacher encourages us to communicate in our native language, which helps us understand the content more clearly.	0.78	4.34	Very High
Category Mean	**0.79**	**4.34**	**Very High**

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Culturally responsive classroom climate in terms of diverse language obtained a category mean of 4.34 with a descriptive equivalent of Very High. This result demonstrates that culturally responsive classroom climate, in terms of diverse language, is very much evident among SHS students. The standard deviation (SD) of 0.79 shows relatively low dispersion of responses around the mean. Moreover, the findings imply that SHS classrooms provide a strongly supportive and language-inclusive environment where students feel that their linguistic backgrounds are respected and integrated into the learning process. These findings align with Lan (2024), who identified affirmation of diverse and home languages as a central dimension of culturally responsive teaching. Likewise, Davila (2020) noted that encouraging the use of native languages in multilingual classrooms enhances socialization, supports language development, and deepens students' cognitive engagement with academic content.

Table 2
Extent of Culturally Responsive Classroom Climate of the SHS students in terms of Cultural Inclusion

Items	SD	Mean	Descriptive Equivalent
My teacher provides examples that relate to my cultural background.	0.82	4.22	Very High
My teacher uses examples from different cultures to explain concepts.	0.72	4.35	Very High
My teacher shows interest in my cultural background.	0.87	4.16	High
My teacher understands aspects of my own cultural background.	0.84	4.18	High
My teacher seems to be aware of differences in students' cultural background.	0.74	4.38	Very High
Category Mean	**0.80**	**4.26**	**Very High**

The students' extent of culturally responsive classroom climate in terms of cultural inclusion has a category mean of 4.34 with a descriptive equivalent of Very High. This indicates that the classroom climate is highly culturally responsive is very much evident among SHS students. The SD of 0.80 reflects a relatively small spread of responses around the mean. The very high mean score on cultural inclusion suggests that the SHS students strongly perceive their classrooms as being culturally responsive in terms of practices like recognizing diverse backgrounds, respecting this emphasis, and valuing multiple cultures. This supportive climate can enhance students' sense of belonging and adjustment in school. Schachner et al. (2021) reported that culturally responsive teaching strengthens students' sense of belonging, motivation, well-being, and achievement by fostering an inclusive diversity climate. Likewise, Bardach et al. (2024) found that such environments enhance engagement and socio-emotional well-being, as students feel valued and included in the classroom.

Table 3
Extent of Culturally Responsive Classroom Climate of the SHS students in terms of Diverse Pedagogy

Items	SD	Mean	Descriptive Equivalent
My teacher uses different forms of instruction to help students understand content.	0.66	4.50	Very High
My teacher provides opportunities for students to learn from one another.	0.66	4.45	Very High
My teacher uses different ways (quizzes, projects, activities) for us to show what we learned.	0.72	4.54	Very High

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My teacher gives enough chances for me to participate and show my learning.	0.72	4.42	Very High
My teacher relates the lesson to real-world examples.	0.71	4.48	Very High
Category Mean	**0.69**	**4.48**	**Very High**

This finding suggests that diverse pedagogy is very much manifested among SHS students. The SD of 0.69 shows that students' responses are only slightly spread out from the mean, indicating relatively consistent perceptions. This implies that students generally experience similar levels of diverse pedagogical practices in their classrooms, reinforcing the strong presence of culturally responsive teaching strategies. In support, Hammond et. al. (2020) pointed to how employing varied means of instruction and assessment like projects collaborative tasks and formative quizzes lets students from diverse backgrounds showcase what they've learned in ways that are authentic to their identities and lived experiences, as a result, empowering students of all sorts of backgrounds and strengthening students' engagement and sense of belonging, both of which are outcomes of culturally responsive classrooms.

Table 4
Extent of Culturally Responsive Classroom Climate of the SHS students in terms of Inclusiveness

Items	SD	Mean	Descriptive Equivalent
My teacher encourages me to express my beliefs in this class.	0.71	4.44	Very High
My teacher encourages students to be mindful of other students' perspectives.	0.72	4.48	Very High
My teacher creates a welcoming environment for all students.	0.78	4.45	Very High
My teacher treats all students fairly, regardless of differences.	0.78	4.44	Very High
My teacher treats all students with equal respect.	0.72	4.52	Very High
Category Mean	**0.74**	**4.46**	**Very High**

Overall, inclusiveness obtained a category mean of 4.46 with a descriptive equivalent of Very High, indicating that it is strongly evident among SHS students. The SD of 0.74 shows that students' ratings are closely clustered around the mean, implying shared and consistent experiences of inclusive practices in the classroom. Eden et al. (2024) found that culturally responsive and respectful classroom climates strengthen students' sense of belonging and inclusion, as fairness and mutual respect promote healthier peer relationships and better socio-emotional adjustment. Similarly, Berlian et al. (2022) emphasized that affirming students' cultural identities and encouraging open dialogue foster psychological safety and shared norms in diverse classrooms.

Table 5
Summary on the Extent of Culturally Responsive Classroom Climate

Indicators	SD	Mean	Descriptive Equivalent
Diverse Language	0.79	4.34	Very High
Cultural Inclusion	0.80	4.26	Very High

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Diverse Pedagogy	0.69	4.48	Very High
Inclusiveness	0.74	4.47	Very High
Overall Mean	**0.76**	**4.39**	**Very High**

The extent of SHS students' culturally responsive classroom climate obtained an overall mean of 4.39 with a descriptive equivalent of Very High, indicating that such a climate is strongly evident. The SD of 0.76, which is below 1.0, indicates responses are tightly clustered around the mean, suggesting that students' perceptions are generally consistent. This result suggests that culturally responsive practices are consistently integrated into the regular classroom interactions experienced by SHS students. Laluna et al. (2024) found that when students perceive strong equality and inclusion in school, they demonstrate better intergroup relations, socio-emotional adjustment, and academic achievement. Similarly, Bardach et al. (2024) reported that multicultural and critically conscious diversity climates are positively linked to achievement, motivation, engagement, belonging, and well-being. Schwarzenthal et al. (2022) further showed that cooperative and multicultural classroom climates enhance adolescents' intercultural competence, while Anyichie et al. (2023) confirmed that culturally responsive teaching is associated with higher academic performance, school belongingness, and life satisfaction in diverse settings.

Table 6
Level of Students' Science Engagement in terms of Engagement on Science Lessons and Tasks

Items	SD	Mean	Descriptive Equivalent
My science lessons and performance tasks are relevant to my life.	0.82	4.17	High
I find my science lessons and performance tasks are interesting and meaningful.	0.75	4.25	Very High
My science lessons and tasks relate to real-life situations.	0.84	4.17	High
I am inspired to learn new things in science class.	0.72	4.37	Very High
I find my science lessons and performance tasks stimulate my curiosity.	0.81	4.27	Very High
I feel encouraged and interested in working on something in science class.	0.84	4.17	High
I am inspired and prepared to come to science class every day.	0.79	4.21	Very High
Category Mean	**0.80**	**4.23**	**Very High**

Overall, engagement on science lessons and tasks obtained a category mean of 4.23 with a descriptive equivalent of Very High, indicating that engagement in science is clearly evident among SHS students. The SD of 0.80, suggests that the distribution of responses remains tightly grouped near the mean. This result suggests that SHS students are generally motivated and actively involved in science when lessons and tasks are meaningful, stimulating, and relevant to their experiences. Prior research consistently highlights the instructional conditions that enhance students' engagement in science. Inkinen et al. (2021) found that high school students reported stronger situational engagement when involved in scientific practices like developing models and constructing explanations in class. In a similar note, Swarat et al. (2022) found that more hands-on'and activity-based instructional episodes elicit more student interest in school science.

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Table 7
Level of Students' Science Engagement in terms of Engagement on Science Learning Involvement

Items	SD	Mean	Descriptive Equivalent
I am having fun during collaborative learning activities in science.	0.75	4.41	Very High
I ask my teacher or classmates for help when I do not understand a lesson.	0.74	4.28	Very High
I want to investigate and understand the societal and environmental impacts and implications of science and technology.	0.76	4.23	Very High
I participate and interact during small-group discussions in science.	0.77	4.22	Very High
I appreciate the nature of the scientific method or process.	0.80	4.26	Very High
I consult and share my views and knowledge with my classmates and science teacher.	0.81	4.26	Very High
I use my creativity and inventiveness in doing my science work.	0.82	4.23	Very High
Category Mean	**0.78**	**4.27**	**Very High**

Students' engagement in science learning involvement garnered a category mean of 4.27 with a descriptive equivalent of Very High, indicating that students are highly engaged in their science learning activities. The SD of 0.78 highlights that dispersion of scores around the mean is slight. Moreover, this result suggests that SHS students demonstrate strong and consistent involvement in collaborative, inquiry-based, and interactive science learning activities. In agreement with Saifuddin & Matloob (2025), who found that structured collaborative learning strategies like Think Pair Share and Jigsaw, significantly improved behavioral, emotional, and cognitive engagement in science lessons and encouraged even the most passive learners to actively participate in secondary lesson activities. In the same way, Marquez (2024) found that relevance and variety of the approaches employed by teachers and opportunities for students to work in groups on appropriate activities would significantly reinforce students' interest in science.

Table 8
Level of Science Engagement in terms of Science Effort and Preparation

Items	SD	Mean	Descriptive Equivalent
I do and finish my science tasks on time.	0.92	4.08	High
I raise my hand to participate in science class discussions.	0.88	4.06	High
I read and review my class notes, handouts, and textbook between classes to make sure that I learn from these Science learning materials.	0.82	4.18	High
I prepare thoroughly before the summative test or exam in science.	0.78	4.19	High
I give maximum effort to my science class.	0.86	4.20	Very High
I always pay attention to my teacher and classmates who communicate during science class.	0.81	4.28	Very High
The support I receive helps me stay engaged in science class.	0.78	4.27	Very High
I follow the instructions closely in doing my science work.	0.75	4.36	Very High
Category Mean	**0.83**	**4.20**	**Very High**

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Science engagement in terms of effort and preparation obtained a category mean of 4.20 with a descriptive equivalent of Very High. This substantiates that the level of science engagement of SHS students in terms of science effort and preparation is very much manifested. The SD of 0.83 suggests that the data show a small spread of responses around the average value. This consistency reflects positive learning discipline, which helps develop good study habits and sustained engagement in science learning. In line with this, Lin (2021) showed that working hard and staying on task in science learning constitutes an important dimension of overall science engagement and is positively associated with students' science self-efficacy and participation. Patall et al. (2023) note that when students exhibit high daily interest in science, they are more likely to work hard, participate, and pay attention to the lessons, pointing to diligent attention as central to sustained engagement.

Table 9
Summary on the Level of Students' Science Engagement

Indicators	**SD**	**Mean**	**Descriptive Equivalent**
Engagement on Science Lessons and Tasks	0.80	4.23	Very High
Science Learning Involvement	0.78	4.27	Very High
Science Effort and Preparation	0.83	4.20	Very High
Overall Mean	**0.80**	**4.23**	**Very High**

The level of SHS students' science engagement yielded a mean of 4.23 with a descriptive equivalent of Very High. This means that the level of SHS students' science engagement is very much manifested. The standard deviation of 0.80 suggests that responses are closely clustered near the mean. Moreover, SHS students consistently demonstrate strong involvement, effort, and participation in science activities and learning tasks.

Additionally, this finding is consistent with the findings of Lin (2021) who reported that Taiwanese senior high school students showed generally high levels of behavioral, cognitive, emotional, social, and agentic engagement in science learning, and behavioral engagement is one of the strongest dimensions. In the same way, Sevilla and Vico (2025) found high overall engagement for Grade 11 non-STEM students in Earth and Life Science, noting that behavioral engagement was the highest across the dimensions.

Table 10
Level of Student-Teacher Relationship in terms of Satisfaction Among SHS Students

Items	**SD**	**Mean**	**Descriptive Equivalent**
I enjoy attending the class of this teacher.	0.76	4.45	Very High
I have a positive relationship with this teacher.	0.85	4.26	Very High
I would feel a sense of loss if this teacher were no longer teaching me.	0.89	4.08	High
I am happy with my relationship with this teacher.	0.82	4.29	Very High
I like this teacher.	0.83	4.37	Very High
Category Mean	**0.83**	**4.29**	**Very High**

Overall, teacher–student relationship in terms of satisfaction yielded a mean of 4.29 with a descriptive equivalent of Very High. The relatively low SD of 0.83 indicates that the that positive relational experiences are consistently perceived across the cohort rather than being confined to a particular subgroup of learners. Overall,

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the findings imply that Senior High School students commonly experience strong satisfaction in their relationships with teachers, characterized by enjoyment, personal regard, and a stable positive relational climate.

Hence, this aligns with Froiland et al. (2019), who found that positive teacher–student relationships support students' basic psychological needs for autonomy, competence, and relatedness, which in turn enhance their happiness and well-being at school. Similarly, Bakadorova and Raufelder (2018) showed that warm teacher–student relations in secondary school predict students' need satisfaction in class over time, suggesting that consistently supportive teachers help maintain positive engagement. In line with this, Jiang et al. (2022) reported that positive teacher–student relationships increase behavioral engagement and school satisfaction.

Table 11
Level of Student-Teacher Relationship in terms of Conflict

Items	SD	Mean	Descriptive Equivalent
I feel more frustrated with this teacher in this class than with my other teachers.	0.89	2.12	Low
I prefer not to be taught by this teacher again next year.	0.83	2.05	Low
I sometimes feel less stressed when this teacher is absent.	0.91	2.18	Low
I believe I can enjoy the class more when it is handled by another teacher.	0.87	2.09	Low
I often feel tension or misunderstandings when interacting with this teacher.	0.86	2.07	Low
Category Mean	**0.87**	**2.10**	**Low**

The category mean for teacher–student relationship in terms of conflict is 2.10, with a descriptive equivalent of Low. The relatively low SD of 0.87 suggests that positive relational experiences are uniformly perceived across the cohort, rather than limited to a specific subgroup of learners. This suggest that while most students experience low levels of conflict, some still report higher levels of frustration and tension in their interactions with teachers. This highlights the need for continued efforts to strengthen positive teacher–student relationships.

This pattern is in line with the longitudinal work of Saxer et al. (2025), who reported that while average levels of teacher-student conflict were low on average, conflict served as an important source of stress that was predictive of later physical complaints and social problems among secondary school students. Likewise, Longobardi et al. (2016) demonstrated that increases in perceived conflict with teachers were predictive of increases in conduct problems and hyperactivity, illustrating that even relatively infrequent conflict can have significant negative consequences for students' adjustment. Roorda et al. (2011), meanwhile, pushed back on the notion that positive relationships can carry a stronger influence than conflictual ones by highlighting that this negative aspect of the relationship with teachers is more strongly related to lesser engagement and achievement than positive dimensions are to positive gains, making it imperative to keep conflict at low levels.

Table 12
Level of Science Engagement in terms of Instrumental Help

Items	SD	Mean	Descriptive Equivalent
I feel comfortable approaching this teacher when I have personal concerns.	0.84	4.19	High
I share personal experiences with this teacher when I feel comfortable.	0.92	4.02	High

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I will go to this teacher if I need help.	0.88	4.11	High
I will go to this teacher if I need someone to listen to me.	0.94	4.03	High
I depend on this teacher for advice.	0.94	4.02	High
Category Mean	**0.90**	**4.07**	**High**

This indicator has a category mean of 4.07 with a descriptive equivalent of High, indicating that this aspect of the teacher–student relationship is strongly felt among SHS students. The SD of 0.90 claims that the data points are concentrated closely around the central value. This result suggests that students generally perceive their teachers as approachable, supportive, and reliable sources of assistance and guidance for academic and personal concerns. Similarly, Halladay et al. (2023) reported that students who perceived their teachers as responsive to their emotional concerns were more likely to recognize mental health issues and seek help within the school setting, highlighting the importance of approachable and supportive teachers in promoting help-seeking behavior. Consistent with the present findings, the longitudinal study of Affuso et al. (2022) demonstrated that teacher support positively predicted students' academic self-efficacy and motivation over time, which subsequently led to improved academic performance.

Table 13
Summary on the Level of Student-Teacher Relationship

Indicators	**SD**	**Mean**	**Descriptive Equivalent**
Satisfaction	0.83	4.29	Very High
Conflict	*1.06	*3.90	Low
Instrumental Help	0.90	4.07	High
Overall Mean	**0.93**	**4.09**	**High**

**computed values resulted from reversed scoring*

Overall, the level of teacher–student relationship among SHS students obtained a mean of 4.09 with a descriptive equivalent of High, reflecting generally positive and supportive relationships. The standard deviation of 0.93 suggests that responses were relatively consistent among the respondents. This result indicates that SHS students experience a learning environment characterized by high satisfaction and instrumental support from teachers, coupled with minimal conflict, which supports positive and effective teacher–student relationships.

This much repeated pattern was nearly identical to the three factor structure of satisfaction, instrumental help and conflict recently confirmed in the Student Version of the Teacher-Student Relationship Inventory (S-TSRI) by Ang, Ong and Li (2020) demonstrating that greater satisfaction and instrumental help, but not conflict, were associated with greater school belonging and lower aggression, while conflict was associated with more behavioral problems. In a related study, Baafi (2020) showed that teachers who had relatively low conflict and high professional closeness with students had better learning outcomes because students were more behaviorally and instructionally engaged in class

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Table 14
Significance of the Relationship between the Variables

Variables Correlated	r-value	p-value	Remarks
Culturally Responsive Classroom Climate and Science Engagement	0.667	< 0.001	Significant
Culturally Responsive Classroom Climate and Student-Teacher Relationship	0.626	< 0.001	Significant
Student-Teacher Relationship and Science Engagement	0.674	< 0.001	Significant

All null hypotheses were rejected, indicating significant relationships among the variables. Specifically, culturally responsive classroom climate positively correlates with science engagement ($p < 0.001$). The correlation coefficient of 0.667 shows a strong positive relationship, meaning that when the classroom climate reflects and respects students' cultural backgrounds, their participation, persistence, and enthusiasm in science are also likely to increase.

In practice, this suggests that when teachers use examples, materials, and interaction styles that mirror students' cultures, learners may feel more valued and are more willing to ask questions, engage in experiments, and sustain effort in challenging science tasks. In support, Dewi et al. (2025) note that culturally responsive teaching in multicultural environments significantly enhances student engagement while culturally relevant strategies actively increase participation. Similarly, Gay (2018) emphasizes that culturally responsive lessons built on trust and acceptance of diversity foster inclusive education and promote both social and academic engagement, underscoring the classroom impact of relationally grounded, culturally attuned pedagogy.

This study confirms and extends the theoretical propositions of Aniyichie et al. (2023) on Culturally Responsive Self-Regulated Learning, demonstrating that culturally responsive classroom practices influence student engagement both directly and indirectly through teacher–student relationships. Through integrating the Culturally Responsive Teaching framework Gay and Ladson-Billings (1995) with Self-Determination Theory Ryan and Deci (2000), the findings illustrate how culturally attuned practices fulfill students' psychological needs and foster caring, trust-based relationships with teachers.

Taken together, the three linkages form a coherent explanatory pattern: a culturally responsive classroom climate directly enhances science engagement while simultaneously strengthening teacher–student relationships, which further amplify engagement. These results confirm that culturally responsive practices and positive relational dynamics function as mutually reinforcing mechanisms, creating a classroom environment where students feel recognized, supported, and intrinsically motivated to participate actively in science learning.

Table 15 presents the regression results that served as the basis for testing the mediation hypothesis. The findings indicate that all four necessary preconditions for mediation were satisfied. Specifically, the causal variable significantly predicted the outcome variable and the mediator, the mediator significantly predicted the outcome variable, and the direct effect of the causal variable on the outcome variable zero after controlling for the mediator. As showed in the table, the results in step one confirmed that culturally responsive classroom climate (independent variable) is a significant predictor of science engagement ($\beta = 0.777$, $p < .001$). Step 2 confirmed that culturally responsive classroom climate is a significant predictor of teacher-student relationship ($\beta = 0.609$, $p < .001$). Also, the results in step 3 confirmed that teacher-student relationship is a significant predictor of science engagement ($\beta = 0.807$, $p < .001$). Finally, step 4 reveals the combined influence of culturally responsive classroom climate and teacher-student relationship on science engagement. The total R-square of 0.553 indicates that 55.3 percent of the variance in science engagement is explained by the combined effects of culturally responsive classroom climate and teacher-student relationship. Since the first three

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conditions were satisfied, indicating that all three paths are significant, an additional mediation analysis was conducted to further evaluate the mediating role of the teacher–student relationship.

Table 15

Steps in Mediation Analysis

Independent Variable	Culturally Responsive Classroom Climate Science
Dependent Variable	Engagement
Mediating Variable	Student-Teacher Relationship
Step 1. Path C (IV and DV)	
Unstandardized Beta (B)	0.777
Standard Error (e)	0.048
p-value	<.001
Step 2. Path B (IV and MV)	
Unstandardized Beta (B)	0.609
Standard Error (e)	0.037
p-value	<.001
Step 3. Path A (MV and DV)	
Unstandardized Beta (B)	0.807
Standard Error (e)	0.056
p-value	<.001
Step 4. Combined Influence of IV and MV on DV	
Teacher-Student Relationship	
Unstandardized Beta (B)	0.381
Standard Error (e)	0.043
Standardized Beta	0.422
Part Correlation	0.329
Culturally Responsive Classroom Climate	
Standardized Beta	0.403
Part Correlation	0.314
Total R-square	0.553

Moreover, the utilization of Medgraph involving Sobel Test presents analysis on the significance of mediation effect of teacher-student relationship in the link of culturally responsive classroom climate and science engagement. In addition to that, to determine whether the mediation is full or partial. As illustrated in Figure 3, the direct effect of culturally responsive classroom climate on science engagement decreased from a beta of 0.667 to 0.403 after incorporating the teacher–student relationship as a mediator in the model. Since the direct effect remains significant, this indicates partial mediation. Kenny (2018) also explained that partial mediation occurs when the path from the independent variable to the outcome variable is reduced but does not reach zero. Therefore, the reduced beta value of 0.403, which is still above zero, confirms partial mediation. Additionally, the Sobel z-test results show that the mediation effect in the model is statistically significant ($z = 7.54788$, $p < 0.05$).

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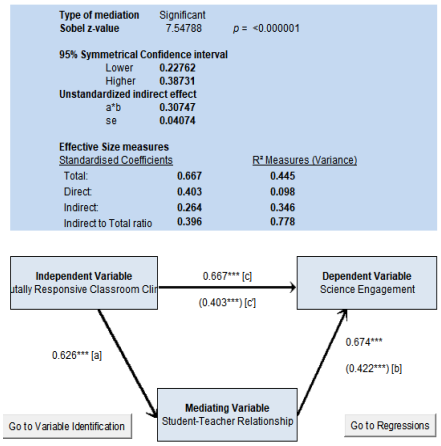

Figure 1. Sobel Test for the Significance of Mediation Effect

Additionally, the indirect effect size (β = 0.264) measures how much effect of culturally responsive classroom climate on science engagement can be attributed to the indirect path through teacher-student relationship (IV to MV to DV). The total effect (β = 0.667) is the summation of both the direct and indirect effects of culturally responsive classroom climate on science engagement. The direct effect (β = 0.403) is the size of the correlation between culturally responsive classroom climate (IV) and science engagement (DV) with teacher-student relationship (MV) included in the regression.

The indirect to total ratio index has an R-square of 0.778, which means that 77.8 percent of the total effect of culturally responsive classroom climate on science engagement goes through teacher-student relationship. The other 22.2 percent of the total effect is either direct or mediated by other variables that are not included in the model.

Thereupon, the findings suggest that teachers should actively integrate culturally responsive practices with relationship-building to maximize student engagement in science. For example, a teacher might use examples that reflect students' cultural backgrounds while encouraging group discussions where every student's perspective is valued. By recognizing diverse viewpoints and providing guidance when students encounter difficulties, teachers strengthen trust and support within the classroom. This relational foundation helps students feel recognized, safe, and motivated, prompting them to participate actively in experiments, projects, and collaborative problem-solving. When teachers combine culturally responsive strategies with strong teacher–student relationships, they create a classroom environment where engagement grows and deepens, demonstrating that relational dynamics directly translate inclusive practices into meaningful learning outcomes.

IV. CONCLUSIONS

The study indicates that Senior High School students experience a strongly culturally responsive classroom, show very high science engagement, and maintain generally positive teacher–student relationships. Both classroom climate and teacher–student relationships significantly influence science engagement, with teacher–student relationships partially mediating the effect of culturally responsive practices on student engagement.

V. RECOMMENDATIONS

Based on the study's findings, it is recommended that Senior High School students actively participate in science and culturally grounded activities; teachers integrate culturally relevant contexts and foster positive teacher–student relationships; school administrators provide sustained professional development and resources to support inclusive science practices; DepEd officials embed relational and culturally responsive competencies into policies and standards; and future researchers and scholars further test, refine, and validate the CR-SRL model across diverse contexts to strengthen its theoretical and practical relevance.

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