The Mediating Effect of the Innovative Teaching Methods on Student Engagement and Academic Performance in Science

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ABSTRACT

This study aimed to determine the mediating effect of innovative teaching methods on the relationship between student engagement and academic performance in science. The study employed a quantitative, non-experimental, correlational design. A total of 303 Grade 11 and 12 students from public senior high schools in the Division of Malaybalay City participated in the study through stratified random sampling. Standardized instruments were used to measure levels of student engagement, academic performance, and perceptions of innovative teaching methods. Descriptive statistics, Pearson correlation, and mediation analysis (via regression and Sobel test) were employed to analyze the data. Results showed high levels of student engagement and academic performance, along with strong positive perceptions of the use of innovative methods such as the flipped classroom. A significant positive correlation was found between engagement and academic performance. Furthermore, mediation analysis revealed that innovative teaching methods partially mediated this relationship, amplifying the effect of engagement on performance. The findings suggest that integrating innovative teaching strategies enhances both student engagement and academic success in science. It is recommended that educators adopt interactive, student-centered approaches to better support learners and improve academic performance in science.

Keywords: Student Engagement, Academic Performance, Innovative Teaching, Flipped Classroom, Science Education, Mediation Analysis

SDG Indicator: #4 (Quality Education)

INTRODUCTION

In today's educational landscape, science education faces pressing challenges in promoting both academic performance and active student engagement. The growing demand for scientific literacy, problem-solving, and critical thinking highlights the inadequacy of traditional, teacher-centered instruction, which often fails to foster meaningful learning experiences (Liu et al., 2022). In response, educational systems are shifting toward student-centered, innovative approaches that prioritize engagement and deeper learning (Fitria et al., 2021). Understanding how these strategies influence the link between engagement and performance is essential for educators who aim to create inclusive and effective science classrooms (Chen & Wang, 2023).

Within the Philippine K–12 curriculum, science education is designed to develop critical thinking and problem-solving skills necessary for lifelong learning and career preparation. However, many senior high school students remain unmotivated in science, especially under lecture-based instruction. Cordero and Martinez (2019) found that learners often fail to grasp scientific concepts that could be more effectively delivered through experiential and applied teaching. This gap contributes to the country's consistently low international science performance, as shown in PISA results, underscoring the need for reform.

Academic performance, a key indicator of educational success, encompasses not only mastery of content but also the ability to use inquiry skills and apply scientific reasoning (Liu et al., 2022). Student engagement—comprising behavioral, emotional, and cognitive dimensions—is likewise a crucial determinant of achievement. Research shows that engaged learners are more motivated, persistent, and successful in their studies (Bond et al., 2020; Fredricks et al., 2021). Yet engagement alone does not always guarantee improved

performance; instructional methods are needed to harness and direct students' motivation effectively (Breso et al., 2021; Zhou et al., 2021).

Innovative teaching methods, such as flipped classrooms, inquiry-based learning, gamification, and problem-based learning, aim to transform passive instruction into active, learner-centered experiences. These approaches provide opportunities for collaboration, experimentation, and real-world application of knowledge, helping students connect abstract concepts to concrete experiences (Wijaya et al., 2022). Studies confirm that these methods can significantly improve understanding, sustain engagement, and create inclusive learning environments (Fitria et al., 2021; Lopez & Tan, 2022). Moreover, research indicates that innovative teaching mediates the relationship between engagement and performance by structuring meaningful learning tasks and collaborative experiences (Garcia & De Leon, 2021; Tuna & Bozdoğan, 2021).

This study is anchored on Engagement Theory (Kearsley & Schneiderman, 1998), which emphasizes the importance of meaningful interaction, problem-solving, and collaboration for student success. Supporting frameworks include Piaget's Constructivist Theory (1947) and Vygotsky's Social Constructivist Theory (1978)**,** both of which highlight the value of experiential and socially mediated learning. Together, these theories affirm that innovative teaching can enhance student engagement and, in turn, academic achievement by shifting the teacher's role from transmitter to facilitator and enabling students to construct their own knowledge.

Figure 1 presents the conceptual framework of this study, illustrating student engagement as the independent variable, academic performance as the dependent variable, and innovative teaching methods as the mediating variable. Specifically, the framework examines how engagement influences academic performance directly (path c) and indirectly through innovative teaching (paths a and b). While this study focuses on Grade 11 and 12 students in Malaybalay City, it acknowledges limitations such as the exclusion of demographic moderators (e.g., gender, socioeconomic status) and cross-cultural comparisons. These gaps highlight the need for further research while emphasizing the urgency of exploring innovative teaching practices in the Philippine science education context.

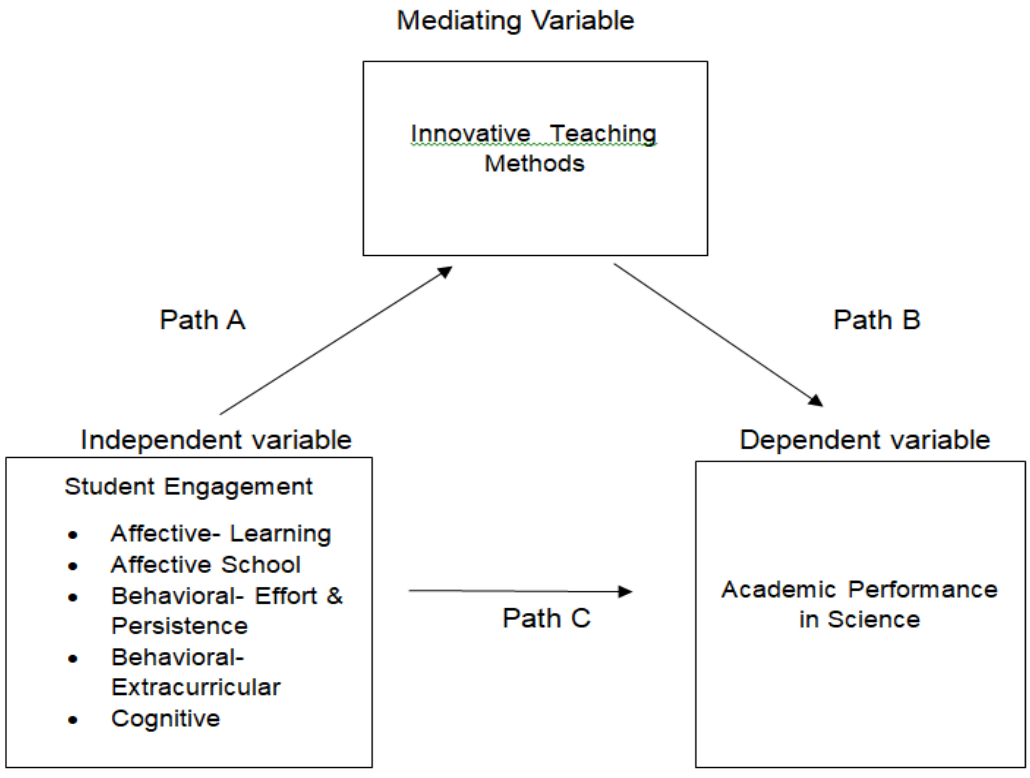


Figure 1. The Conceptual Framework showing the variables of the study

Student engagement, encompassing affective, behavioral, and cognitive dimensions, is a primary driver of learning outcomes. The quality and intensity of engagement are expected to directly influence academic

performance, yet engagement alone may not be sufficient. Innovative teaching methods act as a mediating variable that channels and strengthens the effects of engagement, allowing students to experience deeper, more meaningful, and sustained learning outcomes. This framework highlights the interconnectedness of engagement, innovative pedagogy, and performance, underscoring the responsibility of teachers and administrators to adopt strategies that foster active participation while aligning instruction with modern, student-centered approaches (Torres & Mendoza, 2022).

In the Philippine context, the urgency of this inquiry is underscored by the nation's consistently poor performance in international benchmarks. In the PISA 2018 assessment, Filipino students scored an average of 357 in science, well below the OECD average of 489, ranking 70th out of 79 countries (OECD, 2019). This result reflects gaps in content mastery, problem-solving, and application of scientific concepts, largely attributed to teacher-centered instruction. While prior reforms have focused on curriculum revisions and material provision, there remains limited empirical work—especially in rural-urban areas such as Malaybalay City—examining how innovative teaching may enhance engagement and, in turn, improve performance (Lopez & Cruz, 2021). Addressing this gap is central to this study's contribution.

Anchored on Engagement Theory (Kearsley & Schneiderman, 1998) and supported by Constructivist Learning Theory (Piaget, 1947) and Social Constructivist Theory (Vygotsky, 1978), the framework posits that innovative teaching can serve as the pedagogical bridge between students' engagement and measurable performance outcomes. Engagement Theory emphasizes collaboration and problem-solving as key to meaningful learning, while Constructivist perspectives highlight knowledge construction through hands-on, experiential tasks. Together, these frameworks establish a strong rationale for treating innovative teaching methods as a mediator that ensures engagement is effectively translated into academic achievement.

The objectives of the study are therefore to: describe the levels of student engagement, academic performance, and innovative teaching methods in science; determine the significant relationships among student engagement, innovative teaching methods, and academic performance; and test the mediating effect of innovative teaching methods on the correlation between engagement and performance. To test these objectives, the study formulated the following null hypotheses at a 0.05 level of significance: there is no significant relationship between student engagement and academic performance; there is no significant relationship between student engagement and innovative teaching methods; there is no significant relationship between innovative teaching methods and academic performance; and innovative teaching methods do not significantly mediate the relationship between student engagement and academic performance.

The significance of this framework operates on multiple levels. Locally, it provides empirical evidence for schools in Malaybalay City to redesign science instruction through approaches such as flipped classrooms, inquiry-based learning, and gamification. Teachers and administrators can utilize findings to refine practices and policies that address low engagement and achievement. Nationally, it responds to urgent calls for pedagogical reform in Philippine science education. Globally, it aligns with Sustainable Development Goal (SDG) 4: Quality Education, which emphasizes inclusive, equitable, and transformative learning opportunities. For students, this research underscores how their active participation can be maximized through instructional innovations. For future researchers, it establishes a foundational framework for exploring mediating effects in education, opening pathways to study demographic moderators, cultural contexts, or additional pedagogical variables that shape the engagement–performance dynamic.

METHOD

Research Respondents

The research respondents of this study were Grade 11 and 12 Senior High School students enrolled in public schools within the Division of Malaybalay City. A total of 303 students were selected from the population of 1,409 using Raosoft sampling criteria to ensure adequacy of sample size. Private schools and other grade levels were excluded from the study to maintain focus on public Senior High Schools under the STEM strand. Data collection was conducted specifically in Districts III, IV, and V of Malaybalay City, which encompass both urban centers and rural barangays, thereby representing a diverse mix of communities.

The researcher utilized stratified random sampling, a method that ensures proportionate representation from the target population. Each student had an equal chance of being included in the sample, thus minimizing bias. The inclusion criteria required that participants must be officially enrolled in Grade 11 or Grade 12, be actively attending science classes at the time of the study, and provide informed consent for participation. Students were excluded if they were physically or mentally unable to participate, absent during the extended data collection period, or not actively engaged in their science subjects. Withdrawal from the study was permitted at any stage if either the student or parent expressed a desire to discontinue, and all related data were removed to respect the participant's decision.

No coercion was applied in securing participation. Students were informed that participation was strictly voluntary, and refusal to participate would not result in any negative consequences. For those who chose to respond, the survey was administered in a supportive environment that avoided intimidation or undue pressure. Students were assured that their privacy would be respected, and that their responses would remain confidential and used solely for academic purposes.

Materials and Instruments

The study utilized standardized instruments to measure the key variables: student engagement (independent variable), innovative teaching methods (mediating variable), and academic performance (dependent variable). All tools were carefully selected for their established reliability and construct validity and were adapted to the senior high school science context.

Student engagement was measured using the Student Engagement in Schools Questionnaire (SESQ) developed by Hart, Stewart, and Jimerson (2011). This instrument captures three broad dimensions operationalized in this study through five indicators: affective–learning, affective–school, behavioral–effort and persistence, behavioral–extracurricular, and cognitive engagement. Items were rated on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), where higher scores indicate greater levels of engagement.

Academic performance was assessed using the Academic Performance Scale (APS) by Duay and Doble (2022), which consists of 15 Likert-type items designed to evaluate study habits, time management, comprehension, and self-regulation in learning. Responses followed the same 5-point anchors, with higher scores denoting stronger academic performance.

The effectiveness of innovative teaching methods was measured using the Innovative Teaching Scale developed by Mengesha, Ayele, Misker, and Beyna (2024). This instrument examines students' perceptions of innovative instructional strategies such as flipped classrooms, inquiry-based learning, problem-based learning, gamification, and technology-integrated approaches. Indicators included improved understanding, helpfulness of pre-class materials, in-session engagement, encouragement of active learning, effectiveness of in-class activities, preference over traditional lectures, and overall satisfaction. Items were likewise rated on the 5-point Likert scale, with higher scores reflecting more positive perceptions of the teaching strategies employed.

To maintain consistency across measures, a uniform descriptive interpretation was applied to all scale means: 4.50–5.00 was interpreted as Very High (Strongly Agree), 3.50–4.49 as High (Agree), 2.50–3.49 as Moderate (Neutral), 1.50–2.49 as Low (Disagree), and 1.00–1.49 as Very Low (Strongly Disagree). This interpretation ensured comparability of results across instruments and dimensions.

Prior to administration, the instruments underwent content validation by a panel of experts in science education and pedagogy to ensure clarity, relevance, and appropriateness for the research context. Revisions were made based on expert feedback, and the validators' summary ratings are documented in the appendices. Following validation, a pilot test was conducted to check clarity and administrative flow before full implementation. Reliability values reported in previous studies demonstrate strong internal consistency for the SESQ ($\alpha = 0.87$–0.92), APS ($\alpha = 0.85$), and Innovative Teaching Scale ($\alpha = 0.88$–0.91). In this study, reliability was re-examined after data collection, and the results confirmed their suitability; the summary coefficients are provided in the appendices.

The questionnaires were administered during regular class periods under standardized instructions. Participation was voluntary, and students were assured that there were no right or wrong answers, that their responses would remain confidential, and that the data would be used solely for academic purposes

Design and Procedure

This study adopted a descriptive-quantitative correlational design, which was appropriate for examining relationships among student engagement, innovative teaching methods, and academic performance. According to Creswell (2014), a correlational design determines the extent to which two or more variables are related, making it suitable for educational research that seeks to measure both direct and indirect effects. In this study, mediation analysis was also employed to test whether innovative teaching methods functioned as a mediating variable in the engagement–performance relationship, consistent with recommendations by Nguyen, Schmid, and Stuart (2020).

Both descriptive and inferential statistics were utilized to analyze the data. Descriptive statistics, including means and standard deviations, summarized the levels of engagement, innovative teaching, and academic performance. Inferential statistics were applied through Pearson's r correlation to establish the strength and direction of relationships among variables. Linear regression procedures and Sobel's Z-test were then used to assess whether innovative teaching significantly mediated the relationship between student engagement and academic performance, following the framework of Bhandari (2021). The significance level was set at $\alpha = 0.05$.

Before data collection, the instruments were adapted, translated, and submitted for content validation by expert educators and researchers in science pedagogy. Feedback from validators guided revisions to improve clarity, cultural relevance, and alignment with the study objectives. A pilot test was conducted to ensure reliability and feasibility. Following validation, the final instruments and required documents were submitted to the University of Mindanao Ethics Review Committee (UMERC), which granted ethical approval under Protocol No. 2025-084.

Formal permission to administer the study was obtained from the Division Office and the school principals of participating institutions. Data collection was conducted face-to-face during class hours at designated schedules that minimized disruption to academic activities. Students were briefed on the study's purpose and were assured of the confidentiality of their responses. Participation was voluntary, and students were free to withdraw from the study at any point without penalty.

The study adhered to the ethical principles set by the University of Mindanao Ethics Review Committee (UMERC). The confidentiality of responses was strictly maintained, and data were used exclusively for academic purposes. No coercion or undue influence was applied, and participants were informed of both potential benefits and limitations of the study. Supplementary arrangements were made to ensure that student learning was not negatively affected by the survey administration. The researcher upheld academic integrity throughout the process, avoided misrepresentation of prior works, and reported findings honestly without manipulation of data.

Additionally, the researcher tried to understand each concept and idea of each author in each variable, and there is no trace of claiming any knowledge of different authors in the said study. The researcher identified and mentioned the authors and proponents related to the study. The researcher used an appropriate model in the study. Above all, the researcher has no claim on the work of others. The researcher was honest in the study results of the data collected. There was no manipulation of the data by the researcher. The researcher is very aware of her contribution to this study. However, she knew that she was the primary author on this research, and her advisor was the co-author.

RESULT AND DISCUSSION

This section presents, analyzes, and interprets the data collected about the study's research objectives. The discussion is organized as follows: first, the levels of student engagement, academic performance in science,

and innovative teaching methods in science are examined; second, the significant relationship between student engagement and academic performance is explored; third, the connection between student engagement and innovative teaching methods is assessed; fourth, the relationship between innovative teaching methods and academic performance is evaluated; and finally, the mediating role of innovative teaching methods in the relationship between student engagement and their academic performance is analyzed.

The analysis of data was conducted using descriptive statistics to determine the levels of engagement and academic performance, and inferential statistics to assess the relationship between the two core variables. Where applicable, the mediating role of innovative teaching strategies was also explored. The discussion integrates interpretations of the findings alongside relevant literature to establish theoretical and practical insights that inform the study's conceptual and theoretical frameworks.

Level of Student Engagement

To assess the level of student engagement in science, a survey questionnaire was employed using the following indicators: affective learning, affective school, behavioral effort and persistence, behavioral extracurricular involvement, and cognitive engagement. The primary objective was to determine the extent of students' engagement across these domains. The results concerning the level of student engagement in science are presented in Table 1.

The calculations resulted in a high descriptive statistic, with an overall mean of 4.01 and a standard deviation of 0.44. This shows that respondents' views on student engagement in science are high. Affective- Learning in science, with a mean score of 4.35, which is considered very high. Behavioral - Extracurricular, the lowest indicator, received a lower score of 3.70, but is still considered a high descriptive level.

Table 1 Level of Student Engagement in Science

Indicators	**SD**	**Mean**	**Descriptive Level**
Affective-Learning	0.56	4.35	Very High
Affective-School	0.66	4.03	High
Behavioral-Effort & Persistence	0.52	3.91	High
Behavior-Extracurricular	0.87	3.70	High
Cognitive	0.50	4.05	High
Overall	**0.44**	**4.01**	**High**

Table 1 presents the overall level of student engagement in science as reported by Grade 11 and 12 students. The results show that engagement was generally rated High (M = 4.01, SD = 0.44). Among the five indicators, affective–learning obtained the highest mean (M = 4.35, SD = 0.56), interpreted as Very High, which suggests that students demonstrated a strong emotional connection and interest in learning science content. This was followed by cognitive engagement (M = 4.05, SD = 0.50) and affective–school (M = 4.03, SD = 0.66), both classified as High, reflecting students' deep mental involvement in learning activities and positive feelings toward their school environment. On the other hand, behavioral–effort and persistence (M = 3.91, SD = 0.52) and behavioral–extracurricular (M = 3.70, SD = 0.87) scored slightly lower, with extracurricular participation registering the lowest mean, though still within the High range.

These results suggest that innovative teaching strategies, such as flipped classrooms and inquiry-based approaches, are particularly effective in fostering students' emotional and cognitive investment in science. The consistently high affective and cognitive scores imply that learners not only enjoy science but also engage in reflective thinking and deeper processing of concepts. However, the relatively lower extracurricular engagement highlights potential limitations in opportunities for out-of-class science activities.

In the Philippine context, reduced extracurricular participation may stem from structural and socioeconomic factors. Public senior high schools in rural-urban divisions like Malaybalay City often operate under constrained resources, limiting the availability of science-related co-curricular programs. Students also face competing demands such as household responsibilities, long commutes, and part-time work, which reduce

their ability to participate in after-school activities. Additionally, cultural expectations that emphasize academic achievement over non-academic pursuits may unintentionally discourage involvement in clubs or volunteer initiatives. These barriers illustrate that limited participation does not necessarily reflect disinterest, but rather contextual constraints that prevent students from fully engaging in extracurricular science opportunities.

The findings align with the Engagement Theory of Kearsley and Schneiderman (1998), which stresses that meaningful interaction and participation are essential for learning. Similarly, Hart et al. (2011) emphasized that higher engagement levels are associated with improved academic outcomes and student well-being. More recent evidence by Garcia and De Leon (2021) confirmed that innovative and student-centered pedagogies substantially enhance affective and cognitive engagement, particularly in science contexts where traditional lecture-based methods often fail to sustain attention.

Level of Academic Performance in Science

The next set of results addresses the second research question: What is the level of academic performance among Grade 11 and 12 students? Academic performance was assessed using the standardized Academic Performance Scale developed by Duay and Doble (2022), which evaluates study habits, learning strategies, goal-setting behavior, and academic self-efficacy. The instrument consists of 15 items rated on a five-point Likert scale, with higher scores indicating better academic performance.

Table 2 presents the descriptive statistics, including the mean and standard deviation for each item, as well as the overall score, interpreted according to the standard descriptive scale. It shows that students have an overall high level of academic performance in science (M = 3.78, SD = 0.55). All factors were rated "high," indicating that respondents consistently used successful academic habits and strategies.

Table 2 Level of Academic Performance in Science

Items	**SD**	**Mean**	**Descriptive Level**
I effectively manage my study time.	0.89	3.77	High
I take organized notes during lectures.	0.92	3.73	High
I regularly review my notes and study materials.	0.83	3.66	High
I participate in group study sessions with classmates.	1.02	3.66	High
I find it easy to understand the material presented in my subjects.	0.71	3.76	High
I seek help from teachers or peers when I do not understand something.	0.76	3.97	High
I set specific academic goals for myself each school year.	0.86	3.83	High
I feel confident in my ability to perform well academically.	0.84	3.73	High
I use effective study techniques (e.g., summarization, self-testing).	0.86	3.77	High
I believe that my study habits positively influence my academic performance.	0.90	3.90	High
I often review past exam papers to prepare for upcoming tests.	1.01	3.49	High
I create a study schedule and stick to it regularly.	1.06	3.53	High
I find a quiet place to study without distractions.	0.91	4.07	High
I engage in discussions about course material with my peers outside of class hours.	0.92	3.72	High
I believe that maintaining a healthy lifestyle (e.g., exercise, sleep) helps my studies.	0.81	4.14	High
Overall	**0.55**	**3.78**	**High**

Table 2 shows the self-reported academic performance of Grade 11 and 12 students in science. The overall mean score was 3.78 (SD = 0.55), interpreted as High. All 15 items fell within the High range, indicating generally positive academic behaviors and attitudes among respondents. The highest rating was observed for maintaining a healthy lifestyle (M = 4.14, SD = 0.81), suggesting that students recognize the importance of

well-being practices such as adequate sleep, exercise, and nutrition in supporting academic success. By contrast, the lowest mean score was recorded for reviewing past exam papers (M = 3.49, SD = 1.01). Although still classified as High, this implies that relatively fewer students regularly engage in this strategy, possibly due to limited access to review materials or a preference for newer study techniques encouraged by innovative teaching approaches.

These findings suggest that students demonstrate strong study habits, goal setting, and self-regulation—behaviors essential for sustained academic performance. The results also imply that innovative teaching methods, such as flipped classrooms and inquiry-based activities, may reinforce these habits by promoting active meaning-making, self-assessment, and collaboration. Such strategies not only strengthen content mastery but also cultivate metacognitive awareness, enabling students to reflect on their learning, identify knowledge gaps, and adjust their study strategies accordingly.

The emphasis on health and wellness as a support for learning underscores a holistic understanding of academic performance, aligning with 21st-century learning competencies that highlight autonomy, self-regulation, and lifelong learning (Santos & Reyes, 2020). These findings resonate with Lopez and Garcia (2021), who observed that innovative, student-centered pedagogies encourage learners to take ownership of their learning process, while also fostering accountability and reflective practice. Moreover, the recent study of Mengesha, Ayele, Misker, & Beyna, 2024, found that collaborative learning opportunities embedded in innovative teaching designs promote shared responsibility and social interaction, which further enhance academic achievement

The results are consistent with Constructivist Learning Theory (Piaget, 1947), which emphasizes active involvement and reflection as prerequisites for meaningful learning, and with Duay and Doble's (2022) validation of the Academic Performance Scale, which highlights the positive relationship between structured study habits and higher achievement. Collectively, these outcomes support the claim that innovative teaching strategies do more than deliver content—they build the habits, skills, and dispositions that underlie academic resilience and success in science education.

Level of Innovative Teaching Methods in Science

The next table addresses the mediating variable of the study, which explores students' perceptions of the innovative teaching methods used in their science classes. Specifically, it responds to the mediating role played by these teaching approaches—such as flipped classroom instruction—in enhancing engagement and academic performance. The data were gathered using the standardized Innovative Teaching Scale developed by Mengesha et al. (2024), consisting of seven items rated on a five-point Likert scale. This scale evaluates key dimensions such as understanding, engagement, active learning, satisfaction, and overall instructional preference. Table 3 presents the students' responses, including mean scores and standard deviations, with corresponding descriptive interpretations.

The high overall academic performance supports the assumption that innovative teaching methods can enhance students' ability to manage learning more efficiently. The flipped classroom strategy and other student-centered approaches seem to cultivate habits such as time management, self-assessment, and active collaboration, which are essential for academic success. These behaviors demonstrate not only content mastery but also metacognitive awareness among students.

This result is consistent with the findings of Santos and Reyes (2020), who noted that active and innovative pedagogies significantly improve student performance by promoting autonomy and responsibility in learning. Furthermore, the alignment with Constructivist Learning Theory (Piaget, 1947) supports the idea that when students are actively involved in their own learning process—through reflection, goal setting, and collaboration—they are more likely to achieve higher academic outcomes. These results also echo Duay and Doble's (2022) validation of their Academic Performance Scale, emphasizing that learners who adopt structured and personalized study habits tend to perform better academically, especially in science subjects where abstract thinking and discipline are essential.

Table 3 Level of Innovative Teaching Methods in Science

Items	SD	Mean	Descriptive Level
For me, the innovative teaching approach improved my understanding.	0.67	4.18	High
For me, the materials provided before class were helpful.	0.67	4.17	High
For me, I am more engaged during the innovative teaching sessions.	0.76	4.00	High
For me, the innovative teaching method encouraged active learning.	0.75	4.13	High
The in-class activities were effective in enhancing learning.	0.73	4.10	High
I prefer the innovative teaching method over traditional lectures	0.80	3.89	High
The students overall satisfaction with the innovative teaching methods is high.	0.79	4.00	High
Overall	**0.52**	**4.07**	**High**

Table 3 presents students' perceptions of innovative teaching methods in their science classes. The results yielded an overall mean of 4.07 (SD = 0.52), which falls within the High descriptive level. This finding indicates that students viewed innovative approaches such as flipped classrooms, inquiry-based learning, and active learning activities positively, affirming that these strategies were effective in improving their learning experiences in science.

Among the seven indicators, the highest mean score was for "The innovative teaching approach improved my understanding" (M = 4.18, SD = 0.67), suggesting that students perceived innovative instruction as highly effective in promoting comprehension of scientific concepts. Close behind was the helpfulness of pre-class materials (M = 4.17, SD = 0.67) and active learning encouragement (M = 4.13, SD = 0.75), reflecting the value students place on structured preparation and interactive participation. The lowest-rated indicator was "I prefer innovative teaching over traditional lectures" (M = 3.89, SD = 0.80), which, while still classified as High, suggests that some students remain attached to teacher-centered approaches, possibly due to familiarity and comfort with traditional practices.

In the Philippine educational context, these results highlight both opportunities and challenges. Students' strong agreement with items related to comprehension, preparation, and active engagement signals a growing openness to learner-centered instruction, especially in public senior high schools where traditional lectures remain prevalent. However, the relatively lower preference for innovative teaching compared to lectures may reflect systemic barriers, such as uneven access to digital resources, limited teacher training in innovative pedagogy, or the cautious adoption of new methods in rural-urban school divisions like Malaybalay City. These factors underscore the importance of contextualizing instructional innovations to fit the realities of Filipino learners.

The high overall ratings suggest that innovative teaching methods not only improved content mastery but also helped cultivate a more interactive and student-centered classroom culture. By integrating pre-class preparation with in-class collaboration, students were encouraged to take greater ownership of their learning. Although preferences for traditional lectures persist among some learners, the general sentiment points to openness toward pedagogical innovations that support higher-order thinking and self-regulation. These practices align with the objectives of the K to 12 reforms, which emphasize the development of 21st-century competencies such as critical thinking, collaboration, and independent learning.

These findings are consistent with international and local literature. Johnson et al. (2022) reported that inquiry-based strategies significantly improve students' conceptual understanding in science, while Darling-Hammond et al. (2020) highlighted the importance of flexible learning environments that adapt to learner needs. Similarly, Mengesha et al. (2024) confirmed that innovative instructional models lead to greater student satisfaction, engagement, and achievement. The results also support Constructivist Learning Theory (Piaget, 1947) and Social Constructivist Theory (Vygotsky, 1978), which emphasize that students learn best through active participation, collaboration, and experiential learning. Taken together, the evidence suggests that innovative teaching approaches have a transformative role in shaping Philippine science education by bridging engagement gaps and enhancing learning outcomes.

Correlation Analysis of the Variables

To further support the findings on the influence of student engagement and the mediating role of innovative teaching methods, a correlation analysis was conducted to examine the strength and direction of the relationships among the three core variables: student engagement (independent variable), innovative teaching methods (mediating variable), and academic performance (dependent variable). Pearson correlation coefficients were computed, and all results were tested for statistical significance at the $p < 0.05$ level. Table 4 summarizes the correlation coefficients, p-values, and decisions on the null hypotheses for each pairwise relationship among the variables.

The correlation analysis presented in Table 4 reveals significant positive relationships between the key variables under investigation. Specifically, the analysis demonstrates a moderate positive correlation between student engagement (IV) and academic performance (DV), with a correlation coefficient of .613 and a p-value of .000.

Table 4 Correlation Analysis of the Variables

Pair	Variable	Correlation Coefficient	p-value	Decision on H_o
IV and DV	Student Engagement and Academic Performance	.613***	.000	Reject
IV and MV	Student Engagement and Innovative Teaching Methods	.513***	.000	Reject
MV and DV	Innovative Teaching Methods and Academic Performance	.432***	.000	Reject

The analysis revealed statistically significant and positive relationships for all pairwise combinations. The strongest correlation was observed between student engagement and academic performance ($r = 0.613$, $p < 0.001$), indicating a moderately strong, positive association. A similarly significant but slightly weaker correlation was found between student engagement and innovative teaching methods ($r = 0.513$, $p < 0.001$), while the correlation between innovative teaching methods and academic performance, though the weakest of the three, remained significant and positive ($r = 0.432$, $p < 0.001$).

These results suggest that higher levels of student engagement are associated with improved academic performance and increased receptiveness to innovative instructional practices. Likewise, students who perceive greater use of innovative teaching strategies are more likely to demonstrate better academic outcomes. This aligns with the research of Lei et al., 2021 which emphasized the importance of student engagement as a predictor of academic success.

The findings confirm that student engagement is a crucial determinant of academic success, consistent with the studies of Hart et al. (2011) and Garcia & De Leon (2021), which emphasize the importance of behavioral, affective, and cognitive engagement in predicting educational outcomes. Additionally, the positive correlation between student engagement and innovative teaching methods supports the theoretical premise that engaging instructional strategies cultivate deeper learner involvement. The use of innovative teaching methods is positively related to increased student engagement. This is consistent with studies of Johnson et al (2022) and the National Academies of Sciences, Engineering, and Medicine (2022), which highlight the role of active learning strategies and innovative pedagogies in fostering student involvement and participation

The analysis also revealed a weak positive correlation between innovative teaching methods (MV) and academic performance (DV), with a correlation coefficient of .432 and a p-value of .000. This suggests that the implementation of innovative teaching methods is positively associated with improved academic performance. This connection is supported by research of Zhang et al. (2023), which demonstrated the effectiveness of certain teaching approaches in enhancing student learning and achievement.

Furthermore, the significant association between innovative teaching methods and academic performance echoes the findings of Mengesha et al. (2024), who noted that student-centered approaches like flipped learning contribute to higher achievement by fostering interactive, meaningful learning environments. In all three instances, the p-values were .000, all null hypotheses were rejected, confirming the existence of

significant linear relationships among the variables. Taken together, the correlation results support the conceptual model of the study, indicating that innovative teaching not only complements student engagement but also plays a reinforcing role in driving academic success. These associations reinforce the validity of the mediation framework used in the earlier analysis and show the importance of holistic, learner-centered strategies in science education.

Mediation Analysis

Mediation analysis is a statistical approach used to explore the mechanism through which an independent variable influences a dependent variable via a third variable, known as the mediator. In the context of this study, student engagement serves as the independent variable, academic performance as the dependent variable, and innovative teaching methods as the mediating variable. This analysis seeks to determine whether innovative teaching practices help explain how student engagement affects academic outcomes, offering insights into both direct and indirect pathways of influence.

This analysis provides insights into both the direct and indirect effects of student engagement on academic performance, helping to clarify the role of instructional innovation in enhancing educational outcomes.

Table 5 presents the results of the regression analysis conducted to examine the mediating role of innovative teaching methods in the relationship between student engagement and academic performance. The analysis followed a four-step approach to assess both the direct and indirect effects among the variables.

Table 5 Regression analysis showing the influence of student engagement on academic performance as mediated by innovative teaching methods.

Step	Path	B	S.E.	B
1	c	.764	.057	.613***
2	a	.606	.058	.513***
3	b	.168	.055	.159**
4	c’	.662	.065	.532***

* $p<0.05$, ** $p<0.01$, *** $p=0.000$

The regression analysis presented in Table 5 examined the influence of student engagement on academic performance, with innovative teaching methods as a mediating variable. In Step 1, student engagement significantly predicted academic performance ($\beta = .613$, $p < .001$), supporting recent research of Bond et al., (2020) that highlights the strong link between active participation and improved academic outcomes (In Step 2, student engagement was found to have a significant positive effect on innovative teaching methods ($\beta = .513$, $p < .001$), suggesting that engaged students are more likely to benefit from student-centered and technology-enhanced instruction. (Hew et al., 2020; Moorhouse & Wong, 2021).

In Step 3, innovative teaching methods significantly predicted academic performance ($\beta = .159$, $p < .01$), even after accounting for student engagement. This is similar to the study by Hew et al. (2020), which confirmed that innovative instruction makes a unique contribution to student learning outcomes, reinforcing research that highlights its role in enhancing understanding, motivation, and skill development. Finally, in Step 4, the direct effect of student engagement on academic performance decreased (from $\beta = .613$ to $\beta = .532$), indicating the presence of a partial mediating effect of innovative teaching methods. This partial reduction supports the idea of Moorhouse & Wong (2021) that engagement influences achievement both directly and indirectly through teaching approaches that foster active, inquiry-based, and collaborative learning environments.

These regression findings affirm the evolving pedagogical consensus that innovative teaching methods do not merely enhance content delivery but actively shape how student engagement translates into academic achievement. As student engagement initiates deeper learning behaviors, the presence of innovative strategies strengthens this process by offering more structured, interactive, and personalized learning experiences. According to Zhang and Zhu (2021), such methods—particularly flipped classrooms and blended learning

environments—create conditions where learners internalize concepts more effectively through pre-class preparation and collaborative in-class tasks. Moreover, the partial mediation observed in this study echoes the findings of Martin and Bolliger (2019), who emphasized that instructional design plays a pivotal role in converting engagement into measurable learning outcomes. By confirming that student engagement significantly affects both innovative teaching perception and performance, the study reinforces the theoretical claim that student-centered instruction and active engagement work in tandem to optimize academic results in 21st-century classrooms.

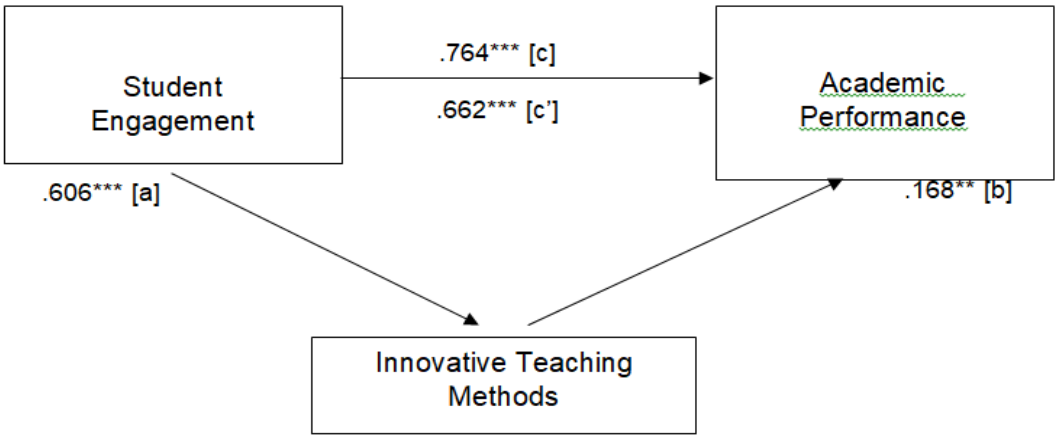
Table 6 Results of statistical analysis on the presence (or absence) of mediating effect

Combination of Variables	Sobel z	p-value	Mediation
student engagement → innovative teaching methods→ academic performance	2.917867	$p<0.05$	Partial mediation

* $p<0.05$

The Sobel test result presented in Table 6 provides statistical evidence for this mediation. The significant z-value (z = 2.917867, p < .05) confirms that innovative teaching methods significantly mediate the relationship between student engagement and academic performance. The analysis further indicates that 13.31% of the total effect of student engagement on academic performance is mediated through innovative teaching methods, with a ratio of the indirect to direct effect of 0.153538. This suggests a partial mediation model, where student engagement directly influences academic performance, and also indirectly influences it by fostering the use of innovative teaching methods, which in turn enhance academic outcomes.

Thus, the study underscores the need for institutional support in promoting both student engagement and pedagogical innovation. This is similar to the study of Tan & Hew (2021) that professional development programs focused on instructional creativity, such as integrating technology-enhanced learning or inquiry-based approaches, can play a key role in boosting both engagement and performance. Institutions should prioritize investments in teacher training and curriculum design that enable the adoption of evidence-based, innovative strategies.



Mediation Analysis

Sobel z	2.917867, $p<0.05$**
Percentage of the total effect that is mediated	13.310181%
Ratio of the indirect to direct effect	0.153538

Effect Size Measures

Unstandardized Coefficients

Total:	0.764
Direct:	0.662
Indirect:	0.606
Ratio Index:	0.793

Figure 2. Medgraph showing the variables of the study

The results of the mediation analysis, visualized in the Medgraph (Figure 2), demonstrate a significant total effect of student engagement on academic performance ($c = 0.764$, $p < .001$), indicating that higher engagement is strongly associated with better academic outcomes. When innovative teaching methods are introduced as a mediator, the direct effect remains significant ($c' = 0.662$, $p < .001$), while the indirect effect ($a \times b = 0.606 \times 0.168$) is also statistically significant ($p < .01$), supporting the hypothesis of partial mediation.

The Sobel test confirms the mediating effect with a z-score of 2.918 ($p < .05$), suggesting that innovative teaching methods significantly mediate the relationship between student engagement and academic performance. The percentage of the total effect that is mediated is approximately 13.31%, and the ratio of the indirect to direct effect is 0.15, indicating that a modest but meaningful portion of the total effect is explained by the mediator.

The significance of the mediation effect in this study supports a growing body of empirical literature affirming that instructional strategies do not merely supplement student engagement—they enhance and structure their effect on academic outcomes. The result is supported by the recent study of Santos and Reyes (2020), that student engagement alone, while a strong predictor of learning performance, reached its full potential only when facilitated by modern pedagogies like flipped classrooms and blended learning. These methods not only activate behavioral and cognitive engagement but also foster reflective thinking, which directly contributes to improved performance metrics. The result is consistent to the study of Mengesha et al. (2024), which emphasized that the active incorporation of student-centered strategies creates a scaffolded environment where learners transition from passive receivers to active constructors of knowledge, a dynamic particularly effective in content-heavy subjects like science. These findings corroborate the present study's results, which demonstrated a statistically meaningful indirect effect, confirming the mediating role of innovative teaching in maximizing student engagement's academic returns.

Furthermore, these mediation findings align with the broader educational shift toward pedagogical designs rooted in social constructivism and learner autonomy. As highlighted by Lopez and Garcia (2021), innovative teaching methods create a feedback loop where students not only engage more deeply but also become more aware of their learning progress, leading to improved academic behaviors such as goal setting, time management, and collaboration. The indirect pathway established in this study, representing 13.31% of the total effect, illustrates how innovative teaching strategies bridge the theoretical link between student involvement and learning achievement by offering context-rich, interactive, and personalized learning experiences. This mechanism is especially relevant in the Philippine context, where traditional teaching models still dominate in many schools. The findings of Torres & Mendoza (2022) underscore the need to advocate for a systemic shift toward scalable, innovative practices that enable students to move beyond engagement as mere participation toward engagement as meaningful, performance-driven learning.

These results are consistent with current educational literature emphasizing the importance of pedagogical innovation in amplifying the effects of student engagement. For instance, a similar study by Hew et al. (2020) found that innovative instructional models such as flipped classrooms and technology-enhanced learning significantly boost student engagement, which in turn contributes to improved academic outcomes. This is also in congruence with the study of Martin & Collie (2020) which argued that engagement operates not only as a direct predictor of performance but also as a driver that motivates educators to adopt adaptive and innovative teaching strategies.

The effect size further strengthens the findings. With a total unstandardized effect of 0.764 and an indirect effect size of 0.606, the results indicate a substantial influence of the mediator. The ratio index of 0.793 suggests that the magnitude of the mediating effect is relatively high compared to the total effect.

These findings support the theoretical framework that student engagement is a catalyst for both direct academic improvement and for encouraging the use of effective teaching methods, which further contribute to academic success. As Zhao (2020) suggests, integrating student-centered and technologically enhanced teaching practices not only fosters engagement but also leads to measurable performance gains.

The presence of partial mediation**,** as opposed to full mediation, is evidenced by the fact that the direct effect of student engagement on academic performance (path $c' = 0.662$) remained statistically significant even after

introducing innovative teaching methods as a mediating variable. This indicates that student engagement continues to exert a strong independent influence on academic performance, separate from the influence channeled through innovative instruction. Although the mediation pathway ($a \times b = 0.102$) was significant—as confirmed by the Sobel z-score of 2.918 ($p < 0.05$)—it accounted for only 13.31% of the total effect, meaning the majority of the impact still comes directly from engagement itself. This suggests that while innovative teaching enhances the learning process by enriching how students interact with content, it does not fully account for the effect of student engagement on performance. Such a finding aligns with Martin and Collie (2020), who emphasized that engagement includes intrinsic motivation, personal discipline, and emotional investment that may independently drive academic success, regardless of the teaching method employed. Therefore, innovative teaching methods act as a supportive enhancer, but not the sole channel, of how student engagement translates into academic achievement.

Thus, there is a need for institutional policies that promote both student engagement and teaching innovation. Professional development programs should focus on equipping educators with tools and strategies for implementing innovative teaching practices that actively engage learners. Furthermore, curricular reforms that incentivize creativity in instruction can create a virtuous cycle—where increased engagement promotes innovation, which in turn enhances academic achievement.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the findings of this study, it can be concluded that the level of student engagement in science among Grade 11 and 12 learners exposed to innovative teaching methods is high, particularly in the affective-learning and cognitive domains. This indicates that students were emotionally invested and intellectually stimulated through the instructional approaches used. Likewise, their level of academic performance was also high, which reflects positive study habits, confidence in learning, and effective comprehension of science concepts. In addition, the implementation of innovative teaching methods, such as flipped classroom strategies and active learning techniques, was perceived to be highly effective by the students, particularly in enhancing understanding, promoting engagement, and increasing satisfaction in learning experiences.

The study further revealed a statistically significant and positive relationship between student engagement and academic performance. Moreover, innovative teaching methods were also found to have a significant positive correlation with both engagement and performance. The mediation analysis confirmed a partial mediation effect, indicating that while student engagement has an independent influence on academic performance, the presence of innovative teaching strategies enhances this effect.

These findings affirm the theoretical underpinnings of Engagement Theory and Constructivist Learning Theory, both of which emphasize the importance of student involvement, real-world application, and learner-centered strategies in achieving meaningful academic outcomes.

Recommendation

In light of these results, it is recommended that, since Behavioral–Extracurricular had the lowest mean, science teachers are encouraged to integrate science-related extracurricular programs, such as science fairs, field visits, and STEM clubs, aligned with the classroom curriculum. These experiences should be structured to reinforce learning and offer hands-on applications of science concepts. The lowest-rated academic performance item was “I often review past exam papers to prepare for upcoming tests.” It is recommended that teachers also provide guided test paper reviews and mock exams using past assessments. These sessions will help students build exam strategies and content recall.

Teachers are encouraged to adopt a blended approach, gradually transitioning from traditional to innovative strategies that promote active learning, such as collaborative group work, inquiry-based instruction, and interactive digital tools. Participation in professional development programs focused on these methods could help enhance instructional effectiveness and classroom management. Sharing best practices among colleagues may also contribute to more consistent implementation of student-centered approaches. School administrators

are encouraged to support teachers through continuous professional development, the provision of teaching resources, and institutional policies that promote instructional innovation. Institutionalize support for extracurricular science programs, provide time slots, funding, and supervision for student-led or teacher-facilitated science activities outside the formal curriculum. These efforts can increase student behavioral engagement and contribute to the school's science culture. Facilitate peer collaboration opportunities through collaborative learning, through structured peer-led study groups or tutoring programs within the school system. This addresses the moderate rating for "I participate in group study sessions with classmates".

Based on the strengths of this study, future researchers and practitioners are encouraged to continue building upon the solid theoretical foundations provided by Engagement Theory and Constructivist Learning Theories. These frameworks strongly support the role of innovative teaching as a mediating factor in enhancing student engagement and performance. The findings affirm that adopting student-centered, active learning strategies is beneficial in addressing the persistent gaps in science education, particularly in local contexts such as Malaybalay City.

However, several limitations must be considered. Since this study excluded private schools and other grade levels, future research should broaden the scope of participants to capture more diverse perspectives across different educational contexts in the Philippines. This would enhance the generalizability of findings and ensure that interventions are responsive to varying institutional environments.

In terms of practice, there is a need to explore and address practical barriers that hinder the adoption of innovative teaching methods. Constraints such as limited infrastructure, availability of instructional technology, and insufficient teacher training often pose challenges to implementation in public schools. Identifying and mitigating these barriers would improve the feasibility of integrating active, student-centered approaches on a wider scale.

Cultural factors should also be examined more deeply, as attitudes toward teaching, learning, and science may uniquely influence engagement and effectiveness of pedagogies in the Philippine setting. Future studies may consider embedding cultural perspectives to ensure that interventions are contextually relevant and meaningful.

Finally, longitudinal designs are recommended to observe how the relationship between student engagement, innovative teaching, and academic performance evolves over time. Sustained monitoring would provide clearer evidence of whether innovative methods create lasting improvements or if their effects diminish without continuous reinforcement. Such insights would guide both policy and practice toward more sustainable reforms in science education.

Curriculum developers should embed practical assessment techniques, which include activities such as test-taking strategies, exam analysis, and peer-review tasks in science learning modules to reinforce low-rated academic practices like exam preparation. Contextualize learning materials since understanding and preference for innovative methods vary, design modules that offer both traditional learning paths and interactive alternatives, enabling teachers to match instruction with student readiness and preferences.

Students are encouraged to self-regulate learning that promotes the habit of reviewing past exam materials by providing reflection logs, self-assessment checklists, and digital access to practice tests. Involve yourself in science-related clubs or competitions and be motivated to participate in STEM-related contests or clubs, which can increase your exposure to real-life science experiences and improve both engagement and academic performance.

Policymakers are encouraged to allocate resources for innovation and enrichment. Provide budget support, infrastructure, and teachers. Establish science engagement benchmarks, set regional indicators for engagement in science, including metrics on extracurricular involvement and classroom innovation practices, to guide monitoring and evaluation across schools.

For future researchers, it could help explore the potential of innovative teaching methods in different learning environments.

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