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Self-Efficacy, Engagement, and Academic Achievement of Learners in Science in an Alternative Delivery Modality

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ABSTRACT: This paper explored senior high school learners' level of self-efficacy and level of engagement in science when classes were transitioned to alternative delivery modality due to impending natural phenomenon. Acknowledging the critical importance of science education as a lever with which to develop scientific literate, empowered citizens, the study probed how learners' confidence and engagement in science learning were impacted by distance and hybrid learning contexts. The study used a descriptive-comparative-correlational research design and data were collected from senior high school learners from a public secondary school situated in an urbanized city in the central Philippines. Learners exhibited high self-efficacy in science under the alternative delivery modality, with males reporting slightly higher confidence than females, though socioeconomic status showed no effect. Engagement was consistently strong across sexes but varied by socioeconomic groups, indicating financial background influenced participation. Academic achievement ranged from satisfactory to very satisfactory, with females outperforming males and most socioeconomic groups achieving higher ratings except the poor group. Statistical analysis revealed sex significantly influenced self-efficacy, while socioeconomic status affected engagement. A moderately strong positive correlation was found between self-efficacy and engagement, underscoring the role of confidence in fostering participation. However, neither self-efficacy nor engagement significantly predicted academic achievement, suggesting other factors drive performance outcomes. These results emphasize the necessity of developing engaging and user-friendly instructional resources such as interactive micro-learning modules that would help increase students' self-efficacy and science engagement, particularly in a setting where class transitions occur.

KEYWORDS: Alternative Delivery Modality, Descriptive-Comparative-Correlational Research Design, Central Philippines, Self-Efficacy, Science Engagement.

INTRODUCTION

Science education plays a crucial role in fostering scientific literacy and preparing learners for 21st century challenges. It emphasizes inquiry-based learning and Science, Technology, Engineering, and Mathematics (STEM) integration to promote innovation and competitiveness (AlAli, 2024). In the Philippines, science education faces ongoing reforms aimed at improving curriculum relevance and accessibility, especially in rural areas, to enhance learners' scientific skills and critical thinking (Alvarado & Galigao, 2024). Despite differing contexts, both countries recognize the importance of fostering scientific literacy to address global and local issues, with recent efforts focusing on curriculum modernization and equitable access to quality science education.

Science engagement is increasingly recognized as an active involvement of learners in scientific inquiry, discussion, and problem-solving, making science meaningful and connected to real-world experiences (Canfield et al., 2020; Giardullo et al., 2024). It is the practice of connecting people with scientific ideas in ways that are interactive, inclusive, and meaningful. It goes beyond simply sharing information, encouraging dialogue and collaboration between teachers and the learners (Chilvers & Kearnes, 2020). As societal challenges such as climate change, public health crises, and technological innovations become more complex, meaningful engagement in the classroom ensures that diverse perspectives are incorporated into scientific decision-making processes.

Contemporary research emphasizes that effective science engagement enhances scientific literacy, by bridging the gap between scientific communities and society (Moemeke, 2023). This confidence in one's own competence influences many areas of learners' behavior, including the decisions they make, the effort they put into activities, how long they endure in the face of adversity, and how they feel about their accomplishments and failures. In the learning process, this core belief will influence

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learners' decisions in choosing given tasks in courses and their perseverance while accomplishing them (Muhammad et al., 2020). Promoting learners' science engagement is also commonly framed in the language of global dominance.

Self-efficacy is widely recognized as a strong predictor of learners' engagement and achievement in science subjects. Research by Söderström et al. (2024) demonstrated that learners with higher science self-efficacy are more likely to engage in active learning strategies and exhibit greater persistence when faced with challenging tasks. It plays a crucial role in motivation, as people with high self-efficacy are more likely to take on challenges and persist through difficulties. Additionally, findings from Alhadabi (2021) emphasize that science self-efficacy significantly correlates with learners' interest and motivation in science-related activities, leading to improved academic performance.

Recent volcanic activity at Mt. Kanlaon has been significant, marked by an explosive eruption. This eruption prompted local authorities to declare suspension of classes in nearby areas, as the volcanic ash posed serious health risks to learners and residents. The ash fall can lead to respiratory problems, particularly in vulnerable populations raising concerns about public health. Beyond these health concerns, the interruption of schooling may compromise learners' academic performance, as prolonged absences hinder their ability to keep up with lessons. Since academic performance is a key indicator of whether learners have truly absorbed knowledge, the impact of eruption extends beyond immediate safety to long-term educational outcomes.

Science, by its very nature, is a subject that benefits greatly from hands-on activities, which are essential for developing learners' self-efficacy. Engaging in experiments and practical applications allows learners to experience success firsthand and validates concepts, reinforcing their belief in their abilities. However, following the recent volcanic activity at Mt. Kanlaon, it prompts for the implementation of alternative delivery modalities to ensure continuity in learning. Alternative Delivery Modality (ADM) is an instructional approach used when traditional face-to-face classes are disrupted, ensuring that learning continues despite challenges such as natural disasters, health crises, or other emergencies (Department of Education, 2021). This shift affects learners' self-efficacy and their engagement in the subject, as they are unable to fully connect theoretical concepts with practical application. This study aimed to determine the level of self-efficacy and engagement of learners in science in an alternative delivery modality. This study served as significant step that may answer the engagement of learners in science once actual experience, the very soul of learning science, is removed due to implementation of ADM. The results of this study will be utilized in developing interactive micro-learning module which delivers concise educational content that engages learners through interactive activities.

This study aimed to determine the level of self-efficacy and engagement of learners in science in an alternative delivery modality. Specifically, this study aimed to answer the following questions: What is the level of self-efficacy of learners in science in an alternative delivery modality when taken collectively and grouped according to sex and socioeconomic status? What is the level of engagement of learners in science in an alternative delivery modality when taken collectively and grouped according to sex and socioeconomic? What is the academic performance of learners in science in an alternative delivery modality when taken collectively and grouped according to sex, and socioeconomic status? Is there a significant difference in the level of self-efficacy of learners in science in an alternative delivery modality when grouped according to sex and socioeconomic status? Is there a significant difference in the level of engagement of learners in science in an alternative delivery modality when grouped according to sex and socioeconomic? Is there a significant relationship between the level of self-efficacy of learners in science in an alternative delivery modality and their level of engagement? Is there a significant relationship between the level of self-efficacy of learners in science in an alternative delivery modality and their academic achievement? Is there a significant relationship between the level of engagement of learners in science in an alternative delivery modality and their academic achievement?

METHODOLOGY

Design

This study used a descriptive-comparative-correlational research design. According to Ghanad (2023) and Ansari et al. (2025), descriptive research is a method used to outline and detail the attributes and traits of a specific population or phenomenon, emphasizing what is happening rather than why it is happening. Comparative research involves examining differences and similarities between two or more groups or variables to understand variations across populations or conditions (Devi, 2023). It is often used to examine how certain factors influence outcomes by analyzing contrasts between populations, settings, or interventions. Correlational research design is a form of research in which the researcher looks at the strength of the relationship

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(positive or negative) between two or more variables (Thomas & Zubkov, 2023). The research designs were deemed appropriate because they allow the study to describe the current levels of self-efficacy and science engagement, compare differences among groups affected by alternative delivery modes, and examine the relationships between these variables.

Locale

The study was conducted in a public secondary school situated in an urbanized city in the central Philippines, providing a unique educational setting influenced by both urban development and environmental challenges. The school's proximity to Mt. Kanlaon, an active volcano, makes it vulnerable to impending eruptions and related disruptions such as ash fall and class suspensions. This geographic context is significant because learners in the area often face interruptions in their studies, requiring the adoption of alternative delivery modalities to ensure continuity of learning.

Respondents

This study used simple random sampling. In quantitative investigations using survey instruments, simple random sampling is a frequently used sampling technique. The selection procedure was solely dependent on chance with this selection approach, which gives every learner an equal chance to take part in the study. The respondents of this study were the senior high school learners from a public secondary school situated in an urbanized city in the central Philippines who were taking science subjects for school year 2024-2025. These respondents were also learners affected by the volcanic eruption who were transitioned to alternative delivery modes of instruction.

Instrument

This study adopted and modified survey questionnaires to determine learners' self-efficacy and engagement levels in science. The researcher prepared a three-part instrument. The first part was intended for the profile of the respondents in terms of sex and socioeconomic status. The second part is a 13-item adapted survey instrument for self-efficacy from Tus (2020) which was modified to be 20-items to better fit the goal of this study. Each weight has a verbal interpretation indicated below.

Table 1. Interpretation of Learners' Level of Self-Efficacy

Weight	Range	Description	Verbal Interpretation
1	1.00 – 1.49	Strongly Disagree	Very Low Self-Efficacy
2	1.50 – 2.49	Disagree	Low Self-Efficacy
3	2.50 – 3.49	Undecided	Moderate Self-Efficacy
4	3.50 – 4.49	Agree	High Self-Efficacy
5	4.50 – 5.00	Strongly Agree	Very High Self-Efficacy

Additionally, the third part was for the level of science engagement, the survey instrument was adapted from the Learners' Science Engagement Scale (SSES) by Baraquia (2019). Each weight has a verbal interpretation indicated below.

Table 2. Interpretation of Learners' Level of Engagement in Science

Weight	Range	Description	Verbal Interpretation
1	1.00 – 1.49	Strongly Disagree	No Engagement
2	1.50 – 2.49	Disagree	Low Engagement
3	2.50 – 3.49	Undecided	Slightly Engaged
4	3.50 – 4.49	Agree	Highly Engaged
5	4.50 – 5.00	Strongly Agree	Very Highly Engaged

Lastly, the learners' academic achievement was measured using their grades in Science. These grades reflected outcomes from written works, performance tasks, and examinations, all of which were administered through standardized materials. Since the assessments were unified, the evaluation ensured consistency and comparability across all respondents. The verbal interpretations of their academic achievement were based on their report cards indicated below:

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Table 3. Interpretation of Learners' Academic Achievement

Range	Verbal Interpretation
90 – 100	Outstanding
85 – 89	Very Satisfactory
80 – 84	Satisfactory
75 – 79	Fairly Satisfactory
Below 75	Did not meet Expectations

Validity

The instruments used by the researcher were subjected to construct and content validity to confirm that the instrument is accurate and effective. A validation from a jury of experts in the field of Science was also observed. Validity denotes the extent to which an instrument measures what it intends to measure (Mohajan, 2017; Rogers & Revesz, 2019). Ten (10) content evaluators who are experts in science evaluated the adopted survey. Validation of the instrument using Good and Scates resulted in a value of 4.90, interpreted as Very Good, while Content Validity Ratio (CVR) found that 50 out of 60 items were essential. The 50 items were carried on the test questionnaire.

Reliability

The instrument was employed for pilot testing for reliability purposes. The researcher tested the instrument to 30 senior high school learners in the school. The learners were not sample in the actual data collection. After the pilot testing, the researcher submitted the data to the statistician for reliability testing using Cronbach's alpha. Cronbach's alpha is regarded as a gauge of scale for internal consistency, or the degree to which a group of elements are related to one another. The computed Cronbach's alpha for the level of self-efficacy and for the level of science engagement is 0.867 and 0.814, respectively; indicating the research instrument for both variables of interest are reliable. After the validity and reliability of the research instrument was established, the researcher proceeded with the actual data collection.

Data Collection Procedure

The researcher wrote a letter to the superintendent and to the school head, asking permission to conduct the study. After the letter was signed, the researcher provided the consent and wavered to ask permission from the parents for their learner to take part in the study. After establishing the validity and reliability of the instruments, the final copy of the questionnaire was produced. Permission to conduct the research was secured by asking for approval from the school division superintendent and the school principal.

Consent and assent forms were distributed to both parents and learners to ensure ethical standards were upheld in the conduct of the study. The consent form provided to parents outlined the purpose of the research, the procedures involved, potential risks and benefits, and the voluntary nature of participation, thereby securing parental approval for their child's involvement. Meanwhile, the assent form given to learners allowed them to personally acknowledge their willingness to participate, ensuring that their voices and autonomy were respected.

After acquiring the consent and assent forms, the researcher personally distributed the questionnaires to the respondents. Sufficient copies were reproduced for distribution to the respondents of the study.

Data Analysis

The numerical data gathered from the instruments were subjected to specific descriptive and inferential statistical treatment. For Problem Nos. 1, 2 and 3, mean and standard deviation were used to determine the level of self-efficacy, level of engagement, and academic performance. For Problem No. 4, in determining the significant difference in the level of self-efficacy of learners in science in an alternative delivery modality when grouped according to sex and socioeconomic status, Mann-Whitney U Test and Kruskal-Wallis Test were used respectively. For Problem No. 5, in determining the significant difference in the level of engagement of learners in science in an alternative delivery modality when grouped according to sex, and socioeconomic status, Mann-Whitney U Test and Kruskal-Wallis Test were used respectively. For Problem No. 6, in determining the significant relationship between the level of self-efficacy of learners in science in an alternative delivery modality and their level of engagement, Spearman's rho was utilized. For Problem No. 7, in determining the significant relationship between the level of self-

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efficacy of learners in science in an alternative delivery modality and their academic achievement, Spearman's rho was utilized. For Problem No. 8, in determining the significant relationship between the level of engagement of learners in science in an alternative delivery modality and their academic achievement, Spearman's rho was utilized.

RESULTS

This section presents the findings of the study on self-efficacy, engagement, and academic achievement of learners in science under an alternative delivery modality. The results highlight statistical relationships among these variables, examining whether confidence in one's abilities and active participation in learning activities translate into measurable academic success. The discussion interprets these outcomes in light of broader educational implications, emphasizing both the strengths and limitations of psychological and contextual factors in shaping science learning.

Table 4. Level of self-efficacy of learners in science in an alternative delivery modality when taken collectively and grouped according to sex, and socioeconomic status

Variables	Mean	SD	Interpretation
Sex			
Male (n=82)	4.076	0.645	High Self-Efficacy
Female (n=74)	3.848	0.677	High Self-Efficacy
Socioeconomic status			
Poor (n=93)	3.927	0.680	High Self-Efficacy
Low Income (Not Poor) (n=22)	3.857	0.751	High Self-Efficacy
Lower Middle Income (n=11)	4.318	0.626	High Self-Efficacy
Middle Middle Income (n=5)	4.030	0.337	High Self-Efficacy
Upper Middle Income (n=14)	3.811	0.566	High Self-Efficacy
Upper Income (n=11)	4.359	0.492	High Self-Efficacy

The Table 4 reveals that learners across sex and socioeconomic status consistently demonstrated high self-efficacy in science under the alternative delivery modality. Male learners showed slightly higher mean scores than females, suggesting marginally greater confidence, though both groups remained within the "High" category. This indicates that gender differences did not substantially affect learners' belief in their ability to succeed in science.

When examined by socioeconomic status, all groups also reflected high self-efficacy, underscoring the resilience of learners regardless of socioeconomic background. Interestingly, the highest mean scores were observed among learners from the lower middle income and upper income groups, which may point to the role of resources in boosting confidence. However, even those from poor and low-income households maintained high self-efficacy, showing that economic challenge did not diminish their determination. The relatively small standard deviations suggest that responses within each group were consistent, strengthening the reliability of the findings. The resilience observed suggests that ADM can foster self-efficacy across diverse contexts, though outcomes may also depend on local resources, institutional support, and cultural dynamics.

These results highlight that the alternative delivery modality did not weaken learners' confidence in science learning despite the challenges posed by the eruption. Instead, learners across diverse backgrounds adapted well and sustained positive beliefs about their academic abilities (Qamar & Akhter, 2020). The result is also in consonance to Brown et al. (2022) which confirms that confidence in science learning was sustained across gender and socioeconomic groups during remote learning. The result also agrees to the findings of Villamor (2020) which it states that self-efficacy strongly influences academic performance regardless of socioeconomic background.

Overall, the findings emphasize the importance of supporting learners' self-efficacy, as it remains a crucial factor in their academic success regardless of sex or socioeconomic status. The research underscores that fostering confidence and motivation is not only beneficial for immediate engagement but also essential for sustaining long-term achievement in science learning. Moreso, scientific self-efficacy predicts engagement in science learning even during disruptions (Yang et al., 2021).

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Table 5. Level of engagement of learners in science in an alternative delivery modality when taken collectively and grouped according to sex, and socioeconomic status

Variables	Mean	SD	Interpretation
Sex			
Male (n=82)	3.820	0.572	Highly Engaged
Female (n=74)	3.751	0.577	Highly Engaged
Socioeconomic status			
Poor (n=93)	3.722	0.582	Highly Engaged
Low Income (Not Poor) (n=22)	3.825	0.602	Highly Engaged
Lower Middle Income (n=11)	4.105	0.427	Highly Engaged
Middle Middle Income (n=5)	4.178	0.400	Highly Engaged
Upper Middle Income (n=14)	3.552	0.569	Highly Engaged
Upper Income (n=11)	4.060	0.401	Highly Engaged

The data in Table 5 reveals that learners across different sexes and socioeconomic statuses are consistently classified as "Highly Engaged" in science under an alternative delivery modality. Male learners show a slightly higher mean engagement score compared to females, though both groups remain within the same interpretation category. Interestingly, socioeconomic status presents more variation in mean scores, with middle middle income learners achieving the highest engagement levels. Poor and low-income learners also demonstrate strong engagement, suggesting that financial constraints do not necessarily hinder participation in science learning.

The relatively high scores across all groups highlight the effectiveness of the ADM in fostering engagement regardless of background. However, the lower mean score among upper middle income learners compared to other groups raises questions about possible differences in motivation or external factors. The small sample sizes in some categories, such as middle middle income and upper income groups, should be considered when interpreting these results. Overall, the findings suggest that engagement in science is broadly inclusive and resilient across demographic divides. This consistency underscores the adaptability of learners in diverse contexts when provided with accessible learning opportunities. The adaptability observed indicates that alternative delivery modalities can sustain learner engagement in varied contexts, though outcomes will depend on local infrastructure, cultural dynamics, and institutional support.

The result of this study goes along with the result of Miles and Naumann (2021) which confirms that both male and female learners sustain science identity and engagement, with slight differences in mean scores. Moreso, the study of Chan (2022) explored how cultural and gender norms shape engagement, showing resilience across sexes despite disparities. Also, the result from the study of Villamor (2020) also gave light to the socioeconomic aspect which mentioned that self-efficacy supports academic performance across income levels, with low-income learners still demonstrating strong engagement.

However, contrasting evidence from Paulsen and McCormick (2020), Lucas et al. (2021), and Tan (2024) indicates that socioeconomic background remains a strong predictor of science participation, with low-SES learners facing systemic barriers and unequal adaptation to online modalities. The divergence between this study and prior findings may be explained by contextual and methodological differences. Unlike Paulsen and McCormick's (2020) focus on online-only environments, this study examined blended alternative delivery modalities that provided more structured support, potentially mitigating disparities. Lucas et al. (2021) and Tan (2024) analyzed broader national datasets, where systemic inequities were more pronounced, whereas the present study's localized sample may reflect community-specific resilience and institutional interventions. Differences in measurement tools and sample sizes also contribute to variation, as smaller, context-bound studies may capture adaptive behaviors that large-scale surveys overlook. Thus, under supportive conditions, learners across diverse backgrounds can sustain high levels of engagement.

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Table 6. Academic achievement of learners in science in an alternative delivery modality when taken collectively and grouped according to sex, and socioeconomic status

Variables	Mean	SD	Interpretation
Sex			
Male (n=82)	82.817	6.944	Satisfactory
Female (n=74)	86.459	6.044	Very Satisfactory
Socioeconomic status			
Poor (n=93)	83.387	6.630	Satisfactory
Low Income (Not Poor) (n=22)	85.364	6.659	Very Satisfactory
Lower Middle Income (n=11)	85.091	6.534	Very Satisfactory
Middle Middle Income (n=5)	88.200	6.907	Very Satisfactory
Upper Middle Income (n=14)	87.000	6.939	Very Satisfactory
Upper Income (n=11)	87.364	6.990	Very Satisfactory

Table 6 highlights the academic achievement of learners in science under an alternative delivery modality, showing clear distinctions across sex and socioeconomic status. Female learners outperform males with a higher mean score, earning a "Very Satisfactory" interpretation compared to the males' "Satisfactory" level. This suggests that female students may be adapting more effectively to alternative learning approaches.

When grouped by socioeconomic status, most categories fall under the "Very Satisfactory" interpretation, except for the poor group, which remains at "Satisfactory." Interestingly, middle middle income learners achieved the highest mean score, indicating that moderate financial stability may provide optimal conditions for academic success. Upper income learners also performed very well, though their scores were slightly lower than those in the middle middle income group. The consistency of "Very Satisfactory" ratings across most income brackets suggests that alternative delivery modalities can support strong achievement regardless of wealth. However, the lower performance of poor learners highlights the persistent challenges faced by those with limited resources.

Although these findings originate from a school community near Mt. Kanlaon in the central Philippines, this result may offer valuable insights for other educational settings disrupted by natural disasters or crises. The patterns observed suggest that alternative delivery modalities can sustain achievement across diverse socioeconomic groups, yet the degree of transferability will depend on how effectively local resources, institutional support, and cultural dynamics align with the demands of disrupted learning environments.

Female learners often outperform males in science achievement, and middle-income learners show optimal performance under alternative delivery modalities. The results obtained in this study is also in congruence to what Ani et al. (2021) and Rosén et al. (2022) also found that female learners outperform males in science achievement. In the aspect of socioeconomic status, the result in the study is also aligned with the result of the study of Eriksson et al. (2021) which confirmed that SES strongly predicts science achievement, with middle-income learners often performing best. In the Philippine setup, it also shows that alternative delivery modalities sustain satisfactory to very satisfactory achievement across SES groups (Calimlim et al., 2021).

Learners belonging to Poor category consistently face challenges, with systemic inequities in access and achievement persisting despite alternative modalities. In contrary, Lucas et al. (2021) highlighted persistent low science achievement among poor learners, contradicting claims of resilience. Moreover, Solis-Foronda and Marasigan (2021) identified challenges in science learning that hinder achievement, especially for disadvantaged groups. Further, the relatively small sample sizes in some groups, such as middle middle income and upper income, should be considered when interpreting the results. Overall, the table demonstrates that while sex and socioeconomic status influence achievement levels, alternative delivery modalities still enable most learners to reach commendable academic performance in science.

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Table 7A. Significant difference in the level of self-efficacy of learners in science in an alternative delivery modality when grouped according to sex

Variable (Sex)	$\tilde{x}$	SD	*p*-value	Sig at α = 0.05	Decision
Male (n=82)	4.076	0.645	0.033	Significant	Reject H_o
Female (n=74)	3.848	0.677			

Table 7A results show that male learners have a higher mean self-efficacy score (4.076) compared to female learners (3.848). The p-value of 0.033 is below the 0.05 significance threshold, which indicates that the difference between the two groups is statistically significant. Because of this, the null hypothesis is rejected, meaning that sex does play a role in learners' self-efficacy under the alternative delivery modality. The interpretation suggests that male learners tend to feel more confident in their ability to succeed in science compared to female learners in this context. This finding highlights the importance of considering gender differences when designing instructional strategies in alternative learning setups.

While both groups show relatively high levels of self-efficacy overall, the gap may point to underlying factors such as confidence, learning styles, or support systems. The rejection of the null hypothesis emphasizes that sex is a variable worth examining in relation to learner self-efficacy. These results may encourage educators to implement targeted interventions to boost female learners' confidence and engagement in science. The observed differences in self-efficacy highlight that alternative delivery modalities can reveal nuanced patterns of resilience, yet their applicability elsewhere will depend on how cultural norms, institutional support structures, and the severity of local disruptions interact with learner adaptation.

Multiple studies confirm that male learners often report higher self-efficacy in science and online learning contexts. In the study of Miles and Naumann (2021), it has found significant gender differences in science self-efficacy, with males reporting higher confidence. It is further supported by the study of Liu et al. (2021), Mwaura (2021) and Kurniawan et al. (2022) which presented males reporting stronger self-regulation and confidence in online learning contexts.

Other studies highlight female learners' strong or equal self-efficacy, especially when contextual factors such as teacher support (Larry & Wendt, 2021), identity development (Alhadabi, 2021), and STEM aspirations (Gallop, 2021) are considered.

Table 7B. Significant difference in the level of self-efficacy of learners in science in an alternative delivery modality when grouped according to socioeconomic status

Cases	Sum of Squares	df	Mean Square	F	*p*-value	Sig at α = 0.05	Decision
Socio-economic Background	3.826	5	0.765	1.757	0.125	Not Significant	Accept H_o
Residuals	65.319	150	0.435				

Table 7B results show that the p-value is 0.125, which is greater than the 0.05 significance level. Because the p-value exceeds the threshold, the difference among groups is not statistically significant. This leads to the decision to accept the null hypothesis, confirming that socioeconomic status does not meaningfully affect learners' self-efficacy in this context. The F-value of 1.757 further supports the conclusion that variations across income groups are not strong enough to be considered significant.

The result also suggests that learners, regardless of socioeconomic status, maintain comparable confidence in their ability to succeed in science under alternative delivery modalities. The finding highlights the inclusivity of the learning approach, as it appears to support self-efficacy across diverse economic conditions. It also implies that factors other than socioeconomic status may play a more important role in shaping learners' confidence. Overall, the table demonstrates that the hypothesis of no significant difference is supported, reinforcing the idea that self-efficacy in science is resilient across socioeconomic divides.

Although these findings are situated in a school community near Mt. Kanlaon in the central Philippines, they may be transferable to other educational settings experiencing disruptions from natural disasters or crises. The resilience observed suggests that alternative delivery modalities can sustain learner confidence in varied contexts.

Several studies claim that self-efficacy is resilient across SES divides, especially when alternative delivery modalities are inclusive and supportive. The study of Bhati and Sethy (2022) emphasized that self-efficacy is shaped more by cognitive and

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motivational factors than SES. In the study of Tan et al. (2023), it revealed that large-scale PISA study shows SES differences in self-efficacy are small and not always significant.

Other large-scale analyses show SES remains a significant predictor of confidence and achievement, with poorer learners disadvantaged. The study of Boman (2023) confirmed SES is substantially associated with self-efficacy and achievement. The study of Laron and Caldoza (2026) reported that SES had linked disparities in literacy and confidence. In the study of Hofer et al. (2024) it shown lower SES learners have more negative self-perceptions, undermining self-efficacy. Moreso, the study of Kastorff and Heine (2025) demonstrated widening SES gaps in science-related confidence and literacy.

Table 8A. Significant difference in the level of engagement of learners in science in an alternative delivery modality when grouped according to sex

Variable (Sex)	$\tilde{x}$	SD	*p*-value	Sig at α = 0.05	Decision
Male (n=82)	3.820	0.572	0.767	Not Significant	Accept H_o
Female (n=74)	3.751	0.577			

The result in Table 8A shows that male learners have a mean engagement score of 3.820, while female learners have a slightly lower mean of 3.751. Despite this small difference, the p-value of 0.767 is much greater than the 0.05 significance level. Because the p-value exceeds the threshold, the difference between male and female learners is not statistically significant. This leads to the decision to accept the null hypothesis, confirming that sex does not meaningfully affect engagement levels in science under the alternative delivery modality.

Both groups are classified as "Highly Engaged," which suggests that the learning approach is effective across genders. The finding highlights that engagement is consistent and resilient, regardless of sex. It also implies that other factors beyond gender may play a more important role in shaping learners' engagement. The acceptance of the null hypothesis reinforces the inclusivity of the modality, showing that male and female learners benefit equally from the approach. Further, the result supports the conclusion that sex is not a determining factor in learners' engagement in science. The consistency of engagement across sexes suggests that alternative delivery modalities can foster inclusivity in varied contexts, though the extent of transferability will depend on cultural norms, institutional support, and the specific nature of the disruption.

Multiple studies confirm that engagement in science is resilient across genders, with both male and female learners classified as "Highly Engaged." The studies of Aguillon et al. (2020), Belova et al. (2024), and Vooren et al. (2022) found that gender does not consistently moderate engagement outcomes in science learning. While attitudes varied, engagement levels in science were not significantly different across sexes (Iwuanyanwu, 2022).

Other studies highlight persistent disparities, particularly in STEM fields like physics, where female learners often report lower self-efficacy and engagement. In the study of Cwik and Singh (2022) it was reported that female have lower self-efficacy, which predicts lower engagement in science, specifically, physics. Also, engagement is being attributed and linked to personality traits and learning styles (Idrizi et al., 2023) and adaptive learning (Ademi & Loshkovska, 2025).

Table 8B. Significant difference in the level of engagement of learners in science in an alternative delivery modality when grouped according to socioeconomic status

Cases	Sum of Squares	df	Mean Square	F	*p*-value	Sig at α = 0.05	Decision
Socio-economic Background	3.894	5	0.779	2.483	0.034	Significant	Reject H_o
Residuals	47.045	150	0.314				

The results Table 8B show that the p-value is 0.034, which is less than the 0.05 significance level. Because the p-value falls below the threshold, the difference among groups is statistically significant. This leads to the decision to reject the null hypothesis, meaning that socioeconomic status does influence learners' engagement in science under the alternative delivery

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modality. The F-value of 2.483 further supports the conclusion that variations across income groups are strong enough to be considered meaningful.

While all groups were previously classified as "Highly Engaged," this test reveals that the degree of engagement differs significantly depending on socioeconomic background. Learners from certain income brackets may have access to resources or support systems that enhance their engagement compared to others. This finding highlights the importance of considering socioeconomic factors when evaluating learner participation and designing equitable educational strategies. The rejection of the null hypothesis underscores that engagement is not entirely uniform across economic groups. Along the same lines, the table demonstrates that socioeconomic status plays a significant role in shaping learners' engagement in science within alternative delivery modalities.

SES remains a strong predictor of science engagement, with middle- and upper-income learners often reporting higher confidence and participation. The study of Nja et al. (2022) found SES which strongly correlated with science students' academic and cognitive outcomes, influencing engagement. Large-scale meta-analysis also shown SES significantly predicts achievement and engagement (J. Liu et al., 2022). In the Philippines, it is reported that SES barriers affect how students experience ADM, with engagement varying by financial background (Calamaan & Trinidad, 2025; Laron & Caldoza, 2026).

Other studies emphasize inclusivity of alternative delivery modalities, showing that engagement remains high across SES groups with no significant differences. Tan (2024) mentioned that SES effects are often overstated, with engagement resilient across income groups. The study of Placencia Jr. and Lopres (2022) highlighted that ADM supports engagement inclusively, minimizing SES disparities. The study of Niez (2024) also reported that high engagement across SES groups, with differences not significant.

Table 9. Significant relationship between the level of self-efficacy of learners in science in an alternative delivery modality and their level of engagement

Variable		Self-efficacy	
Engagement	Spearman's rho	0.596	Reject H_o
	p-value	< .001	

The result in Table 9 shows a Spearman's rho correlation coefficient of 0.596, which indicates a moderately strong positive relationship between the two variables. The p-value is reported as being less than .001, which is far below the 0.05 significance threshold. Because the p-value is highly significant, the null hypothesis is rejected. This means that learners with higher self-efficacy also tend to demonstrate higher levels of engagement in science. The finding highlights the close link between confidence in one's abilities and active participation in learning activities.

The result suggests that boosting self-efficacy could be an effective way to enhance engagement in alternative delivery modalities. The strength of the correlation underscores the importance of psychological factors in shaping academic behaviors. While engagement and self-efficacy are distinct constructs, their significant relationship shows that they reinforce each other in meaningful ways. Overall, the table provides strong evidence that the hypothesis of no significant relationship is not supported, as self-efficacy and engagement are positively and significantly connected. The positive link between self-efficacy and engagement suggests that psychological resilience can be fostered through alternative delivery modalities, though the extent to which this relationship holds elsewhere will depend on local resources, institutional support, and cultural conditions.

Multiple studies confirmed a moderately strong positive correlation between self-efficacy and engagement. In the Philippine study, Bangga (2021) presented significant correlation between self-efficacy and engagement in online science classes. The study of Miao et al. (2025) also confirmed that higher self-efficacy predicts stronger engagement and achievement. Moreover, a path analysis from Rahim (2022) also presented self-efficacy as a significant predictor of engagement in distance learning.

Other studies highlight that self-efficacy is not always the strongest predictor. Engagement is often mediated by teaching competencies (Rahim, 2022), peer support (Whitcomb et al., 2023), and teacher support (Shu, 2022; Tan et al., 2025) playing larger roles. Also, findings reveal weaker correlations in adaptive learning environments, suggesting that other contextual factors may intervene in shaping academic outcomes.

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Table 10. Significant relationship between the level of self-efficacy of learners in science in an alternative delivery modality and their academic achievement

Variable		Self-efficacy	Decision
Academic achievement	Spearman's rho	0.010	Accept H_o
	p-value	0.905	

The result in Table 10 shows a Spearman's rho correlation coefficient of 0.010, which is extremely close to zero, indicating virtually no relationship between the two variables. The p-value of 0.905 is far greater than the 0.05 significance threshold, meaning the observed correlation is not statistically significant. Because of this, the null hypothesis is accepted, confirming that self-efficacy does not meaningfully influence academic achievement in this context. This finding suggests that learners' confidence in their abilities does not necessarily translate into higher performance scores in science.

The result also highlights those other factors, such as study habits, instructional quality, or external support, may play a more critical role in shaping achievement outcomes. The acceptance of the null hypothesis also emphasizes that self-efficacy and achievement are independent in this learning setup. While self-efficacy remains important for motivation and engagement, it does not directly predict academic success here. This result contrasts with the earlier finding that self-efficacy and engagement are significantly related, showing that engagement may act as a separate mediator of achievement. In summary, the table demonstrates that the hypothesis of no significant relationship is supported, as self-efficacy and academic achievement are statistically unrelated in this study. The independence of self-efficacy and achievement observed suggests that alternative delivery modalities can sustain confidence without necessarily guaranteeing performance, a pattern that may recur in other disrupted contexts depending on local resources, instructional quality, and cultural dynamics.

Several studies confirm that self-efficacy does not always translate into higher achievement. Other factors such as study habits (Svartdal et al., 2022), motivation and support (Basileo et al., 2024; Suryaratri et al., 2022), and instructional quality (Khine & Nielsen, 2022) may be stronger predictors. In the studies mentioned, it revealed that motivation and support are more predictive of achievement than self-efficacy. Also, empirical studies show contexts where self-efficacy does not predict achievement. Further, findings also show variability across cultures, with achievements not consistently tied to self-efficacy. Consequently, it is social support that is deemed more critical than self-efficacy for achievement outcomes.

Despite several studies which do not support the link between self-efficacy and academic achievement, meta-analyses and large-scale datasets consistently show self-efficacy as a significant predictor of achievement, often mediated by engagement. Moreover, studies confirm significant positive correlation between self-efficacy and achievement. The study of Meng and Zhang (2023) confirmed that self-efficacy predicts achievement indirectly via engagement. In addition, findings reveal consistent positive associations across multiple contexts. The result of the study of Miao et al. (2025) also reported strong positive correlation in learners.

Table 11. Significant relationship between the level of engagement of learners in science in an alternative delivery modality and their academic achievement

Variable		Engagement	Decision
Academic achievement	Spearman's rho	-0.043	Accept H_o
	p-value	0.598	

The result in Table 11 shows a Spearman's rho correlation coefficient of -0.043, which is very close to zero and even slightly negative, indicating no meaningful relationship between the two variables. The p-value of 0.598 is far greater than the 0.05 significance threshold, confirming that the observed correlation is not statistically significant. Therefore, the null hypothesis is accepted, meaning that engagement does not significantly influence academic achievement in this context. This finding suggests that while learners may be highly engaged, their level of engagement does not necessarily translate into higher academic performance.

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The result also highlights another idea that achievement may depend more on other factors such as study strategies, instructional quality, or external support systems. The acceptance of the null hypothesis also emphasizes that engagement and achievement are independent constructs in this study. While engagement remains important for motivation and participation, it does not directly predict academic success here. This result contrasts with the earlier finding that engagement and self-efficacy are significantly related, showing that achievement may be shaped by different dynamics.

Although these findings stem from a school community near Mt. Kanlaon in the central Philippines, they may hold relevance for other educational settings disrupted by natural disasters or crises. The observed independence between engagement and achievement suggests that alternative delivery modalities can sustain engagement without necessarily ensuring performance, a dynamic that may also emerge in other contexts depending on the interplay of local resources, instructional quality, and cultural conditions.

Several studies confirm that engagement does not always translate into higher achievement. The study of Mizani et al. (2022) found that engagement was not a consistent predictor of achievement during pandemic remote learning. Moreover, the study of Wong and Liem (2022) noted conceptual ambiguity as engagement does not always translate into measurable achievement outcomes. Also, the study of (2023) reported contexts where engagement may not predict achievement, highlighting other mediating factors.

On the other hand, the study of Lei et al. (2021) confirmed significant positive correlation across multiple studies. Also, the study of Luo et al (2023) demonstrated that engagement mediates the effect of self-efficacy on achievement. Lastly, the study of Salcedo and Paglinawan (2025) reported strong positive correlation in the Philippine contexts.

CONCLUSION

Learners collectively demonstrated high self-efficacy in science under the alternative delivery modality. Male learners reported slightly higher confidence compared to females, while socioeconomic differences did not significantly affect self-efficacy. This indicates that learners' belief in their ability to succeed remains strong across demographic groups. Overall, self-efficacy is consistently high, showing that learners adapt well to alternative learning approaches.

Learners in this study demonstrated consistently high engagement in science regardless of sex. However, engagement varied across socioeconomic groups, with financial background influencing engagement and aligning with broader evidence that economic conditions shape learning outcomes. While the findings diverge from some studies that report stronger disparities, the study's results suggest that under supportive delivery modalities, engagement can remain inclusive, though still sensitive to socioeconomic differences.

Academic performance ranged from satisfactory to very satisfactory across groups. Female learners achieved higher performance compared to males, while most socioeconomic categories performed very satisfactorily except the poor group. This highlights that both sex and socioeconomic background influence achievement outcomes. In general, learners achieved commendable performance despite differences in demographic factors.

A significant difference in self-efficacy was found between sexes, with males reporting higher confidence than females. No significant difference was observed across socioeconomic groups. This shows that sex influences self-efficacy, but financial background does not. Therefore, gender is a more critical factor in shaping learners' confidence levels.

No significant difference in engagement was found between male and female learners. However, socioeconomic status showed a significant effect on engagement levels. This indicates that economic background is a more important factor in engagement than sex. Learners' participation is therefore more closely tied to financial conditions than to gender.

A moderately strong positive relationship was found between self-efficacy and engagement. Learners with higher confidence tended to be more engaged in science learning. This demonstrates that self-belief is closely linked to active participation. Strengthening self-efficacy can therefore enhance learners' engagement in science.

Self-efficacy was not significantly related to academic achievement. Learners' confidence did not directly translate into higher performance scores. This suggests that other factors beyond self-efficacy determine achievement outcomes. Academic success may depend more on instructional quality, study habits, and external support.

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Engagement was also not significantly related to academic achievement. Highly engaged learners did not necessarily achieve higher academic performance. This emphasizes that engagement and achievement are independent constructs in this study. Achievement outcomes may be influenced by factors other than engagement, such as resources and learning strategies.

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