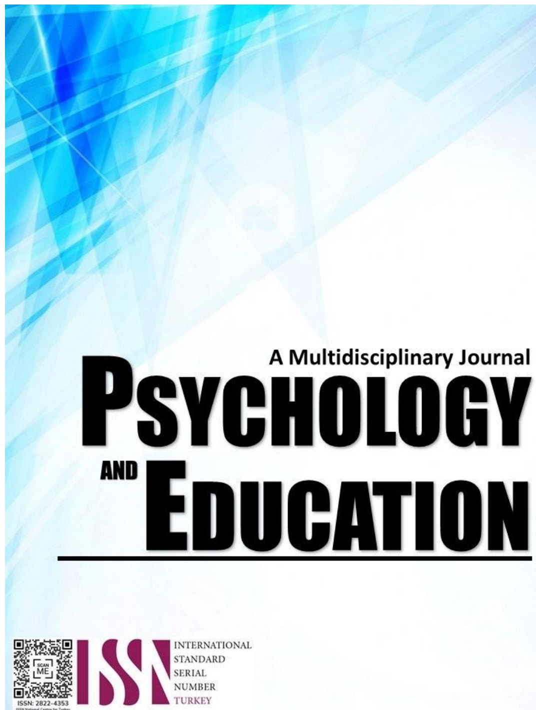
EXAMINING SELF-EFFICACY SOURCES, MATSI-BASED ATTITUDES, AND PERFORMANCE: A STUDENT-CENTRIC APPROACH TO SPECIALIZED SCIENCE CURRICULUM REDESIGN



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Research Article

Examining Self-Efficacy Sources, mATSI-Based Attitudes, and Performance: A Student-Centric Approach to Specialized Science Curriculum Redesign

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Abstract

This study aimed to investigate the relationships among self-efficacy, attitudes towards specialized science (measured by the Modified Attitudes Toward Science Inventory [mATSI]), and academic performance among junior high school students. A descriptive-correlational design was employed to assess students' science self-efficacy, attitudes, and academic performance, and to examine the factors influencing these variables. Data were collected using validated survey instruments for self-efficacy and attitudes, along with students' final grades in science, and analyzed using descriptive statistics, correlation analysis, and regression analysis. Findings indicated moderate self-efficacy and favorable attitudes. Regression analysis revealed that social persuasion and emotional states strongly influenced self-efficacy, while "desire to do science" was the key predictor of attitudes. Academic performance was proficient to highly proficient based on Department of Education standards. A strong positive correlation existed between self-efficacy and attitude, but not with performance. The study recommends curriculum redesign focus on enhancing mastery and vicarious experiences, strengthening social persuasion, addressing emotional states, connecting science to real-world applications, and fostering student autonomy. Interventions should prioritize grades 8 and 9 to foster a positive learning environment, improve self-efficacy, and enhance student engagement in specialized science.

Keywords: *anxiety toward science, mastery experience, self-concept toward science, social persuasion, vicarious experience*

Introduction

Fostering robust scientific literacy and developing future Science, Technology, Engineering, and Mathematics (STEM) professionals are critical national priorities. This is particularly true within specialized science education programs that are designed to cultivate advanced aptitude and deeper engagement. Understanding the complex interplay of student psychological factors within these demanding environments is essential for optimizing learning outcomes and preparing students for future scientific endeavors.

In the Philippines, this national commitment is evident with the issuance of DECS Order No. 69 series of 1993, which initiated the creation of various science high schools. These institutions aim to provide an intensive and advanced secondary education program with a special focus on science, mathematics, and the communication arts. Many other schools have since developed their own specialized science curricula in alignment with this mandate.

A prime example is Saint Mary's University High School. In SY 2000-2001, curriculum developers successfully applied for permission to establish the SMU Science High School, marking a major revision of the science curriculum since 1970. Its implementation was approved for SY 2001-2002. This initiative was further guided by DepEd Order No. 55, s. 2010, which provided policies and guidelines on strengthening science and mathematics education at the secondary level. Consequently, SMU now operates two distinct high school programs: SMU Science High School and SMU High School.

The science curriculum of SMU Junior High School offers subjects in addition to the mandated K to 12 curriculum. Specifically, within the science department, specialized subjects such as Environmental Science, Biotechnology, Laboratory Techniques, Selected Topics in Chemistry, and Science Research were integrated into the SMU Science High School Curriculum. It is noteworthy that students in this specialized science curriculum are preselected due to their above-average ability and demonstrated aptitude in science and technology.

Despite their inherent aptitude, students in specialized science programs face unique academic and psychological challenges. Research indicates that low self-efficacy or negative attitudes towards science can significantly hinder science literacy and lead to lower academic performance, even among capable learners (Mao et al., 2021). While the importance of self-efficacy in science learning is widely recognized, a significant research gap persists in understanding how the specific sources of self-efficacy (mastery experience, social persuasion, vicarious experience, and physiological & emotional states) differentially impact student engagement and achievement within demanding, specialized science subjects. Furthermore, despite the recognized influence of psychological factors on learning outcomes, curriculum design often overlooks the nuanced interaction between student attitudes towards science and their self-efficacy beliefs (Tyler & Osborne, 2012; Britner & Pajares, 2006). This lack of understanding can limit the effectiveness of targeted interventions aimed at optimizing specialized science curricula.

This study, therefore, directly addresses this gap by investigating the multifaceted nature of student experiences in specialized science subjects. By utilizing the mATSI instrument to measure attitudes towards science and analyzing students' academic performance alongside self-efficacy sources, this research seeks to provide valuable insights for curriculum reengineering. The ultimate goal is to foster positive attitudes, enhance self-efficacy, and ultimately improve student achievement in specialized science subjects through empirically informed curriculum adjustments.

Research Questions

This study aimed to determine the sources and the relationship of science self-efficacy, attitudes, and academic performance of the Science High School students of Saint Mary's University for the first semester of SY 2024-2025, which provided valuable insights for the science curriculum reengineering. Specifically, the following questions were answered:

1. What are the levels of science self-efficacy, attitudes toward specialized science subjects, and academic performance among the students?
2. How do the four sources of self-efficacy—mastery experiences, social persuasion, vicarious learning, and physiological and emotional states—influence students' science self-efficacy?
3. How do the five attitudinal factors—perceptions of science teachers, science anxiety, perceived societal value of science, self-concept in science, and desire to engage in science activities—predict students' attitudes toward science?
4. What are the significant relationships among science self-efficacy, attitudes toward science, and academic performance?
5. How can these findings inform curriculum design to enhance student engagement and achievement?

Methodology

Research Design

This study will employ a descriptive-correlational research design. This design is particularly suited for this investigation as it aims to describe the levels of the identified variables (science self-efficacy, attitudes toward specialized science subjects, and academic performance) and then determine the nature and strength of the relationships among them, without manipulating any variables.

A descriptive-correlational design allows for the systematic collection of data to characterize the current status of phenomena (descriptive component) and to identify associations between variables (correlational component). This approach is grounded in the tradition of quantitative research methodology, which emphasizes objective measurement and statistical analysis to uncover patterns and make inferences about a population from a sample (Creswell & Creswell, 2018; Fraenkel, Wallen, & Hyun, 2012). The insights gained from identifying these relationships will then serve as an empirical basis for informing potential curriculum reengineering efforts.

Respondents

Stratified random sampling determined the 227 respondents across grades 7-10 (87% response rate), calculated using Raosoft with a 5% margin of error. Informed consent from parents/guardians and assent from students were obtained. A pilot study refined instruments and procedures. Participation was voluntary and confidential.

Instrument

A validated self-efficacy instrument developed by Peru et al. (2021), which was contextualized within a science setting, was used to measure students' perceptions of their capabilities to perform successfully in science-related tasks and overcome challenges. This adopted instrument utilizes a 4-point Likert scale to assess student confidence. From the pilot testing done on 25 randomly selected students, the self-efficacy instrument revealed a Cronbach's alpha of 0.937, which indicates excellent internal consistency reliability for the scale used in this context.

The Modified Attitudes Toward Science Inventory (mATSI) by Weinburgh and Steele (2000) is a well-validated, adopted instrument designed to assess student attitudes toward science. It comprises a total of 25 statements, categorized across five key aspects: Perception of the Science Teacher, Anxiety toward Science, Value of Science in Society, Self-concept of Science, and Desire to do Science. Participants respond to these statements using 4-point Likert scale (Strongly Disagree to Strongly Agree). The established scoring typically involves calculating a mean score for each aspect, with higher scores indicating a more positive attitude towards that specific aspect of science. The pilot testing done revealed a Cronbach's alpha of 0.954, which indicates high internal consistency reliability for the scale used in this context.

The final grades in the specialized science subject for the first semester served as the measure of academic performance. This data was obtained from official student records ensuring an objective measure of student achievement. These grades typically reflect a comprehensive combination of assessments, structured according to DepEd Order 8 s. 2015: 40% from Written Works (e.g., chapter tests, laboratory reports, essays, concept maps, data recording analyses, reaction or reflection papers, and surveys); 40% from Product or Performance-based Tasks (e.g., investigatory projects, models and diagrams construction, prototype building, research papers, debates, designing and implementation of action plans, designing various models, doing scientific investigations, issue awareness campaign, laboratory activities, multimedia presentations, simulations, skills demonstrations, and verification experiments); and 20% from Quarterly Examinations. These final grades are typically reported as a percentage from 70 as the lowest possible grade to 100 as the highest possible grade.

Procedure

Permission was secured from the principal. Information packages with consent and assent forms were distributed. Data were collected electronically via a secure online platform (Google Forms) with unique access links, ensuring confidentiality.

Data Analysis

SPSS was used for analysis:

Descriptive Statistics: Means, medians, standard deviations, and frequencies summarized self-efficacy, attitudes, and performance, as well as the distribution of self-efficacy sources and mATSI factors (Qualitative Descriptions provided).

Regression Analysis: Two analyses examined the influence of self-efficacy sources on overall self-efficacy and the prediction of overall attitudes by mATSI factors.

Correlation Analysis: Relationships between self-efficacy, attitude, and academic performance were explored.

Curriculum Reengineering Considerations: Findings informed potential curriculum improvements.

Ethical Considerations

The study involving minor participants underwent ethical review by Saint Mary's University Research Ethics Board (SMUREB). Voluntary participation, confidentiality, and anonymous feedback options were ensured. Parental consent and student assent were obtained. Potential conflicts of interest due to researcher-participant affiliation were addressed through ethical review and transparent consent processes. Data privacy and security were maintained through coding, secure storage, and eventual data destruction. Minimal risks were mitigated by allowing participants to skip questions and withdraw. The study aimed to benefit the Specialized Science curriculum. Informed consent detailed the study procedures and participant rights.

Results and Discussion

This section presents the findings of the study, organized according to the research questions. The results are discussed in relation to relevant literature, providing context, interpretation, and insights for potential curriculum reengineering.

Levels and Sources of Student Science Self-Efficacy

Table 1 presents the mean levels of students' self-efficacy across its four distinct sources and their overall science self-efficacy in specialized science subjects, categorized by grade level.

Table 1. *Students' Self-efficacy in the Different Special Science Subjects.*

Grade Level	*Mastery Experience*		*Social Persuasion*		*Vicarious Learning*		*Physiological and Emotional States*		*Overall Self-efficacy*	
Grade 7	3.13	MS	3.06	MS	3.16	MS	2.88	MS	3.06	MS
Grade 8	2.91	MS	2.80	MS	3.02	MS	2.40	MS	2.78	MS
Grade 9	3.02	MS	2.88	MS	3.01	MS	2.69	MS	2.90	MS
Grade 10	2.90	MS	2.99	MS	3.12	MS	2.49	MS	2.88	MS
Total	2.99	MS	2.92	MS	3.07	MS	2.61	MS	2.90	MS

***Legend**: 1.00–1.49 – Very Low Self-Efficacy (VLS); 1.50–2.49 – Low Self-Efficacy (LS); 2.50–3.49 – Moderate Self-Efficacy (MS); 3.50–4.00 – High Self-Efficacy (HS).*

Self-Efficacy from Mastery Experiences

As shown in Table 1, the overall mean for self-efficacy stemming from mastery experiences is 2.99 (Moderate Self-efficacy). This indicates that, on average, students in the specialized science curriculum possess a reasonable, but not consistently high, level of confidence derived from their past successes in understanding and applying science concepts. Grade 7 students reported the highest mean (3.13), suggesting a strong initial foundation in their transition into the specialized program, possibly due to recent successes or positive introductory experiences. Conversely, Grade 8 (2.91) and Grade 10 (2.90) exhibit slightly lower moderate scores, pointing to potential periods where students may encounter more significant challenges or experience occasional doubts despite their inherent aptitude. For example, the moderate scores for items like "I consistently perform well on assignments and quizzes in Special Science" suggest that while students generally perceive good performance, consistency in high achievement might fluctuate. Similarly, "Even challenging Special Science" topics make sense to me after I put in the effort to learn them" implies that effort is recognized, but full conceptual grasp may still be challenging for some.

This finding aligns with Bandura's (1986) Social Cognitive Theory, which identifies mastery experiences as the most powerful source of self-efficacy. The moderate levels observed suggest that while students have experienced some success, there is significant room for strengthening their belief through more consistent and impactful mastery opportunities. A meta-analysis by Oje, Adesope, and Oje (2021) supports this, demonstrating a statistically significant, moderate positive effect of hands-on learning on STEM students' self-efficacy (d = 0.51). This reinforces the notion that curriculum redesign should prioritize diverse and challenging hands-on activities that provide clear pathways to incremental success. Such targeted approaches, particularly in Grades 8 and 10 where scores are slightly lower, can directly address areas of doubt and bolster confidence in mastering complex science concepts, potentially leading to improved engagement and performance.

Self-Efficacy from Social Persuasion

Table 1 also reveals that students, on average, perceive a moderate level of self-efficacy (mean = 2.92) based on social persuasion within specialized science subjects. This indicates that while students receive some encouragement and constructive feedback, its potential to significantly boost their self-efficacy is not fully maximized. Grade 7 students again reported the highest mean (3.06), possibly reflecting the positive reinforcement they receive upon entering the specialized program. However, Grade 8 shows the lowest mean (2.80), suggesting a potential decrease in the perceived effectiveness or quantity of social persuasion during this crucial developmental period.

The moderate levels across grades highlight a clear opportunity for curriculum reengineering to enhance social persuasion. Research consistently emphasizes the importance of supportive interactions; for instance, Britner and Pajares (2006) underscore that positive verbal feedback from credible sources (like teachers and peers) can significantly influence academic self-efficacy, especially when paired with genuine effort. Therefore, interventions could include structured peer mentoring programs, collaborative learning projects that necessitate positive interdependence, and professional development for teachers on providing specific, constructive, and personalized feedback. Cultivating a truly supportive and collaborative classroom culture could directly address the observed moderate levels, particularly in Grade 8, and amplify the impact of social persuasion on students' science self-efficacy.

Self-Efficacy from Vicarious Learning

Student self-efficacy based on vicarious experiences is also shown in Table 1 to be at an overall moderate level (mean = 3.07). This suggests that while students are learning from observing others, the impact on their confidence in specialized science subjects could be more pronounced. Grade 7 students again lead with the highest mean (3.16), while Grade 8 shows the lowest (3.02), with Grades 9 and 10 maintaining consistent moderate scores. The relatively uniform distribution of scores across grades suggests a consistent, but not exceptional, role for observational learning.

Bandura (1986) highlights vicarious experiences as a key source of self-efficacy, where observing successful models—especially those perceived as similar to oneself—can foster beliefs in one's own capabilities. The moderate scores indicate that students could benefit from more structured and diverse opportunities to observe successful peers, guest speakers from STEM fields, or demonstrations by experts. Curriculum redesign should therefore incorporate strategies to enhance vicarious learning, such as inviting scientists or engineers to speak, showcasing diverse pathways in STEM, implementing peer demonstration sessions, or utilizing educational videos featuring successful individuals applying science concepts. These initiatives could provide more compelling and relatable models, ultimately boosting student confidence and engagement in specialized science subjects.

Self-Efficacy from Physiological and Emotional States

Table 1 presents student self-efficacy based on physiological and emotional states, revealing an overall moderate level (mean = 2.61). However, this score is notably close to the low self-efficacy threshold, indicating that a significant portion of students experience negative emotional or physical influences (e.g., anxiety, stress) that impact their confidence in science. Grade-level variations highlight a concerning trend: while Grade 7 exhibits moderate self-efficacy (2.88), Grades 8 (2.40) and 10 (2.49) fall within the low self-efficacy range for this specific source. This suggests that as students progress through the curriculum, they may face increasing academic pressures or personal anxieties that significantly undermine their self-efficacy. The relatively broad standard deviations across all grades further indicate wide variability in how emotional and physical states affect individual students.

This finding aligns with previous research indicating that anxiety and stress can significantly hinder academic performance and self-efficacy (e.g., Mao et al., 2021). The particularly low scores in Grades 8 and 10 underscore a critical need for targeted interventions. Curriculum redesign must incorporate strategies to address physiological and emotional states, such as integrating stress management techniques, mindfulness exercises, and fostering a psychologically safe and supportive learning environment. Science teachers should be equipped to actively address student anxiety, ensure a non-threatening space for questions, and provide adequate preparation support for assessments. As Hayat et al. (2020) demonstrated the connection between positive emotions, self-efficacy, and learning strategies, prioritizing emotional well-being within the curriculum can directly enhance student self-efficacy and overall learning outcomes in specialized science.

Overall Science Self-Efficacy

As presented in Table 1, the overall self-efficacy of students towards specialized science subjects reveals a consistent moderate level (mean = 2.90) across all grade levels (ranging from 2.78 for Grade 8 to 3.06 for Grade 7). This indicates that, on average, students in the specialized science curriculum perceive themselves as moderately capable in these subjects. This result is consistent with the findings of Hasanah et al. (2021), who also reported a medium (moderate) level of science self-efficacy among junior high school students in both private and public schools. This consistency across different contexts suggests that achieving higher levels of science self-efficacy among junior high students remains a widespread challenge, even in specialized programs.

The observed moderate overall self-efficacy, while positive, suggests that there is substantial room for growth to reach a "high self-efficacy" level. As Bandura (1986) posited, higher self-efficacy is associated with greater effort, persistence, and resilience in the face of challenges. Therefore, the curriculum redesign should adopt a holistic approach, focusing on strategies that improve overall self-efficacy by reinforcing all four sources. This includes providing more explicit opportunities for mastery experiences, fostering a consistently supportive learning environment through social persuasion, integrating diverse and relatable vicarious learning models, and proactively addressing students' physiological and emotional states related to science learning, particularly for the identified lower-scoring grades (8 and 10). By doing so, the curriculum can move students beyond moderate confidence to a robust belief in their scientific capabilities, leading to enhanced engagement and higher academic achievement.

Influence of Self-Efficacy Sources on Overall Self-Efficacy

Table 2 presents the results of a regression analysis illustrating the influence of the four distinct self-efficacy sources—mastery experiences, social persuasion, vicarious learning, and physiological and emotional states—on students' overall science self-efficacy in specialized science subjects.

Table 2. *Influence of the Four Sources of Self-Efficacy on the Overall Students' Self-Efficacy*

Sources of Self-efficacy	*Standardized Coefficients (Beta)*	*t*	*sig*
(Constant)	0.002	1.217	0.225
Mastery Experience	0.308	443.424	<0.0005
Social Persuasion	0.467	681.062	<0.0005
Vicarious Experience	0.331	482.155	<0.0005
Physiological and Emotional States	0.422	858.853	<0.0005

As depicted in Table 2, all four sources of self-efficacy—mastery experiences ($\beta = 0.308$, $p < 0.0005$), social persuasion ($\beta = 0.467$, $p < 0.0005$), vicarious experience ($\beta = 0.331$, $p < 0.0005$), and physiological and emotional states ($\beta = 0.422$, $p < 0.0005$)—demonstrated a highly statistically significant positive influence on students' overall science self-efficacy. This comprehensive significance across all sources confirms their individual importance as contributors to students' beliefs in their scientific capabilities within this specialized curriculum. This finding aligns with Bandura's (1986) Social Cognitive Theory, which posits that self-efficacy is cultivated through these multiple pathways.

A notable insight from the analysis is the relative strength of influence among the sources, as indicated by their standardized Beta coefficients. Social persuasion emerged as the strongest predictor of overall self-efficacy ($\beta = 0.467$), followed closely by physiological and emotional states ($\beta = 0.422$). Vicarious experience ($\beta = 0.331$) and mastery experience ($\beta = 0.308$) also exerted significant, though comparatively weaker, influences.

This finding, particularly the prominence of social persuasion and physiological/emotional states, offers a critical divergence from some previous research, such as the meta-analysis by Britner and Pajares (2006), which found mastery experiences to be the most potent predictor of academic self-efficacy among adolescents. This difference may be attributable to several factors unique to the present study's context. Firstly, the respondents are Filipino junior high school students, whose cultural context might emphasize the importance of social approval, collective effort, and emotional support in academic settings more strongly than individual mastery alone (Church, 1987; David, 2009; Triandis, 1995).

In a collectivist culture, the validation and encouragement received from teachers and peers (social persuasion) and the emotional comfort derived from a supportive learning environment (physiological and emotional states) can profoundly impact an individual's self-belief and willingness to persevere in challenging subjects like specialized science.

Secondly, the specialized nature of the science curriculum itself, which can be inherently challenging, might amplify the need for external encouragement (social persuasion) and effective emotional coping mechanisms to sustain self-belief when mastery experiences are not consistently overwhelmingly positive. For instance, students might rely more on their teachers' belief in them (social persuasion) or their ability to manage anxiety (physiological states) when encountering difficult concepts, as reflected by the lower moderate scores in physiological states for Grades 8 and 10 in Table 1.

The significant influence of social persuasion underscores the critical role of teachers, peers, and parents in fostering student confidence. Positive verbal feedback, constructive criticism, and encouragement from these credible sources appear to be exceptionally powerful in shaping self-efficacy in this context.

Similarly, the substantial impact of physiological and emotional states highlights the necessity of addressing students' stress, anxiety, and comfort levels in the learning environment. This suggests that effective emotional regulation and a supportive classroom atmosphere are not merely supplementary but are primary drivers of self-efficacy.

Therefore, curriculum reengineering efforts should not solely focus on providing mastery opportunities but must also strategically integrate robust mechanisms for social persuasion and emotional support. Initiatives such as structured teacher-student feedback sessions, peer mentoring programs, and explicit strategies for managing academic stress and anxiety within science instruction are likely to yield substantial improvements in students' overall self-efficacy within this specialized science curriculum.

Levels of Students' Attitudes Towards Specialized Science Subjects

Table 3 presents the students' attitudes towards specialized science subjects, disaggregated by grade level and across five key attitudinal factors: Value of Science in Society, Self-Concept in Science, Anxiety Towards Science, Desire to Do Science, and Perceptions of Science Teacher. The attitudes were measured using a 4-point Likert scale, with interpretation guides provided at the bottom of the table.

Table 3. *Students' Attitude Towards the Specialized Science Subjects*

Grade Level	*Value of Science in Society*		*Self-Concept in Science*		*Level of Anxiety towards Science*		*Desire to do Science*		*Perceptions of Science Teacher*		*Overall Attitude*	
Grade 7	3.23	M	2.49	L	2.46	L	2.89	M	3.17	M	3.17	FME
Grade 8	3.36	M	2.74	M	2.24	L	2.92	M	3.18	M	3.18	FME
Garde 9	3.40	M	2.60	M	2.22	L	2.72	M	3.04	M	3.04	FME
Grade 10	3.39	M	2.64	M	2.34	L	3.00	M	3.30	M	3.30	FME
Total	3.34	M	2.62	M	2.31	L	2.87	M	3.16	M	3.16	FME

Legend*: 1.00–1.49 – Very Low (VL); 1.50–2.49 – Low (L); 2.50–3.49 – Moderate (M); 3.50–4.00 – High (H)*
Overall: *1.00–1.49 – Favorable to a Very Little Extent (FVLE); 1.50–2.49 – Favorable to a Little Extent (FLE); 2.50–3.49 – Favorable to a Moderate Extent (FME); 3.50–4.00 – Favorable to a Great Extent (FGE).*

Value of Science in Society

As indicated in Table 3, students' perception of the value of science in society registered an overall mean score of 3.34, falling within the "Moderate Value" category. This suggests that while students acknowledge the importance of science, they may not yet fully grasp its extensive societal implications and profound impact on various aspects of life. The consistency of mean scores across all grade levels (ranging from 3.23 to 3.39) within this "Moderate Value" category implies that students' recognition of science's societal utility remains stable throughout their junior high school years. This perception aligns with the utility value component of Eccles' Expectancy-Value Theory (2002), which posits that students are motivated by tasks they perceive as useful for their future goals or society.

This moderate perception highlights an opportunity for curriculum enhancements. Research consistently shows that connecting learning to real-world applications and societal relevance significantly enhances student engagement and value perception (Akben, 2020; National Research Council, 2012). For instance, explicit discussions and activities demonstrating how science solves everyday problems, contributes to national development, or opens up career opportunities (as reflected in survey items like "Science is useful for solving the problems of everyday life" and "It is important to know science to get a good job") can elevate students' appreciation for science. Furthermore, linking this finding to self-efficacy (as observed in Table 1), a moderate feeling of success in science may naturally lead to a moderate perception of its value. By emphasizing the tangible benefits and broader impact of scientific knowledge, the curriculum can foster a deeper appreciation for science beyond the classroom, potentially strengthening both its perceived value and student engagement.

Self-Concept in Science

Table 3 shows that students' self-concept in science yielded an overall mean score of 2.62, falling into the "Moderate" category. This suggests that students generally feel capable in science but may not view themselves as highly proficient or exceptional science learners. While most grade levels reported moderate self-concept, Grade 7 (2.49) registered a "Low" self-concept, marking a notable dip during this transition year. This lower confidence in Grade 7 could be attributed to the increased academic rigor, the introduction of more complex specialized science concepts, or adjustments to a new learning environment. For instance, items like "I do not do very well in science" or "I often think, 'I cannot do this,' when a science assignment seems hard" may contribute more significantly to negative self-perceptions for these younger students.

This finding is crucial given the strong link between self-concept and academic performance, as articulated by Shavelson, Hubner, and Stanton (1976), where self-concept is a multifaceted construct influencing behavior. The moderate self-concept scores observed here are consistent with the moderate self-efficacy scores detailed in Table 1, reinforcing the intrinsic connection between a student's belief in their abilities and their overall self-perception as a learner. The particularly low self-concept in Grade 7 suggests a strong likelihood of correspondingly lower self-efficacy within this grade level, highlighting a critical point for intervention. To enhance students' self-concept, the curriculum and teaching strategies must be deliberately designed to provide frequent opportunities for success, offer specific and positive feedback that validates effort and progress, and foster a sense of belonging in the science classroom (e.g., through collaborative learning). Emphasizing students' growth and celebrating small achievements can significantly contribute to building a stronger self-concept, particularly in the foundational Grade 7, ultimately promoting more positive attitudes and greater academic achievement in specialized science.

Anxiety Towards Science

The data in Table 3 indicates that students, on average, exhibit a low level of anxiety towards science, with an overall mean score of 2.31. All grade levels consistently reported mean scores below 2.5, placing them within the "Low" anxiety category. This suggests that the majority of students in the specialized science curriculum do not experience high levels of nervousness or apprehension related to science. This positive finding aligns with the expectation that students pre-selected for science aptitude might naturally experience less anxiety.

The observed low anxiety levels are a favorable condition for learning, as high anxiety is known to impede cognitive processing and performance (Tobias, 1985). This finding also correlates positively with the moderate self-efficacy and self-concept scores observed in Table 1 and in the preceding discussion, reinforcing the idea that students who experience less anxiety toward science are more likely to hold positive beliefs about their abilities and themselves as science learners. To maintain these beneficial low anxiety levels, science teachers should continue to cultivate a supportive and non-threatening learning environment, ensure clear and concise instructions, and provide ample opportunities for students to experience success. While generally low, the slightly higher anxiety levels in Grade 7 (2.46) could be addressed through targeted orientation sessions or early intervention strategies to ease the transition into the specialized program, ensuring a comfortable and confident start to their science learning journey.

Desire to Do Science

As shown in Table 3, students' desire to do science registered an overall moderate level, with a mean score of 2.87. This suggests that while students generally have a positive inclination towards science, their passion for the subject may not be overwhelmingly strong. The mean scores across all grade levels (ranging from 2.72 to 3.00) consistently fall within the "Moderate" category, indicating a stable level of interest throughout their secondary education in the specialized program.

This moderate desire aligns with the intrinsic value and attainment value components of Eccles' Expectancy-Value Theory (2002), where interest and the importance of doing well in a subject drive engagement. While positive, the moderate level implies room for further enhancement to foster deeper intrinsic motivation. Research by Hidi and Renninger (2006) on interest development suggests that engaging activities and real-world relevance can deepen situational interest into individual interest. Therefore, to effectively enhance student engagement and intrinsic motivation, science teachers should implement strategies that go beyond basic enjoyment. This includes incorporating more hands-on activities, promoting student choice and autonomy in projects, explicitly connecting science learning to students' real-world interests and potential career aspirations, and fostering a stimulating and challenging yet supportive learning environment. Such approaches can help to elevate students' desire to actively pursue science-related activities and knowledge beyond the classroom.

Perceptions of Science Teacher

Table 3 also presents students' perceptions of their science teachers, with an overall mean score of 3.16, indicating a moderate perception. This suggests that students generally view their teachers as effective and competent, but perhaps not consistently exceptional in fostering engagement or providing highly individualized support. The mean scores across all grade levels (ranging from 3.04 to 3.30) are relatively stable within the "Moderate" category, implying a consistent level of positive perception throughout the junior high school years.

These findings underscore the significant role of the teacher, as highlighted by numerous educational studies (e.g., Darling-Hammond, 2010), in shaping the overall learning experience. Positive teacher perceptions can directly influence student self-efficacy, self-concept, desire to engage in science, and even reduce science anxiety, as teachers are key agents of social persuasion and create the classroom climate. When students view their teachers as clear, understandable, interesting, and supportive, they are more likely to be motivated and engaged in the learning process, leading to improved academic outcomes. To enhance students' perceptions of their science teachers, professional development could focus on strategies for maximizing student engagement, building even stronger teacher-student relationships beyond competence (e.g., through active listening, personalized interaction), and consistently demonstrating genuine enthusiasm for science. Targeted interventions may be beneficial for grades where perceptions are slightly lower, such as Grade 9, to ensure consistent positive interactions and a highly favorable learning atmosphere for all students.

Overall Attitudes Towards Specialized Science Subjects

As reflected in Table 3, students' overall attitudes towards specialized science subjects show a mean score of 3.16, falling within the "Favorable to a moderate extent" range. This indicates that students generally hold a positive attitude towards these specialized subjects, recognizing their merits and agreeing with their positive aspects, though their enthusiasm may not be overwhelmingly strong or passionate. The consistency of this "Favorable to a moderate extent" across all grade levels (ranging from 3.04 to 3.30) suggests a relatively stable, moderately positive outlook throughout their junior high school specialized science education.

This moderately favorable attitude is a crucial starting point, as positive attitudes are strongly linked to increased engagement, persistence, and academic achievement in science (e.g., Potvin & Hasni, 2014). The observed moderate scores are consistent with the moderate levels seen across the individual attitudinal factors and the moderate self-efficacy scores (Table 1), indicating a strong interconnectedness among these variables as components of students' overall motivational profiles. This corroborates the findings of Pedrona (2020), which also suggested a strong relationship between students' overall perceptions of various factors affecting their science-related attitudes and their academic performance. Consequently, it is reasonable to infer that enhancing any of the contributing attitudinal factors (value perception, self-concept, desire, teacher perception, and anxiety reduction) or improving self-efficacy would synergistically contribute to an improvement in the overall student attitude towards specialized science. Curriculum redesign should thus focus on a holistic approach that not only strengthens self-efficacy but also consistently reinforces the value, fosters positive self-concept, reduces anxiety, and enhances students' desire to do science by making the subjects more engaging, relevant, and intrinsically motivating.

Influence of Attitudinal Factors on Overall Student Attitude Towards Specialized Science Subjects

Table 4 presents the results of a multiple regression analysis investigating the influence of five key attitudinal factors—Perceived Value of Science in Society, Desire to do Science, Self-Concept in Science, Anxiety toward Science, and Perception of Science Teachers—on students' overall attitude toward specialized science subjects.

Table 4. *Influence of Factors of Attitude on the Overall Students' Attitude toward the Specialized Science Subjects*

Factors	*Standardized Coefficients (Beta)*	*t*	*sig*
(Constant)	.001	.795	.427
Perceived Value of Science in Society	.278	1371.900	.000
Desire to do Science	.541	2410.467	.000
Self-concept in Science	.342	1420.021	.000
Anxiety toward Science	.370	1601.314	.000
Perception of Science Teachers	.203	970.397	.000

As shown in Table 4, the regression analysis indicates that all five attitudinal factors—Perceived Value of Science in Society (β = 0.278, $p < 0.001$), Desire to do Science (β = 0.541, $p < 0.001$), Self-Concept in Science (β = 0.342, $p < 0.001$), Anxiety toward Science (β = 0.370, $p < 0.001$), and Perception of Science Teachers (β = 0.203, $p < 0.001$)—demonstrate a highly statistically significant positive influence on students' overall attitude toward specialized science subjects. The consistent significance across all factors confirms their crucial role in shaping student attitudes, underscoring the multifaceted nature of attitudes toward science (Osborne et al., 2003).

Examining the standardized Beta coefficients reveals the relative strength of each factor's influence.

Desire to do Science (β = 0.541) emerged as the strongest predictor of overall attitude. This highlights the profound impact of students' intrinsic motivation and genuine interest in engaging with science. This finding aligns strongly with Expectancy-Value Theory (Eccles et al., 1983), where intrinsic and utility values (which contribute to "desire") are central drivers of choice and persistence in academic domains. When students genuinely enjoy and want to pursue science, their overall attitude is significantly more favorable. Therefore, educational practices must prioritize fostering this intrinsic desire through engaging, hands-on, and personally relevant learning experiences (Hidi & Renninger, 2006).

Anxiety toward Science (β = 0.370) exhibited the second strongest influence. The negative correlation implied by the phrasing (lower anxiety means better attitude) underscores the critical role of emotional well-being. This result is consistent with extensive research demonstrating that high anxiety can significantly impede positive attitudes and learning (Uitto, Laine & Plihtari, 2021). The finding suggests that cultivating a supportive and non-threatening learning environment, providing clear expectations, and offering strategies for stress management are paramount not just for self-efficacy (as seen in Table 2) but also for shaping a positive overall attitude towards science.

Self-Concept in Science (β = 0.342) was the third most influential factor. This strong relationship underscores the importance of students' beliefs about their own competence as science learners. A positive self-concept fosters confidence, which in turn leads to more favorable attitudes and greater willingness to engage with the subject (Shavelson et al., 1976). This finding reinforces the interconnectedness between self-efficacy and self-concept discussed in Table 1 and Table 3. Building students' self-belief through opportunities for success and constructive feedback is thus essential.

Perceived Value of Science in Society (β = 0.278) showed a substantial, albeit fourth, influence. When students perceive science as relevant and important to their lives and societal development, they are more likely to develop positive attitudes. This aligns with research emphasizing the importance of relevance in science education for fostering positive attitudes (e.g., Holbrook & Rannikmäe, 2009). Curriculum should continually emphasize real-world applications and societal contributions of science to enhance this perception.

Perception of Science Teachers (β = 0.203), while having the weakest relative influence among the significant factors, still plays a meaningful role in shaping overall student attitude. This result corroborates the general understanding that positive teacher-student relationships and effective instructional delivery contribute to a favorable learning environment (Darling-Hammond, 2010). Although less impactful than intrinsic desire or emotional state, teachers who make science interesting, present material clearly, and offer individual help (as measured in this factor) still contribute positively to students' attitudes.

These findings highlight that fostering a positive overall attitude toward specialized science subjects requires a multifaceted approach. While students' desire to do science is the most potent leverage point, proactively addressing anxiety and bolstering self-concept are equally critical for cultivating sustained positive attitudes. Furthermore, consistently emphasizing the value of science in society and ensuring positive perceptions of science teachers provide foundational support. These insights underscore the importance of educational practices that prioritize student motivation, emotional well-being, and a sense of competence, all within a supportive and engaging learning environment.

Academic Performance in Specialized Science Subjects

Table 5 presents the academic performance of students in the specialized science subjects across different grade levels, measured by their final grades for the first semester and categorized by DepEd proficiency levels.

Table 5. *Academic Performance of the Students in the Specialized Science Subjects*

	N	*Mean*	*SD*	*Proficiency levels*
Grade 7	57	90.89	2.87	Highly Proficient
Grade 8	69	87.33	5.46	Proficient
Grade 9	64	89.32	3.11	Proficient
Grade 10	37	91.41	2.76	Highly Proficient
Total	227	89.45	4.18	Proficient

DepEd Proficiency Levels: Highly Proficient – 90–100; Proficient – 75–89; Nearly Proficient – 50–74; Low Proficient – 25–49; Not Proficient – 0–24.

As displayed in Table 5, the overall academic performance of students in the specialized science subjects is Proficient (mean = 89.45, SD = 4.18). This aggregate finding is noteworthy, indicating that students in this specialized program generally achieve a strong level of mastery in their science coursework. Upon closer examination of the grade levels, both Grade 7 (mean = 90.89, SD = 2.87) and Grade 10 (mean = 91.41, SD = 2.76) achieved a Highly Proficient status. This suggests that students perform exceptionally well in their introductory year of the specialized curriculum and again in their culminating year. In contrast, Grade 8 (mean = 87.33, SD = 5.46) and Grade 9 (mean = 89.32, SD = 3.11) maintained a Proficient level. The slightly lower mean in Grade 8 and higher standard deviation suggest a greater variability in performance, indicating a period where some students may face more significant academic challenges.

These performance levels are generally expected within a specialized science curriculum, where students are pre-selected based on aptitude and receive focused instruction. However, the variations observed across grade levels warrant further discussion, especially when considered alongside the findings on self-efficacy and attitudes. For instance, the transition year of Grade 8, where we observed a "Low" self-efficacy from physiological/emotional states (Table 1) and the lowest self-concept (Table 3), appears to correlate with its "Proficient" but comparatively lower academic performance and higher variability. This alignment supports the established educational psychology literature, which consistently demonstrates a positive relationship between self-efficacy, positive attitudes, and academic performance (e.g., Bandura, 1997; Schunk & Pajares, 2009; Wigfield & Eccles, 2000). Students with higher self-efficacy are more likely to persevere through challenging tasks, while positive attitudes foster engagement and motivation, all contributing to improved academic outcomes.

Specifically, the "Highly Proficient" status in Grade 7 and 10 might be bolstered by their relatively higher self-efficacy for physiological/emotional states (Grade 7) and sustained moderate self-efficacy (Table 1), along with their generally favorable attitudes (Table 3). Conversely, the "Proficient" but comparatively lower performance in Grade 8 and 9, particularly in Grade 8, could be linked to the observed dips in self-efficacy sources (Table 1) and self-concept (Table 3), suggesting a potential interconnectedness.

The consistent achievement of proficient or highly proficient academic performance, despite moderate overall self-efficacy and attitudes (as discussed in Tables 1 and 3), suggests that while students are meeting expected standards, there is potential for further enhancement. By strategically enhancing students' self-efficacy and fostering more robustly positive attitudes—particularly focusing on areas where slight dips or lower influences were noted (e.g., self-concept in Grade 7, physiological/emotional states in Grade 8 and 10, and overall self-efficacy in Grade 8)—the curriculum could potentially push more students into the "Highly Proficient" category and minimize variability. These findings underscore that targeted interventions aimed at strengthening students' beliefs in their capabilities and cultivating more profoundly favorable attitudes could serve as a powerful leverage point for further elevating academic performance in the specialized science curriculum.

Relationship Among Students' Self-Efficacy, Attitude, and Academic Performance

Table 6 presents the results of a Pearson correlation analysis, which examines the linear relationships between students' overall self-efficacy, their overall attitude toward specialized science subjects, and their academic performance.

Table 6. *Relationship among Students' Self-efficacy, Attitude, and Academic Performance in the Specialized Science Subjects*

Pair of variables	*Pearson r*	*p-value*
Self-efficacy, Attitude	.561**	<.0005
Self-efficacy, Academic Performance	.088	.188
Attitude, Academic Performance	-.070	.294

***. Correlation is significant at the 0.01 level (2-tailed)*

As shown in Table 6, a strong, statistically significant positive correlation was observed between students' self-efficacy and their attitudes toward science (Pearson r=.561, p<.0005). This finding indicates that students who possess higher levels of self-efficacy in specialized science tend to exhibit more favorable attitudes toward the subject, and conversely, those with more positive attitudes are likely to report higher self-efficacy. This reciprocal relationship is well-established in educational psychology literature. Bandura's (1986) Social Cognitive Theory posits that self-efficacy influences behavior (like engagement and attitudes), and successful experiences (which affect self-efficacy) can also lead to more positive attitudes. Similarly, Expectancy-Value Theory (Eccles et al., 1983) suggests that an individual's beliefs about their competence (self-efficacy) are intricately linked to their subjective task values (attitude). This strong interdependence aligns with our descriptive findings from Table 1 (moderate self-efficacy) and Table 3 (favorable to moderate attitudes), reinforcing the notion that these two psychological constructs are deeply intertwined within the context of specialized science education. This result reinforces and is consistent with the findings of Retni S. et al. (2021) that a significant relationship between attitude and self-efficacy exists.

Conversely, the analysis revealed a weak and non-significant correlation between self-efficacy and academic performance (Pearson r=.088, p=.188). Similarly, the correlation between attitude and academic performance was also weak and non-significant (Pearson r=−.070, p=.294). These findings suggest that, for this cohort of specialized science students, neither self-efficacy nor attitude alone is a direct or primary predictor of their academic performance.

This non-significant direct correlation is a crucial finding that warrants further interpretation, especially given the common expectation in literature for positive relationships (e.g. Robbins et al., 2004, found significant correlations between academic attitudes/skills and college outcomes; Wigfield & Eccles, 2000, emphasize the link between expectancy-value constructs and achievement). However, our result might be explained by several contextual factors. Firstly, as shown in Table 5, the students in this specialized program already demonstrate proficient to highly proficient academic performance. This high baseline performance across the cohort might lead to a restriction of range, where variations in self-efficacy or attitudes do not translate into discernible differences in already high grades. In such a scenario, other factors such as inherent cognitive ability, effective study habits, access to high-quality resources, or the structure and rigor of the specialized curriculum itself may exert a more dominant influence on academic outcomes, especially for a homogenous group of high-achieving students.

Furthermore, our findings appear to diverge from some studies, such as Pedrona (2020), who emphasized a strong relationship between students' perceptions of science-related attitudes and academic performance. This discrepancy could be attributed to differences in specific populations studied (e.g., general science vs. specialized science students), the precise instruments used to measure attitude and performance, or variations in the overall educational context. While Pedrona's work highlights the general importance of attitudes, our specific findings suggest that within an already high-performing specialized science context, the direct linear predictive power of attitude and self-efficacy on grades might be less pronounced than other contributing factors.

The overall implications of Table 6 highlight a critical insight for curriculum reengineering. While fostering strong self-efficacy and positive attitudes in specialized science students is undoubtedly important due to their robust interrelationship, these factors are not the sole determinants of academic performance in this high-achieving context. Therefore, a holistic approach is essential. Science educators should continue to implement strategies aimed at enhancing self-efficacy and attitudes, recognizing their value in fostering motivation, engagement, and persistence. However, to further elevate academic performance or address the subtle variations observed across grades (e.g., Grade 8 in Table 5), interventions must also explicitly target cognitive factors, advanced study skills, critical thinking, problem-solving strategies, and perhaps even specific instructional methodologies designed for high-ability learners. This balanced approach ensures that while psychological readiness is cultivated, the necessary cognitive tools for exceptional academic achievement are also sharpened.

Conclusions

This study sought to describe the levels of self-efficacy, attitudes, and academic performance in specialized science subjects among junior high school students, and to investigate the relationships among these variables. The findings reveal a complex interplay where students generally exhibit moderate self-efficacy and favorable attitudes, contributing to proficient to highly proficient academic performance. While mastery experiences remain foundational, social persuasion and physiological/emotional states emerged as particularly influential sources of self-efficacy in this context, suggesting the significant role of social support and emotional well-being. Furthermore, students' desire to engage in science, coupled with low anxiety levels and a positive self-concept, are strong predictors of their overall positive attitude toward the subject. Crucially, a robust positive correlation was observed between self-efficacy and attitude, indicating that these two psychological constructs are deeply intertwined. However, it was also found that neither self-efficacy nor attitude demonstrated a direct, significant correlation with academic performance in this high-achieving cohort.

These findings carry significant implications for teaching practice and curriculum design in specialized science education. Firstly, educators should not solely focus on providing mastery experiences, but must strategically leverage social persuasion through consistent encouragement, affirmation of students' capabilities, and highlighting their collective efforts. Simultaneously, creating a psychologically safe and supportive learning environment that helps students manage anxiety and foster positive physiological/emotional states is paramount for building self-efficacy. Secondly, to cultivate strong, positive attitudes, efforts should prioritize igniting and sustaining students' desire to do science through engaging, real-world applications and fostering intrinsic motivation. Addressing and maintaining low anxiety levels through clear expectations and supportive feedback, alongside building a strong self-concept through opportunities for success, are equally vital. While positive perceptions of science teachers also contribute, the most impactful strategies involve fostering students' intrinsic motivation and emotional resilience. The absence of a direct correlation between self-efficacy/attitude and academic performance in this high-performing group implies that while these psychological factors are critical for engagement and well-being, curriculum reengineering should also explicitly address cognitive factors, advanced study skills, and problem-solving strategies to further elevate achievement among already capable learners. Therefore, a holistic approach that simultaneously targets both attitudinal and cognitive dimensions is recommended to ensure sustained success and deeper engagement in specialized science.

Despite these valuable contributions, this study is subject to several limitations that inform directions for future research. Being a cross-sectional, correlational study, it cannot establish causality or track developmental changes over time. The reliance on self-report measures for self-efficacy and attitudes, coupled with the specificity of the sample from a single specialized science high school, limits the generalizability of the findings to broader educational contexts. Most notably, the non-significant correlations between self-efficacy/attitude and academic performance in this high-achieving student group necessitate further investigation into other potentially more dominant factors influencing their grades, such as inherent cognitive abilities, comprehensive learning strategies, or socio-economic influences. Therefore, future research would greatly benefit from employing longitudinal designs to understand developmental trajectories, incorporating qualitative components (e.g., interviews, focus groups) to gain deeper, nuanced insights into student experiences, and exploring additional variables that might account for academic performance variance in specialized and high-achieving cohorts. Furthermore, comparative studies across different types of schools (e.g., non-specialized science programs) could provide valuable insights into the generalizability of these findings.

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