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Unveiling the Barriers to Science Learning Among Low-Performing Non-Stem Senior High School Students in Science: A Basic Psychological Need Theory Perspective

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Abstract — Low-performing non-STEM senior high school students often struggle in science, yet the underlying psychological factors behind this issue are underexplored. Anchored on the Basic Psychological Needs Theory, this study examined the connections between frustrations of autonomy, competence, and relatedness, proposing that learning barriers are manifestations of these psychological needs. The study aimed to (1) identify the specific barriers experienced by non-STEM students in learning science and (2) determine whether these barriers significantly predict their self-efficacy in learning science. A total of 336 low-performing non-STEM students participated, and a researcher-made Barriers to Science Learning Scale and Self-efficacy for Learning Form were administered. The latent factors were determined by the use of Exploratory Factor Analysis, and the correlation between the barriers and self-efficacy was tested using descriptive statistics and multiple regression. Four major barriers emerged: social exclusion, conceptual difficulty, inflexible instruction, and failure expectancy. These barriers reflect frustrations in relatedness, competence, and autonomy. Regression analysis showed that none of the identified barriers were significant predictors of self-efficacy, suggesting a more complex, indirect relationship, possibly mediated by motivational quality and engagement over time. The barriers to science learning seem to stem from psychological need rather than inability. Science teachers should adopt need-supportive instructional practices - encouraging autonomy, providing competence scaffolds, and fostering meaningful teacher-student and peer relationships.

Keywords: barriers. science learning, psychological needs, exploratory factor analysis, self-efficacy

I. INTRODUCTION

A significant trend in science education is the pervasive difficulty non-STEM senior high school students face. Anecdotal observations from classroom interactions and preliminary discussions with educators suggest a pattern of severe challenges in comprehending scientific concepts, methods, and real-world applications. This is supported by research indicating that such difficulties are widespread among this demographic, with studies reporting similar challenges across diverse settings and cultures (Prabha, 2020). These struggles do not merely hinder academic progress; they also erode students' confidence and interest, thereby affecting their overall engagement in science learning processes.

Students often face challenges learning scientific content and fear asking questions in class due to ridicule or judgment (Buban 2023; Prabha, 2020). This reluctance to clarify further increases their difficulties, leaving them with gaps in understanding that affect both their content knowledge and practical application. These challenges result in poor performance in most domains of scientific literacy, including content knowledge, scientific practices, social understanding, and functionality (Ganajová et al., 2025).

Riza and Andayani (2024) pointed out that certain teaching methods, among all other things, can have an impact on the development of students' interest. Educators must take into account that something more needs to be done, especially in teaching -learning approaches, by realizing that students are diverse and have different difficulties and learning styles, to improve students' academic performance (Cardino & Cruz, 2020). Widlund et al. (2024) also suggested that parents and teachers should be aware of how motivational beliefs might affect students' motivational beliefs and, consequently, students' educational choices. By understanding these barriers from the student's point of view, teachers can gain critical information about certain obstacles, including areas where the students feel unsupported, confused, or rejected. This only means that educators should actively seek and value students' insight about their struggles or barriers in science learning.

While exploring these, it aims to expose the barriers and point out the channels that guide educators and program implementers toward the solutions. Knowing various issues affecting student opinions concerning the complexity of science can be helpful for teachers trying to promote a broader understanding and more accommodating teaching methods. Addressing issues distinctive to science subjects will help us narrow the gap between the subject's complexity and students' preferences.

Literature Review

Students learning problems in science are frequently associated with understanding science concepts, which could result in misconceptions affecting students' learning experience. Students' attitudes may affect their science process skills, which could greatly determine their science achievements. Moreover, many other things, including motivation towards learning, self-efficacy, fear of science, knowledge of science, view on science teachers, participation in science-related activities, and interest in pursuing science-related jobs affect student's attitude to learning (Nishimura et al., 2020).

Difficulties in Learning Science

Science is often perceived as a difficult subject because it involves abstract concepts, technical language, and complex processes. Many students encounter difficulties in understanding scientific concepts and applying them to real-life situations (Amaliyah & Fajar, 2024). Various studies have shown that poor students from low-income families, certain races, and rural areas obtain poor results in mathematics and science (Banerjee, 2016;Tomul et al., 2021).

Although some students have reasonably good content knowledge in natural science subjects, there is insufficient procedural knowledge (knowing how to do something) and epistemic knowledge – understanding the reasoning behind how something is done (Bellova et al., 2018). Reyna et al. (2025) explained the intricacies that define science education, identifying a number of barriers that students must navigate. Among these is cognitive overload, which is a process in which a student is overwhelmed by the mass and the complexity of scientific information, leaving them unable to process and integrate the new information. Therefore, they are unable to utilize them in problem-solving activities.

This is supported by another study, which explained that the number one factor for students' difficulty in understanding something is their lack of science vocabulary (Buban, 2023). When one lacks the basic necessary knowledge, as essential as vocabulary, it would be difficult to understand and do other tasks such as doing calculations, answering questions, and translating problems to what is asked, which is very common in a science learning process. In the same study, when asked, "When people speak science concepts to you, how much do you understand?" 50% admitted that, although they can speak some of the science concepts fluently, some other ideas are not fully understood. This can be linked to their difficulty in science vocabulary and reading ability in science (Buban, 2023). When this happens, students are likelier to shy away from speaking their minds, fearing that they might get laughed at for having a poor understanding of science. These difficulties can lead to negative learning experiences, reduced interest in science, and lower academic performance.

Effects of Difficulties on Learning

Learning difficulties can influence students' engagement and persistence in science learning. When students repeatedly encounter challenges in understanding scientific concepts, they may develop negative attitudes toward the subject. Reyna et al. (2025) highlight how contextual voids, cognitive overload, and these educational discrepancies compound these difficulties and affect students, and lead to them performing poorly in classes. The cumulative effect of these is a situation where students, especially those who are already struggling, will have a more difficult time to effectively interact with science content. Based on the study, students who blame failure on factors within their control, such as ineffective strategies, are more likely to improve their performance, whereas those who attribute it to uncontrollable factors, such as poor ability, tend to perform poorly.

Tanquilan and Lomibao (2025) define the mathematical preparedness gaps as a key problem that non-STEM students have to deal with. This mismatch between the preparation and course requirements of students propagates in a series of problem with no competence in mathematical instruments that science uses, students are not able to access the facts of science comprehensively, and this restriction inhibits their capacity to acquire the procedural and epistemic knowledge that science demands. The lessons affect student achievement due to difficulty, especially when facilitated instructions fail to meet cognitive loads. Difficulties are said to increase feelings of stress, helplessness, and frustration, which leads to low intrinsic motivation. These unfavorable effects of difficulty are compounded where students have high extraneous cognitive load because they disengage from learning tasks. The mathematical preparedness difficulty is not only cognitive but psychological as well. These experiences may contribute to avoidance behaviors and decreased participation in science-related activities.

Effects of Difficulties on Self-Efficacy

Students who realize that they are not skilled in what other students have may feel shame, anxiety, or hopelessness feelings that further enhance learning because they use cognitive resources that could be use to study content (Tanquilan & Lomibao, 2025). Self-efficacy is the level of confidence an individual has in his/her ability to execute specific behaviors to produce intended results. Students' beliefs about their ability to succeed in science significantly affect their confidence, motivation, and overall performance (Zhu & Luo, 2024). Chun (2022) have also stated that children of parents in professional occupations tend to outperform others who are not. This disparity could be due to the availability of resources, exposure to the enriched learning environment, and higher parent involvement that enhances students' confidence and self-efficacy in science learning.

Further supporting this perspective, Honicke et al. (2023) have discovered that students inherently use successful past performance information to build self-efficacy beliefs and, in turn, continue to rely on successive performance outcomes to make or enhance these beliefs. The problem is that, when self-efficacy is more contingent upon past performance, and low-performing students lack significant mastery experiences, they can have a hard time developing or maintaining the confidence they need to manage to endure the challenge, This cycle indicates that low achievers might have difficulty building or sustaining self-efficacy because failure results in experiences in science that are possibly recurrent. As a result, they may appear to be unmotivated and are not likely to put in the effort they need to overcome any barriers to learning science.

Self-efficacy affects achievement mediated by metacognitive self-regulation and critical thinking strategies (Paz-Baruch, 2025). This implies that the view of the students on their capabilities does not only determine their persistence but also their learning process-strategies that they use in order to comprehend complex information.

Importance of the Basic Psychological Needs

Oram and Rogers (2022) provided empirical evidence highlighting the universal importance of the three basic psychological needs for optimal functioning and overall well-being across cultures. It points out that as these needs are unmet, people experience ill-being, which may be associated with poor achievement in learning environments. Oram and Rogers (2022) emphasized that BPNT is relevant to fostering intrinsic motivation. In their study, it emphasized that established unmet psychological needs with negative academic behavior, such as procrastination and motivation. González-Arias et al. (2025) discovered that the need satisfaction has an indirect impact on academic performance by influencing motivation and positive effect. Students whose need of autonomy, competence and relatedness were met had more autonomous motivation-attended their studies being better interested and having a personal sense of meaning in them as opposed to being compelled by outside forces. They also expressed that their academic lives were more positive. Such affective and motivational states, in their turn, forecasted improved academic performance.

These studies show that when the needs are recognized as being met by the achievement of students and a better understanding of the course material, students are more motivated, perform better in their academics, and are less likely to procrastinate. On the other hand, failing to meet these needs results in demotivation and decreased performance. This is important in science learning, especially for low-performing students in the subject who may experience similar patterns due to unmet needs in autonomy, competence, and relatedness.

Learning Barriers

Even after the spectrum of intelligence has been established and identified, learners may still need help acknowledging their unique interests and strengths. Learning barriers hinder the application during the learning process (Alparuq et al., 2024; Suyedi, 2019). Until more recently, influential educational researchers, such as Scholkmann (2021), have often depicted learning barriers in psycho-medical terms rooted in the notions of the individual. For instance, Scholkman (2021) demonstrated that the barriers or mislearning, learning defense, and learning resistance are valuable constructs to examine why students may not be able to cope with the demands of learning.

Friedensen et al. (2021) states that the obstacles in learning do not arise due to specific deficits only but as an interplay of both individual factors and the environment factors. The plight of students cannot be perceived outside the social settings within which they study, their attitudes by those in their surroundings, or the organizational forms that determine their possibilities. Risks can be considered external and internal barriers to development and learning. Understanding the research surrounding external and internal factors helps shift focus from these issues to make them a vital part of a comprehensive, multifaceted answer to overcoming barriers to learning, development, and teaching.

Furthermore, Friedensen et al. (2021) oppose the purely individual-related views by demonstrating how organizations are designed and social settings cause barriers that are not dependent on student abilities or even efforts. A student can be intellectually able to excel in science yet fail due to hostile learning environment, learning instruction does not meet his or her learning requirements, or student cannot identify him or herself in the scientific community. Such barriers are not solvable by individual remediation but they can only be changed by modifying the environments where learning takes place. Alparuq et al. (2024) states that barriers that can arise in science learning are the sophistication of the curriculum, the learning process, and access to resources. These are potential learning barriers that we should be wary of or, if not, would lead to our students declining in science.

Self-Efficacy as Learning Barriers

Beyond the difficulties rooted in content and pedagogy, a significant psychological barrier to learning is low self-efficacy. Bandura (1997) defines self-efficacy as an individual's belief in their capacity to execute behaviors necessary to produce specific performance attainments. In an academic context, this translates to a student's confidence in their ability to successfully learn and perform in a specific subject.

Low self-efficacy functions as a powerful barrier by influencing students' cognitive, motivational, and affective processes. Students with low self-efficacy are more likely to avoid challenging tasks, such as complex science problems, as they doubt their capabilities to succeed (Honicke et al., 2023). When they encounter difficulties, they are prone to giving up more easily, attributing failure to a lack of inherent ability rather than to factors within their control. This creates a self-fulfilling prophecy where the expectation of failure leads to reduced effort and persistence, which in turn results in actual poor performance, further reinforcing the low self-belief (Schunk & DiBenedetto, 2020).

This study posits that the experiences of need-frustrating barriers, as defined by BPNT, are critical antecedents that can undermine a student's self-efficacy. For instance, repeated competence frustration (e.g., consistent failure to understand concepts) provides direct negative mastery experiences, the most powerful source of efficacy information (Bandura, 1997). Similarly, a restrictive learning environment (autonomy frustration) prevents students from developing a sense of personal control over their learning, while social exclusion (relatedness frustration) removes potential sources of encouragement and vicarious learning. Therefore, investigating the relationship between these BPNT-based barriers and self-efficacy is crucial for understanding the complete motivational profile of low-performing students.

II. METHODOLOGY

Research Design

The researcher used a cross-sectional predictive design based on the dimensions of objective and time of data as proposed by Johnson (2001). The study's main objective was predictive in that it sought to identify the factors of BPN frustration in learning science and how these factors could forecast low self-efficacies in learning science. Data were collected at a single point in time.

Participants

The participants for this study were senior high school students enrolled in non-STEM strands (i.e., Humanities and Social Science [HUMSS], Accountancy and Business [ABM], Information and Communications Technology [ICT], and Electrical Installation and Maintenance [EIM]) at Sindangan National High School for the school year 2024-2025. The primary criterion for inclusion was a record of low performance in science, defined as a grade below 80% based on the school's official grading records from the previous semester. The final sample was drawn from the qualified pool using a proportionate stratified sampling technique. This ensured that the sample accurately represented the distribution of students across the different non-STEM strands. The proportion of students to be selected from each strand was calculated based on their relative numbers in the total qualified population. A random selection method was then used within each stratum to select the specific participants. The final sample consisted of 336 students. This sample size was based on a subject-to-item ratio of 20:1 for factor analysis, which is considered robust for stable factor solutions (Costello & Osborne, 2005).

Measures

The measure of barriers to science learning was developed for this study. To develop the item pool, a preliminary survey was conducted for experience sampling to identify specific experiences of learning barriers from 10 to 15 students from each strand. They were asked to specify the situations or contexts of their experience of learning barriers. The information gathered from the survey was used to formulate items to ensure that each item specified a realistic experience of learning barriers. This approach to item pool development was patterned after the work of Villavicencio (2010). An initial pool of 80 items was generated, which was then reviewed by experts in scale development. The final instrument was administered using a 5-point scale response format from 1 (*never happened to me*) to 5 (*always happened to me*). Mean scores were obtained for each dimension extracted from the analysis. Higher mean scores represented a higher extent of experience of barriers to science learning.

Students' self-efficacy for learning science was measured using the Self-efficacy for Learning Form (SELF; Zimmerman & Kitsantas, 2007). The scale consists of 19 items (see Appendix A), all about the student's self-efficacy in learning in a particular subject or domain. The participants were prompted to think of their self-beliefs, specifically in their learning in the science subject they were currently taking, and responded to each item on a 5-point scale from 1 (*never happened to me*) to 5 (*always happened to me*). Each participant was assigned a mean score for self-efficacy. The higher the mean score, the higher their self-efficacy for learning science.

Procedures

A preliminary survey was conducted with a random sample of 10–15 students from each non-STEM strand, who were asked to complete a brief open-ended survey describing at least ten experiences in their science classes that they found dissatisfying, frustrating, or difficult. The qualitative responses were then transcribed and analyzed to identify recurring themes and situations, which were used to generate an initial pool of items for the "Barriers to Science Learning" scale. The item pool underwent expert validation by at least three specialists in educational psychology, scale development, and science education, who evaluated the items for clarity, relevance to the Basic Psychological Needs Theory (BPNT) constructs, and appropriateness for the target respondents; revisions were made based on their feedback. For data collection, formal permission was first secured from the school principal and the science teachers involved. Eligible participants were then identified through academic records, and informed consent was obtained from the students (and their guardians if minors). Finally, the validated "Barriers to Science Learning" questionnaire and the Self-Efficacy for Learning Form (SELF) were administered to the participants in a scheduled group session while ensuring confidentiality and a conducive environment for responses.

Data Analysis

The collected data were screened for completeness and coded for statistical analysis. Descriptive statistics were used for a preliminary inspection of the data. Exploratory factor analysis (EFA) using Maximum Likelihood extraction and Promax rotation was used to determine the underlying factor structure of the barriers to science learning. Internal consistency for each derived factor and the self-efficacy scale was computed using Cronbach's alpha. Means and standard deviations were calculated for all barrier factors and self-efficacy to describe the sample's experiences. A multiple regression analysis was conducted to test if the identified barrier factors significantly predicted the students' levels of self-efficacy for learning science.

Ethical Considerations

To ensure ethical compliance, a clear informed consent form was provided explaining the study's purpose, procedures, and potential risks. Permission from the administration of Sindangan National High School was obtained prior to data collection. Participation was voluntary, and written informed consent was secured from all respondents after a full briefing on the study and their rights, including the option to withdraw at any time without consequence. Confidentiality of responses was maintained, and to minimize possible mild psychological discomfort when reflecting on learning barriers, the survey was conducted in a supportive environment with sufficient time provided for completion and access to supportive resources. All participants were treated fairly and without prejudice in accordance with the principle of justice.

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III. RESULTS AND DISCUSSION

To examine the structure of the scale on barriers to science learning, an Exploratory Factor Analysis (EFA) was employed. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .89, which is excellent according to Kaiser (1974). Bartlett's test of sphericity, χ^2 (630) = 3991.04, $p < .001$, indicated that correlations between items were sufficiently large for EFA. Factor extraction was conducted using Maximum Likelihood because the data satisfied the assumption of multivariate normality. To achieve a more interpretable solution and because the constructs were expected to be correlated based on Basic Psychological Needs Theory (BPNT), an oblique rotation (Promax) was applied. An initial eight-factor solution was produced using Kaiser's criterion (eigenvalues > 1.0), but a four-factor solution yielded the cleanest and most interpretable loadings.

TABLE 1
FACTOR CHARACTERISTICS

Factor	Eigenvalues	Sum of Sq. Loadings	Proportion Variance	Cumulative Variance
Factor 1	8.592	4.483	0.125	0.125
Factor 2	3.42	2.704	0.075	0.200
Factor 3	1.858	2.537	0.070	0.270
Factor 4	1.450	1.494	0.041	0.312

The Exploratory Factor Analysis (EFA) successfully identified a coherent four-factor structure underlying the barriers to science learning, accounting for a total of 31.2% of the cumulative variance in the data (Table 1). Factor 1, *Social exclusion,* encompasses ten items that collectively describe a profound experience of social and academic isolation within the science learning environment. This factor has the highest eigenvalue and explains the largest portion of variance among the four factors. Items loading on this factor consistently have high positive loadings (> 0.45). These items reflect experiences of being socially isolated or feeling that one's presence and contributions are undervalued in the classroom. . The items indicate that students feel disconnected from their peers, believing their contributions are disregarded and their presence is undervalued *(e.g.,"I feel like my classmates don't value my opinions,"* and *"I feel like I don't belong").* When students perceive poor interpersonal support, exclusion, or disrespect, their basic need for connection and belonging is thwarted, which undermines engagement and willingness to participate (*e.g. "I feel hesitant to participate in science class when my classmates disregard my ideas in science class, murag dili sila interesado").* The social dimension of classroom interactions therefore constitutes an important barrier through relatedness pathways.

Social exclusion directly signifies the frustration of the need for relatedness. The items describing feelings of being ignored, undervalued, or disconnected from peers and teachers reflect a profound lack of belongingness. According to BPNT, relatedness involves feeling connected to others and cared for (Ryan & Deci, 2017). This need is actively derailed when students feel that their opinion is undermined or that they do not fit in the science class. This frustration creates a climate of psychological unsafety, where students are hesitant to engage in discussions or ask questions for fear of social judgment. Peer relatedness encourages students' help-seeking from their peers in the classroom; having this outlook, can encourage students to take academic risks by tackling a challenging problem rather than giving up or seeking the easy way out (Mikami, et. al., 2017). Positive peer interactions along with cooperative learning environments can eventually enhance peer support and lead to an increase in students' engagement in classroom learning activities (Van Ryzin et al., 2024). Its absence, as captured by this factor, leads students to withdraw emotionally and behaviorally, reducing their engagement and willingness to invest effort in science learning. The absence of a supportive peer and teacher network removes a critical source of vicarious learning and verbal persuasion (Bandura, 1997), thereby stifling the collaborative interactions necessary for deeper conceptual understanding. The role of social exclusion in the classroom as a psychological barrier, in turn, diminishes the opportunities to participate and engage in learning together, thereby compromising the social scaffolding that is frequently required in developing a deeper conceptual knowledge.

Factor 2, *Conceptual difficulty,* captures the students' pervasive sense of inadequacy and inability to grasp scientific concepts. Items that loaded strongly on Factor 2 capture the feeling of cognitive overload, frustration, and inadequacy in understanding science content. Loadings range from approximately 0.41 to 0.75, indicating a strong and consistent contribution of these items to the construct. This factor emphasizes the sense of being overwhelmed by science lessons and the perception of being slow or unable to keep up with peers (*e.g. "My constant struggles with science concepts lead to frustration, lisod kaayo sabton"*) .Uniqueness values (around 0.49–0.73) show that a reasonable proportion of each item's variance is captured by the factor model, supporting its construct validity. The items reflect experiences of frustration, self-doubt, and being overwhelmed by the complexity and pace of the science curriculum *(e.g., "I get frustrated when I don't understand the lesson," "I feel slow in science class,"* and *"I feel overwhelmed by the complexity"*). This is primarily a competence frustration (students' perception of repeated failures and inefficacy) as there is overlap: genuine learning difficulties can produce competence frustration, and competence frustration may exacerbate difficulties. The factor therefore captures both the subjective experience of being overwhelmed and the competence pathway described in BPNT.

Conceptual difficulty reflects competence frustration. Students who repeatedly fail to grasp abstract or complex science concepts may interpret these difficulties as personal inadequacy. Repeated academic failure experiences lower perceived mastery and belief in their ability to achieve success- a major predictor of competence satisfaction (Vansteenkiste et al., 2020). When repeated inability is perceived in BPNT terms, the learner receives a signal that he is not an effective agent in his environment. With time, it might result in the loss of intrinsic motivation and avoidance or learned helplessness. When students repeatedly encounter science content that is too complex or paced too quickly, they receive continuous feedback of failure, thwarting their need for competence. This frustration, as Vansteenkiste et al. (2020) note, leads to helplessness and a tendency to disengage from challenging tasks as a form of self-protection. Thus, the barrier is not just the objective difficulty, but the subjective, need-thwarting experience of being overwhelmed and inefficacious. Mastery experiences as Bandura (1997) observed are the most powerful source of self-efficacy; in cases where students rarely succeed, competence frustration and negative self-judgments grow stronger. The resulting helplessness and tendency to disengage are direct consequences of this chronic competence frustration, as students learn to associate science with inevitable failure.

Factor 3, *Inflexible instruction***,** describes a learning environment perceived as rigid, controlling, and unresponsive to individual learning preferences. Factor 3 includes items with loadings ranging from 0.41 to 0.52. While these loadings are slightly lower than those of Factors 1 and 2, they are still above the commonly accepted threshold of 0.40, making them statistically meaningful. These items reflect the perception that the learning environment is rigid, overly structured, and does not allow students freedom to choose or explore alternative learning approaches. The slightly higher uniqueness values suggest that students' experiences of autonomy frustration are influenced by other individual or contextual factors not captured by this model. Students report a lack of freedom in their approach to learning, being compelled to adhere to a single, fixed method of instruction *("I am forced to learn in a way that doesn't interest me,"* and *"I don't feel free to try my own way"*).

Inflexible instruction thwarts the need for autonomy. When teachers rely on rigid, highly structured, or controlling teaching practices, students are deprived of opportunities for choice, volition, and self-direction (Reeve, 2016). Teachers who apply an autonomy-supportive motivating style cultivate a supportive classroom environment that allows the students to internalize their goals, appreciate their work, and pursue it with personal interest, which consequently results in their inquisitiveness, engagement, and commitment (Wang, et.al., 2025). Conversely, inflexible instructional styles encourage external control- learning because of obedience or fear of punishment as opposed to one learning out of curiosity. This externally exerted control directly results in the lack of excitement and enjoyment in science classes as reported by the students. The presence of this factor highlights how teacher-centered pedagogies can unintentionally suppress students' sense of agency and ownership in science learning. When instruction is overly directive and denies meaningful choice, learning becomes a passive process of compliance. This suppresses curiosity, initiative, and the personal relevance of the subject matter, directly reducing intrinsic motivation and the willingness to explore and persist with challenging tasks; autonomy is thereby frustrated and motivation declines.

Factor 4, *Failure expectancy,* includes three items with loadings ranging from 0.44 to 0.65. These items represent the emotional consequence of competence frustration — feelings of being pressured, discouraged, and ready to disengage from science altogether. Although the number of items is fewer, the factor still holds theoretical significance as it represents a distinct psychological state beyond immediate confusion or overwhelm. The moderate loadings confirm that these items are coherent indicators of the construct, but the higher uniqueness values (0.47–0.68) suggest that there is more item-specific variance, which may explain the slightly lower reliability (Cronbach's alpha = 0.63) reported later. It moves beyond the immediate feeling of being overwhelmed to a more entrenched state of discouragement and resignation. Students begin to internalize their difficulties, leading to a belief that they are inherently incapable of success in science ("*I start to believe that I am not capable of excelling")*. The fast pace of lessons contributes to a high-pressure environment that feels inescapable, resulting in a loss of motivation and a desire to disengage entirely ("*My difficulty... leads to ongoing discouragement, wala na dayon ko'y gana mupadayon [I immediately lose the will to continue]").*

Failure expectancy captures the affective outcome of prolonged competence frustration. It reflects a state of discouragement and resignation where students internalize their struggles and begin to believe they are "not capable of excelling" due to the relentless pace and difficulty. Students with high failure expectancy anticipate poor performance and will disengage in advance in order to avoid the negative affect of failure. This aspect highlights the cyclical competence frustration: the initial failures cause beliefs in the negative, which in turn decrease effort and involvement, thus ensuring failure and confirming low self-concept. This factor represents discouragement, resignation, and emotional pressure that arise when competence is chronically thwarted. This aspect fits the competence facet of BPNT but moves over to affective self-perceptions that affect learning behavior (Skinner, 2016). Such negative emotions as anxiety or hopelessness can be used as internal stimuli that can be viewed as indicators of inefficacy (Bandura, 1997). Hence, failure expectancy is a demonstration and a reinforcer of competence frustration, sustaining maladaptive learning patterns.

Collectively, these findings confirm that the barriers to science learning for these students are fundamentally psychological, systematically frustrating students' basic needs for connection, mastery, and autonomy. This provides a powerful, needs-based explanation for why these students are low-performing: their motivational fuel is being depleted by the very structure and climate of their science classes.

This study synthesizes these disparate issues into a unified BPNT framework, arguing that their ultimate detrimental effect operates through the psychological mechanism of need frustration. The learning environment, as perceived by the students, systematically frustrates their basic needs for connection, mastery, and self-direction. This finding provides a powerful, needs-based explanation for why these students are low-performing: their motivational fuel is being depleted by the very structure and climate of their science classes. Previous studies often report negative correlations between learning barriers and self-efficacy (Bandura, 1997; Schunk & DiBenedetto, 2020). This inconsistency of important association is in contrast to those results, and potentially can be attributed to cultural context, sample traits, or that other mediating factors, such as teacher support or peer encouragement, buffer the effects of these barriers on self-beliefs.

All four barriers to science learning are positively and significantly correlated with each other

($p < .001$), with coefficients ranging from moderate (0.27) to strong (0.48). This indicates that students who experience one type of need frustration are highly likely to experience others. As per the motivational theory, the four barriers were found to have a positive relationship with each other and, thus, when a logical need is frustrated, the other needs are also susceptible to frustration. For instance, students who feel left out during group work often also struggle to understand lessons, experience rigid teaching with little choice, and eventually expect to fail—showing that these barriers rise together rather than separately.

Predictive Relationship Between Barriers in Learning and Self-efficacy

Multiple Regression Results for Barriers Predicting Self-Efficacy

Predictor	B	SE B	t	p	95% CI
Social exclusion	0.00	0.04	0.02	0.98	[-0.09, 0.09]
Conceptual difficulty	-0.03	0.05	-0.53	0.60	[-0.13, 0.07]
Inflexible instruction	0.03	0.05	0.52	0.61	[-0.08, 0.13]
Failure expectancy	0.01	0.04	0.30	0.76	[-0.07, 0.10]

A multiple regression was conducted to determine whether the four barrier factors predicted self-efficacy. The overall regression model was not statistically significant, $F(4, 335) = 0.142$, $p = .966$, adj. $R^2 = -0.01$, indicating that the factors did not account for the variance in self-efficacy. As shown in Table 7, none of the individual barriers were significant predictors of self-efficacy. The results of the multiple regression analysis, confirm the absence of a predictive relationship between the identified barriers and self-efficacy.

Relationship Between Barriers and Self-Efficacy

Although the current study did not reveal any significant direct correlation between the barriers identified and self-efficacy, this result does not negate the theoretical relevance of need frustration to efficacy beliefs. Instead, it suggests that the relationship may be indirect, mediated by other motivational and affective processes.From the perspective of BPNT and Social Cognitive Theory, the link between barriers and self-efficacy can be understood through a temporal and mediational pathway. Barriers such as social exclusion, conceptual difficulty, rigid instruction, and failure expectancy are the examples of barriers that serve as the antecedents of need frustration, the results of which trigger maladaptive motivational regulations (Vansteenkiste et al., 2020). When students' basic needs are chronically thwarted, they are more likely to shift from intrinsic to controlled motivation, characterized by external pressures or avoidance of guilt (Deci & Ryan, 2008). In prolonged cases, this may even progress to amotivation, or the absence of intentional engagement.

The direct consequence of these need frustrations may not be an immediate erosion of self-efficacy, but rather the formation of maladaptive motivational regulations. These maladaptive motivational states reduce students' persistence and willingness to engage in challenging tasks, resulting in fewer mastery experiences—the most potent source of self-efficacy (Bandura, 1997). Moreover, social exclusion restricts vicarious learning and verbal persuasion of teachers and peers as well as rigid instruction reduces autonomy and exploration based on curiosity. These factors together weaken the ground of self-efficacy overtime without necessarily demonstrating a statistical correlation after all in a cross-sectional design.

It is this shift in motivational quality that may serve as the critical mediator undermining self-efficacy. For instance, a student with conceptual difficulty (competence frustration) can be amotivated because he/she thinks that his/her efforts are useless. This discouragement causes them to give up, leaving mastery experiences that would be necessary to develop self-efficacy. A student experiencing inflexible instruction (autonomy frustration) risks developing a controlled motivation, in which he/she is involved in work at a superficial level, without committing significant cognitive resources to it. This superficial interaction does not allow building a real skill and confidence, and in the end undermines self-efficacy. A student with social exclusion (relatedness frustration) can be inactive to avoid social judgment. With this withdrawal, they are deprived of teacher and peer encouragement and social persuasion, which are also important sources of efficacy information (Bandura, 1997).

The mediator in this mediated model is that the barriers initially influence daily state motivation and engagement. The persistence of amotivation, controlled regulation, and disengagement is what, in the long run, turns into a hardened thinking of low self-efficacy. The cross-sectional design might have been able to capture the initial frustration but not the downstream, cumulative process by which it ultimately destroys core self-belief. he students in this sample may still be reporting on a moderately held self-efficacy belief that is being buffered by positive experiences in other subjects or supportive networks outside the science classroom, even as their motivation within science is being systematically undermined. Thus, the connection between need-frustrating barriers and self-efficacy is probably indirect, operating through the deterioration of students' quality of motivation and engagement.

This mediated pathway explanation is consistent with several other factors that could buffer a direct association. First, the cultural context may play a role; students in collectivist cultures might derive their self-worth from sources outside the academic domain, such as family and community roles, which can temporarily insulate their global self-efficacy from classroom-specific frustrations. Second, specific sample traits are crucial; these are non-STEM students who may have already disidentified with science, compartmentalizing their struggles in this subject and preventing it from contaminating their overall academic self-concept. Third, other mediating factors, such as strong teacher support in other subjects or encouraging peer and family networks, may sustain general self-efficacy even in the face of science-specific barriers (Wang et al., 2024). Finally, students may employ adaptive coping mechanisms, such as attributing their difficulties to external, unstable factors like poor teaching or subject difficulty, thereby protecting their core self-belief in the short term.

IV. CONCLUSION

The research was able to define four main psychological impediments that thwart the basic needs of relatedness, competence, and autonomy of the low performing non-STEM students in science. The identified factors provide a clear, theory-driven answer that the primary barriers are the chronic frustrations of students' basic psychological needs for relatedness, competence, and autonomy (Ryan & Deci, 2017). This finding aligns with existing literature on science education, which highlights issues like social anxiety (Prabha, 2020), foundational knowledge gaps (Amaliyah & Fajar, 2024; Buban, 2023), and rigid instructional methods as key challenges. This study synthesizes these disparate issues into a unified framework, arguing that their ultimate detrimental effect is through the psychological mechanism of need frustration. The analysis revealed that the problem is not that students are struggling, but rather that their environment is in a way that challenges their sense to participate in it because it does not encourage their basic psychological needs. The most prevalent barrier was Conceptual Difficulty in learning science, highlighting a critical gap in foundational understanding and support.

However, contrary to the initial hypothesis, these barriers were not directly associated with lower self-efficacy in this specific sample now. This crucial finding suggests a decoupling of the experience of a need-thwarting environment from students' broader academic self-concept. It implies that the academic self-concept of students is multifaceted and can be supported by external resources and cognitive buffers beyond the immediate setting of the science classroom. The problem of low performance appears directly rooted in a need-thwarting learning environment, but the problem of low motivation is more nuanced.

The non-significant result should not be interpreted as evidence that barriers are irrelevant to self-efficacy. Instead, it highlights a more complex motivational dynamic where need frustration directly impacts engagement and performance, but its effect on the deeper construct of self-efficacy is likely indirect and mediated over time. The immediate effect of these barriers may be on day-to-day engagement and emotional states, and it is the long-term accumulation of these negative experiences, unmitigated by support, that would be expected to eventually undermine self-efficacy. This suggests the students in this sample possess a degree of resilience, where their belief in their overall capability to learn remains moderately intact despite daily experiences of confusion, isolation, and control, potentially due to the protective factors and mediating processes previously discussed.

It is plausible that these students are maintaining their self-efficacy through positive experiences outside of the science learning context measured here. Success in other academic subjects or non-academic pursuits may provide a generalized sense of competence that protects their overall academic self-concept. The support, and confirmation by family, friends or community outside the school setting can be an effective buffer to classroom disappointments. Students' reasons or attribution for success and failure also play a significant role in shaping their academic self-efficacy and expectations for future performance (Asrori & Tjalla, 2024). This external attribution insulates their core self-belief.

The deviation of the current results can be explained by the situational inconsistencies, including the support systems of the school or the cultural influence, or the fact that the self-efficacy of the sample in this study is somehow resistant to the classroom limitations (Taghap, 2023). Thus, the need-frustrating barriers can certainly be the direct cause of poor performance, as well as involvement, in science, though they cannot directly cause an already existing, moderately maintained level of the general academic self-efficacy maintained by other factors. The barriers prevent success in science, but students do not necessarily internalize this lack of success as a global failure of their abilities.

The practical imperative is to transform the science classroom into a need-supportive one, not to first build students' confidence, but to create conditions where their resilient self-efficacy can finally be matched with actual success and engagement in science.

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