International Journal of Science Education and Teaching
Vol. 4, No. 3, pp. 193-205, Sep. – Dec. 2025
http://doi.org/10.14456/ijset.2025.13

Research Article

Beyond Formula: Exploring Students' Lived Experiences in Physics Problem-Solving

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Received: 2 Dec. 2025 Revised: 22 Dec. 2025 Accepted: 23 Dec. 2025

Abstract. Understanding how students engage during physics problem-solving is crucial for improving learning outcomes. Despite efforts to enhance conceptual understanding and support meaningful learning, few studies have examined how strategic, emotional, and agentic engagement intersect in students' lived experiences of solving physics problems. This study explored how high school STEM students from Baybay City, Leyte, experience and express these dimensions, highlighting engagement as extending beyond formulas into meaning-making and self-directed learning. Using a descriptive phenomenological design guided by Giorgi's (2009) method, ten students were interviewed with semi-structured, open-ended questions that prompted them to narrate their problem-solving experiences. Interviews were audio-recorded, translated from Bisaya to English using AI-assisted tools, and analyzed through phenomenological reduction, segmentation into meaning units, and synthesis into essential psychological structures. Analysis revealed four interrelated constituents of engagement: (1) strategic engagement, reflected in deliberate, organized problem-solving methods such as GAFSA and visual representations; (2) emotional engagement, manifested in regulating anxiety, stress, and excitement into calmness and satisfaction; (3) agentic engagement, demonstrated through proactive self-direction and collaboration, including creating reviewers, clarifying concepts, and supporting peers; and (4) transformative impact, where students internalized clarity, reflection, and initiative as transferable skills. Physics problem-solving thus emerged as a lived experience integrating thought, emotion, and action. The study concludes that reflective, student-centered pedagogies that cultivate these three dimensions can humanize physics learning, fostering conceptual mastery, emotional resilience, and empowered, self-directed learners.

Keywords: Strategic engagement; Emotional engagement; Agentic engagement; Phenomenology; physics problem-solving

INTRODUCTION

Physics is more than formulas and equations. It is a puzzle, a challenge, and sometimes a battlefield of the mind. For many Filipino students, solving physics problems can feel overwhelming as they try to translate abstract concepts into step-by-step solutions and apply mathematical reasoning to unfamiliar situations (Laguindab & Cagas, 2025). Teachers often point out that weak mathematical foundations make problem-solving one of the hardest skills to master. Despite these challenges, some students persist, finding strategies and small victories that often go unnoticed. By examining how students navigate challenges, interpret abstract concepts, and employ mathematical reasoning,

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educators and researchers can develop instructional practices that are more responsive to learners' needs (Pasigon, 2024). This focus aligns with contemporary educational priorities that emphasize holistic learning, student well-being, and the cultivation of lifelong problem-solving skills (OECD, 2023). Moreover, insights into students' experiences can inform curriculum design, teaching strategies, and assessment methods that not only evaluate conceptual understanding but also nurture curiosity, persistence, and confidence in tackling complex scientific tasks.

Physics education research has predominantly emphasized cognitive outcomes, such as conceptual understanding, misconceptions, and problem-solving performance (Mestre et al., 2011; Favale & Bondani, 2014). While these studies have yielded important instructional insights, they often overlook the subjective experiences that shape students' engagement and learning strategies. For instance, students' frustration, anxiety, or excitement during problem-solving can significantly influence both their performance and motivation, yet these affective dimensions remain underexplored in the Philippine context. Recent international studies suggest that addressing these experiential factors is linked to higher persistence, improved self-efficacy, and better learning outcomes in STEM education (Mohamoud, 2024; Pasigon, 2022).

Despite the recognized challenges of physics problem-solving, few studies focus on the Filipino learners' personal experiences as they navigate abstract and mathematically intensive problems. Existing research tends to measure performance outcomes without exploring the cognitive-emotional interplay that occurs during the problem-solving process. This gap limits our understanding of how students develop strategies, sustain effort, and negotiate complex tasks, leaving educators with an incomplete picture of learners' needs.

Studies from other contexts highlight that students' engagement in problem-solving involves both cognitive strategies and affective responses. Espinoza (2020) and Nautiyal et al. (2025) observed that students frequently encounter moments of confusion, trial-and-error experimentation, and strategic reflection, which are crucial to conceptual development. These findings suggest that examining lived experiences provides complementary insights to traditional performance-based assessments, revealing processes that are otherwise hidden in test scores.

While localized and innovative teaching approaches have shown promise in improving performance, there remains a lack of research capturing how students personally experience these interventions in the Philippine context. Understanding students' emotional, strategic, and agentic responses can inform more targeted instructional designs that enhance engagement, persistence, and confidence in physics learning.

Paulmitan and Manceras (2025) and Gardose et al. (2025) demonstrate that contextualized modules and multimodal strategies improve conceptual understanding. However, the studies do not address how students internally process these experiences, make decisions during problem-solving, or reconcile abstract concepts with practical applications. Integrating these experiential insights could deepen the impact of instructional interventions and promote more learner-centered approaches.

In the Philippines, physics continues to be one of the most challenging subjects for high school students. National assessments and classroom observations indicate that learners often struggle with mathematical formulations, interpreting physical models, and applying theory to unfamiliar problems (Bogador et al., 2024; Donalie et al., 2024). Teachers report that students' engagement varies widely, with some demonstrating resilience and strategic initiative, while others experience persistent anxiety and avoidance behaviors. These patterns highlight the need for research that examines both the cognitive and affective dimensions of problem-solving within the local educational context.

This study aims to explore the lived experiences of Filipino high school students as they engage in physics problem-solving. Specifically, it investigates how students navigate challenges, integrate conceptual understanding with mathematical reasoning, and exercise personal initiative during problem-solving tasks. By capturing these experiences, the study seeks to identify patterns in students' strategies, emotional responses, and reflective practices, providing insights that can inform learner-centered instruction and support holistic science education.

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The primary aim of this paper is to provide a rich, qualitative understanding of students' experiences in physics problem-solving, moving beyond traditional performance measures. By documenting the narratives of how students perceive, interpret, and respond to complex tasks, this study contributes to the development of instructional approaches that enhance conceptual mastery, confidence, and persistence. Ultimately, it seeks to advance inclusive and equitable science education by informing interventions that support not only academic success but also the well-being and engagement of learners in the Philippine context, in alignment with SDG 4.

RESEARCH QUESTION

How do students experience and express their engagement in physics problem-solving?

METHODOLOGY

Research Design

This study employed a descriptive phenomenological research design to explore the lived experiences of students' while solving physics-related problems. Descriptive phenomenology is appropriate for this study because it aims to uncover the essential structure and meaning of a phenomenon as it is experienced by individuals rather than to test hypotheses or measure variables (Creswell & Poth, 2018). The research followed Giorgi's (2009) method, which involves a systematic approach to analyzing first-person narratives and transforming them into psychologically sensitive meaning units. Specifically, the researcher first adopted a phenomenological attitude through bracketing, setting aside personal assumptions to maintain objectivity. Each transcript was then read repeatedly to gain a holistic understanding, followed by identification of meaning units and their transformation into expressions that capture the psychological essence of participants' experiences. This step-by-step process ensured that the analysis remained grounded in the participants' lived experiences, providing detailed insight into how students think, feel, and act during physics problem-solving. By clearly outlining the procedural steps of data analysis, this study enhances methodological transparency and allows for replication in similar educational contexts.

Participants

The participants in this study consisted of ten High School students enrolled in the Science, Technology, Engineering, and Mathematics (STEM) Program at Baybay city, Leyte. This sample size aligns with recommendations for descriptive phenomenological studies, which emphasize depth over breadth to generate rich, detailed data suitable for uncovering lived experiences (Creswell & Poth, 2018). Purposive sampling was employed to ensure that all participants had firsthand engagement with physics problem-solving and could articulate their engagement. This approach provided in-depth insights essential for addressing the study's focus on understanding how students navigate and experience physics problem-solving beyond formulas.

Table 1. Participants of the Study.

Participants	Sex	Age	Q1- Science Grade '25-26
P1	F	15	97
P2	M	16	94
P3	F	15	94
P4	M	15	94
P5	F	15	93
P6	M	17	98
P7	F	16	97
P8	F	15	97
P9	F	15	92
P10	F	16	97

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Research Tools

This study employed semi-structured interviews with carefully designed open-ended questions to explore participants' lived experiences in depth. Aligned with Englander's (2012) phenomenological perspective, the interviews prioritized detailed descriptions of participants' experiences rather than rigid questioning.

Interviews began with broad invitations to describe relevant situations, followed by context-sensitive prompts that avoided leading assumptions, ensuring both depth and flexibility in data collection. Responses were captured through audio recordings and supplemented with observational notes. The interview protocol was reviewed for clarity and piloted with a small sample to confirm its effectiveness.

To enhance trustworthiness, member checking, peer debriefing, and detailed field notes were employed. Ethical considerations, including informed consent, confidentiality, and participant comfort, were strictly observed. These measures collectively strengthened the reliability, credibility, and rigor of the research tool.

The semi-structured interview protocol consisted of open-ended questions designed to capture the participants' lived experiences in solving physics problems. Questions began with broad prompts such as, "Can you describe a situation where you solved a physics problem?" and were followed by context-sensitive probes to explore strategic approaches, emotional responses, and initiatives taken during problem solving, for example: "What steps did you take to organize information or visualize the problem?", "How did you feel when you encountered confusion or difficulty?", and "Did you help yourself or others during the process? If so, how?" Each question was carefully formulated to avoid leading assumptions and encourage rich, descriptive responses. The protocol was piloted with a small sample to confirm clarity, relevance, and flexibility, and revised based on feedback. To ensure quality, measures such as member checking, peer debriefing, and detailed field notes were employed, strengthening the reliability, credibility, and rigor of the research tool.

Data Collection

Data were collected through individual semi-structured interviews with ten participants, guided by Englander's (2012) recommendations for descriptive phenomenological interviewing. Each interview began with an open-ended invitation for participants to recount specific situations in which they solved physics-related problems, followed by context-sensitive prompts to encourage elaboration while minimizing researcher bias.

Interviews were conducted in a quiet, mutually agreed-upon space within the school to ensure participants' comfort and privacy, with each session lasting approximately 20–25 minutes. With informed consent, all interviews were audio-recorded using a dedicated device, with a backup software application to prevent data loss. Additionally, key responses were highlighted in written bullet form during the session, and follow-up questions were collected via Google Forms for participants who preferred non-face-to-face interaction. Detailed field notes were taken during and immediately after each session to capture non-verbal cues, contextual factors, and reflexive observations (Merriam & Tisdell, 2016).

Together, these data collection ensured an accurate, comprehensive, and ethically sound record of each participant's account. Furthermore, the explicit description of data collection procedures enhances the study's transparency and replicability, allowing other researchers to follow the same systematic steps in future phenomenological investigations (Lincoln & Guba, 1985).

Data Analysis

The study employed Giorgi's descriptive phenomenological method (Giorgi, 2009) to analyze the interview data and uncover the phenomenological structure of students' lived experiences of in physics problem-solving. Following Giorgi's (2009) five-step Descriptive Phenomenological Method, the researcher: (1) adopted the phenomenological attitude through bracketing; (2) read each transcript repeatedly to gain a holistic sense; (3) segmented the data into meaning units at points of psychological significance; (4) transformed these units into psychologically sensitive expressions

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while preserving participants' intent; and (5) synthesized the transformed units to articulate the general structure of students' strategic, emotional, and agentic engagement in physics problem-solving. Grounded in Husserlian phenomenology (Husserl, 1913/1982), this method aims to describe phenomena as they are lived rather than explain them through external theories. By following Giorgi's approach, participants' first-person accounts were systematically organized and transformed into psychologically sensitive expressions that captured the essence of their experience.

Meaning units emerged directly from participants' narratives without pre-assigned categories. Units reflecting cognitive, emotional, or behavioral significance were transformed into psychologically sensitive expressions. For example, statements describing organizing information, drawing diagrams, or sequencing steps were interpreted as strategic engagement; managing anxiety or taking reflective pauses were categorized as emotional engagement; and preparing reviewers, sharing solutions with peers, or suggesting instructional improvements were identified as agentic engagement. Through repeated comparison and synthesis, these constituents naturally emerged from the data, grounded in students' lived experiences rather than researcher assumptions.

Artificial intelligence (AI) tools were utilized to assist in translating students' statements from Bisaya to English to ensure clarity and linguistic accuracy while preserving the authenticity of their meanings. AI-assisted applications were also employed for grammar and spelling refinement to enhance the readability of transcribed and translated data. However, all processes of interpretation, meaning transformation, and phenomenological reduction remained entirely researcher-driven in accordance with Giorgi's (2009) method.

Throughout the analysis, the researcher maintained methodological rigor by carefully following Giorgi's (2009) systematic steps. Trustworthiness was enhanced through reflexivity—*regularly reflecting on personal assumptions to minimize bias*—and by keeping a clear, transparent record of all analytic decisions (Lincoln & Guba, 1985). This careful approach ensured that the findings accurately reflected students' lived experiences and provided a credible basis for the constituents discussed in the Findings section.

Ethical Consideration

To ensure the ethical conduct of this research, informed consent was obtained from parents or guardians, and assent was secured from student participants to confirm their voluntary participation and right to withdraw at any time without academic or personal consequence. Confidentiality and anonymity were strictly maintained by assigning pseudonyms and securely storing all research data in compliance with the Philippine Data Privacy Act of 2012. The researchers upheld a respectful and empathetic stance throughout the interviews to minimize distress, while participants were encouraged to seek assistance from the school's support services if needed. These measures were implemented in alignment with the ethical principles of respect for persons, beneficence, and justice, as well as the standards set by the Department of Education's Basic Education Research Agenda (DepEd Order No. 39, s. 2016).

RESULTS AND DISCUSSION

This section presents the findings on students' lived experience in solving physics problems. Data from interviews were analyzed to show how students' approach/engagements and its impact during physics problem-solving. Each finding is discussed in relation to its implications for learning and understanding physics.

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Table 2. Students' Strategic, Emotional, and Agentic Engagement in Physics Problem-Solving.

Constituents	Identification Number of Participants
The use of organized, step-by-step methods and visual tools to handle physics problems.	
- Students used structured methods like GAFSA or *"list, draw, substitute"* to organize information and reduce confusion.	P1, P5, P7, P9, P10
- Students commonly wrote down given/asked values, recalled formulas, and converted units to SI before computing to avoid errors.	P2, P6, P9
- Many drew diagrams or sketched setups to visualize the problem and guide groupmates.	P3, P4, P5, P9
- A number preferred to solve independently first and then share results with peers to ensure clarity and spot mistakes.	P6, P8, P10
Managing stress, confusion, and excitement while solving physics problems.	
- Students often started tasks feeling confused or anxious, especially under time pressure or new topics.	P1, P3, P5
- Several panicked at wrong answers but used notes or calming strategies to stay composed.	P2, P5, P6
- Many shifted from frustration to relief and pride after fixing mistakes or confirming answers.	P3, P5, P7, P9
- Students balanced excitement and worry during real or outdoor experiments, feeling more connected after succeeding.	P2, P9
Taking initiative to support one's own learning and improve group performance.	
- Students often asked for clarification and reviewed notes to grasp difficult parts.	P1, P3, P6
- Several made reviewers, flashcards, or simplified steps before tests to guide themselves under pressure.	P4, P5, P6, P10
- Many led in explaining formulas, drawing setups, or suggesting improvements to help their group.	P2, P6, P8, P9
- Even quieter students shared notes online and used AI only to confirm their solutions, showing proactive self-help.	P6, P9, P10
Transformative impact on students' future approaches to physics learning	
- Students realized that practice and breaking down problems eased anxiety and built confidence for future tasks.	P1, P3, P5
- Many learned to ask questions and double-check their work, seeing these as skills they can carry to harder topics.	P3, P5, P6
- Several adopted habits like unit checking, neat tables, and visualizing setups, making physics feel like teamwork and self-management.	P2, P6, P9, P7

Table 2 presents the lived experiences of high school students enrolled in the STEM Program as they engage in physics problem-solving. The phenomenological analysis of their narratives revealed four core constituents that frame the essential structure of this experience: *(1) strategic engagement, (2) emotional engagement, (3) agentic engagement, and (4) their transformative impact on learning.* These constituents emerged from transformed meaning units distilled from the students' own descriptions, capturing how they organize, feel, and take initiative during problem-solving and how these actions reshape their approach to future tasks.

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Use of organized, step-by-step methods and visual tools to handle physics problems

The first constituent highlights students' intentional use of organized, step-by-step methods to approach physics problems systematically. Many participants described adopting structured approaches such as the GAFSA method (Given, Ask, Formula, Solution, Answer) or "list, draw, substitute" to arrange information and reduce confusion. This experience was consistently lived as turning something initially confusing into something understandable and orderly. Participants reported identifying known and unknown values, selecting appropriate formulas, converting quantities into SI units, and sketching diagrams to visualize scenarios. These actions were experienced not as routine habits but as deliberate moves to bring clarity, reduce mistakes, and sustain a sense of progress in the problem-solving process.

One participant expressed this experience by stating:

> *"I usually use the GAFSA method (Given, Asked, Formula, Solution, Answer) when solving physics problems because it makes everything clearer and easier to follow. Before, I would get confused about where to start, but with GAFSA, everything becomes organized and I immediately know what comes first and what to do next. This step-by-step approach helps me avoid confusion and trace my errors. It has become my go-to method because it gives me confidence and a sense of 'peace of mind gyud' whenever we answer in class." (P1)*

Another student echoed this mindset, saying,

> *"First, I organized everything clearly in my notebook. I made a clean table showing all the given values and available measurements, and I highlighted the unknown so I would know exactly what to look for. I also wrote down the units for each quantity and converted them to SI to avoid mistakes during computation. Doing this makes the flow of my solution clearer and helps me trace where I went wrong if ever I make a mistake—para dili ko malipat ba [so that I won't get confused/forget]." (P2)*

These statements show that students lived the act of writing, listing, and tabulating as a way of externalizing the problem, transforming it from a confusing situation into one that could be sequentially managed (Wienecke et al., 2023).

This tendency is also evident in students' use of visual tools. P4 and P9 illustrated how visual strategies supported their problem solving. Being a visual learner, the participant described starting by drawing the lens and marking the placement of the screen to understand the problem more clearly. This aligns with the findings of Bande (2025), which showed that students enhance their understanding when lessons are presented visually, as it allows them to see and organize abstract concepts more concretely. They noted that this practice extends beyond classroom activities, as they also sketch scenarios at home whenever possible before carefully inputting the data (Cabugwason, et al., 2024). This shows that visual representation was not a mere supplement but was lived as part of the thinking process itself (Endiape et al., 2023). Drawing allowed students to "see" and "grasp" relationships that were otherwise abstract, making the situation more concrete and manageable (Bacarro et al., 2024).

Taken together, these findings suggest that organized methods and visual tools serve as intentional structures that reshape how students live through the difficulty of solving physics problems. This idea aligns with a study showing that students who adopt structured strategies demonstrate stronger problem-solving performance and cognitive regulation in physics learning (Sauro, 2024). Cognitively, they transform complex and confusing tasks into clear, ordered sequences by making information easier to follow, showing where to begin, and allowing students to retrace their steps whenever needed; this is supported by studies reporting that learners use planning, monitoring, and evaluating strategies to organize their thought processes during problem solving (Presto & Menorca, 2023). Emotionally, they generate a lived sense of control, calmness, and confidence that counters

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the anxiety often felt in problem solving; this is consistent with evidence that effective instructional and learning strategies reduce anxiety and improve students' self-efficacy in physics contexts (Hermoso, 2025). In phenomenological terms, students are not merely applying techniques but are constituting the learning situation so that it is less overwhelming and more approachable. This description emerged through careful attention to participants' accounts while setting aside presuppositions, allowing the essence of their experience to show itself.

The essential meaning that emerges from this constituent is the experience of *"clarity through structure."* Through listing, drawing, tabulating, and sequencing, participants consistently described a shift from confusion to order, from uncertainty to predictability, and from anxiety to assurance. This essence captures how organized, step-by-step methods and visual tools are not just aids but integral to the lived experience of making physics problems solvable and livable.

Managing stress, confusion, and excitement while solving physics problems

The second constituent highlights how students manage stress, confusion, and excitement while solving physics problems. Their narratives reveal that emotional experiences are not separate from cognitive activity but are interwoven with the very act of solving. Students do not simply "feel" nervous or excited; they regulate these states through deliberate strategies that allow them to persist in the task.

One participant expressed this experience by stating,

> *"At the start, I felt nervous because the task was timed and individual. I even noticed my hands getting a bit cold. But once I began writing the given and the formula, I started to calm down because I knew the process—nakabalo ko unsay buhaton [I know what to do.]." (P5)*

Another student reflected,

> *"At first, I felt excited because it was a new topic, and total internal reflection was interesting for me. But I also knew I sometimes got confused with the ratio of indices, so I felt a bit anxious. When I got the wrong answer, I felt discouraged for a moment, but I reminded myself to 'tan-awa balik sa formula' [Check the formula again]. After correcting it and finally getting the right angle, I felt relieved and even a little proud." (P6)*

These statements reveal that emotions such as nervousness, discouragement, and excitement are not static; students employ self-reminders, procedural routines, and calm re-checking to manage them. This recurring pattern shows how emotional states shift in relation to problem-solving actions. Several students described starting from confusion or anxiety, experiencing momentary panic when an answer seemed wrong, and then moving toward relief and pride once they corrected the mistake or confirmed their answer (Esto et al., 2025). In line with this study, Filipino learners who demonstrated stronger self-regulation and emotional regulation skills were more likely to perform well in complex tasks, such as science and mathematical reasoning (Molina et al., 2025). P3, for example, noted that at first, they were *"confused and a little nervous"* but "*began to feel more relaxed as the steps became clearer"* and eventually felt *"very happy and relieved"* upon reaching the correct answer. In phenomenological terms, this reflects a lived experience in which emotional regulation emerges within the act of solving itself. Recent studies show that students apply self-monitoring or reflective pauses during challenging tasks (Siason et al., 2025). Students' strategic actions such as writing lists, checking formulas, or taking deep breaths serve as coping mechanisms through which stressful moments are transformed into calmer and more confident engagement (Haberlin, 2024).

The essence of this constituent lies in the way emotions are inseparably woven into the experience of problem solving. Stress and confusion initially disrupt the process but are gradually transformed through actions such as writing down givens, checking formulas, or taking deliberate pauses. Excitement likewise becomes interlaced with the effort, intensifying the sense of relief and pride

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once solutions are reached. Across participants, the invariant meaning is that emotional regulation is not an additional step but part of the essential structure of the lived experience of solving physics problems (Pasigon, 2022).

Taking initiative to support one's own learning and improve group performance

The third constituent highlights how students demonstrated initiative to strengthen their own learning and enhance the performance of their group. Rather than relying passively on instructions, they prepared resources, clarified uncertainties, and introduced improvements during activities.

One participant expressed this experience by stating,

> *"During the quiz, I couldn't ask the teacher for help, but I had already prepared by practicing problems at home. I also made my own short reviewer from the module, writing simplified steps like 'list, draw, substitute, check units' in bold at the top. This was my initiative to guide myself during timed tests—para ma-guide akong self jud [To guide myself properly.]" (P5)*

Another student described,

> *"Even though I'm usually quiet, I took the initiative to share my answers with the group. I explained that* $\sin\theta_c = n_2/n_1$ *and why it shouldn't be reversed. I also suggested to the teacher that having a printed formula sheet for the next activity would save time. I have a habit of making flashcards for formulas to use during review, and I also share them with my groupmates on Messenger—ako jud nag-take initiative [I really took the initiative]." (P6)*

These accounts show that initiative is not limited to leadership roles; even quieter students develop personal strategies and contribute actively to the collective learning process. The essential structure revealed that students' initiative emerged in two interrelated forms (Briones et al., 2023). On the individual level, they created their own reviewers, flashcards, and simplified steps ahead of tests to reduce stress and guide themselves under pressure (Yusefzadeh et al., 2019). On the group level, they explained formulas, suggested improvements such as printed formula sheets, and shared learning materials to support collective outcomes, leveraging professionally guided worksheets that include formulas and visual cues to help students systematically approach and solve problems, thereby reducing confusion and enhancing understanding.

These actions represent intentional acts of self-direction and collaboration that shaped the classroom into a space of shared problem solving rather than passive reception (Cagatan & Quirap, 2024). The essence of the experience is that initiative gives students a sense of confidence, resilience, and agency, while also fostering a culture of mutual support among peers (Blegur et al., 2019).

Transformative Impact on Students' Future Approaches to Physics Learning

The fourth constituent highlights how students rely on emotion-focused and socially mediated coping strategies to sustain their learning in physics. Rather than simply enduring stress or confusion, they regulate their emotions, pause intentionally, and seek support to remain engaged with the subject.

One participant expressed this experience by stating,

> *"When I feel nervous, I pause and review my notes instead of panicking. It's like a reminder to chill lang, ayaw dali-dali [just relax, don't rush.]. Sometimes I play music or take a short break to calm down. After that, my mind is clearer, and I feel more confident returning to the task—mas confident ko mu-balik sa task [I feel more confident to go back to the task]." (P2)*

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This experience reflects how students use emotional regulation as part of their study routine, pausing and resetting themselves to regain focus before continuing a problem-solving task (Simpal, 2024). Another participant (P3) noted that asking for help and checking notes made learning "easier and less stressful," demonstrating that seeking support and leveraging personal resources are integral to coping with academic challenges. These acts reveal students' awareness that effective learning is sustained not by avoidance, but by intentional self-care and connection with others..

Students described positive self-talk, social support, and encouragement from peers or family as vital in maintaining motivation. In phenomenological terms, these are intentional coping acts that transform anxiety and confusion into manageable experiences. Students consciously shift from isolation to engagement, relying on small emotional resets and supportive interactions to remain active in learning (Felizardo et al., 2024).

The essential structure of this experience shows that coping is not a peripheral behavior but a core aspect of learning physics. Emotional regulation and social connection allow students to restore calm, think clearly, and re-engage with the subject (Panjaitan et al., 2025; Tomas et al., 2015). Through these strategies, students develop a sense of control and resilience, enabling them to approach future physics tasks with greater confidence and persistence (Serrano & Reyes, 2022).

Taken together, the four constituents reveal physics problem-solving as a holistic experience where thinking, feeling, acting, and becoming are intertwined. Students engaged strategically, organizing information to transform confusion into clarity and gain control over problems. Emotional regulation emerged alongside these strategies, with reflective pauses, self-reminders, and careful rechecking supporting persistence. This interplay fostered agentic engagement, as students guided their own learning, supported peers, and suggested improvements. Over time, these patterns reshaped their approach to future physics tasks, building confidence, resilience, and a positive relationship with the subject. Physics problem-solving, therefore, is not merely technical but a transformative process in which students construct meaning, regulate themselves, and develop agency as learners.

This holistic engagement was evident throughout the learning process. Students began by organizing information, identifying unknowns, and applying structured strategies such as GAFSA, listing, and drawing. During problem-solving, they regulated emotions, checked formulas, corrected errors, and persisted despite confusion or anxiety. Participation extended beyond individual tasks, as students prepared reviewers, shared explanations, suggested instructional improvements, and reflected on how strategies and emotional regulation would guide their future learning.

CONCLUSION AND IMPLICATIONS

The phenomenological analysis revealed that students' lived experiences of physics problem-solving are structured by four interrelated constituents: *(1) strategic engagement, (2) emotional engagement, (3) agentic engagement, and (4) their transformative impact on learning.* Overall, students actively created meaning, clarity, and composure while navigating physics problems. They experienced strategic engagement as a process of transforming confusion into order through deliberate organization, listing, drawing, and sequencing steps that made abstract concepts more approachable. Emotional engagement manifested as a shift from anxiety and uncertainty toward calmness, relief, and satisfaction, as students regulated their emotions through self-reminders, reflective pauses, and positive coping strategies.

Students also demonstrated agentic engagement by taking initiative to improve understanding, share insights, and support peers—even those who were usually quieter. The transformative impact emerged as students recognized that these ways of thinking, feeling, and acting reshaped their relationship with physics and their sense of self as learners. This shows that physics problem-solving is not merely a technical or intellectual task but a lived experience where strategy brings clarity, emotion provides balance, and agency fosters confidence. Learning physics thus became an experience of self-formation, where students lived through confusion, effort, and reflection to develop a more grounded and resilient awareness of themselves as learners.

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These findings suggest that physics education should intentionally cultivate strategic, emotional, and agentic engagement. Teachers can integrate structured problem-solving methods, reflective practices for emotional regulation, and opportunities for learner autonomy and collaboration. For example, educators might use concept maps or checklists (strategic), reflective journaling or stress breaks (emotional), and peer teaching or choice-based problem tasks (agentic). By nurturing these interconnected dimensions, physics instruction can move beyond formulaic learning toward a more humanized and empowering practice that supports cognitive growth, emotional well-being, and authentic participation in scientific learning. Ultimately, this approach contributes to inclusive and transformative science education, aligning with SDG 4 by fostering reflective, capable, and self-directed learners.

LIMITATION OF THE STUDY

The findings of this study should be interpreted in light of several limitations. First, the results are based on a small and context-specific group of students, and therefore are not intended to be generalized to all physics learners or instructional settings. Second, the analysis relied on participants' self-reported narratives, which, while essential for capturing lived experience in phenomenological research, may be influenced by recall, articulation, or social desirability. Third, the study focused on students' experiences within particular physics problem-solving tasks and instructional conditions, and does not account for variations across different topics, grade levels, or longer learning periods. Finally, although methodological rigor and reflexivity were maintained, the interpretation of meanings remains shaped by the researcher's analytic lens, as complete elimination of subjectivity is not possible in phenomenological inquiry.

RECOMMENDATION

Based on the study's findings, it is recommended that teachers and curriculum designers adopt reflective, student-centered strategies that foreground learners' lived experiences in physics problem-solving. Instruction should integrate cognitive structuring techniques, such as the GAFSA method, with opportunities for emotional expression, self-regulation, and peer collaboration. Embedding reflective activities like journaling, group dialogue, or process-based feedback can help students become more aware of their thinking and emotional patterns while solving problems.

Future researchers are encouraged to extend this phenomenological approach to other physics domains or grade levels to examine how engagement evolves across contexts. Comparative studies may explore how strategic, emotional, and agentic engagements manifest among diverse learners or under different instructional modalities. Moreover, it is recommended that the participants or sample include an equal proportion of males and females to provide a more balanced perspective on experiences in physics learning.

Finally, professional development programs should equip teachers to recognize affective and agentic dimensions of learning and design lessons that support student agency and resilience. By following these directions, both educational practice and research can further humanize physics learning, empowering students to engage meaningfully with science beyond mere formulas.

ACKNOWLEDGEMENTS

The researcher extends sincere gratitude to the Science, Technology, Engineering, and Mathematics (STEM) students of Baybay City, Leyte for their invaluable participation in this study. Their openness in sharing their lived experiences and reflections on physics problem-solving made this research possible. Their insights, effort, and sincerity greatly contributed to deepening the understanding of student engagement in the context of physics learning.

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USE OF ARTIFICIAL INTELLIGENCE TOOLS

Artificial intelligence (AI) tools were utilized to assist in the translation of students' statements from Bisaya to English to ensure clarity and accuracy while preserving the original meaning of their responses. In addition, AI-assisted applications were used for grammar refinement and spelling correction to maintain the academic quality and readability of the manuscript. All AI tools were employed solely as linguistic and editorial aids, while the interpretation and analysis of data remained entirely researcher-driven.

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