



Research Article

Finding Their Place in Science Teacher Education: The Lived Experiences of Students from Non-Science Academic Backgrounds

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Abstract. The increasing number of students from non-STEM academic backgrounds pursuing science teacher education has raised concerns regarding their preparedness to meet the academic demands of science learning. Although previous studies have documented strand-related differences in academic performance, STEM readiness, and learning outcomes, limited research has explored how non-STEM students experience the transition into science teacher education and make sense of this journey. In line with this, the study explored the lived experiences of non-STEM students enrolled in the Bachelor of Secondary Education major in General Science (BSEd-General Science) program and examined how they navigated the challenges of learning science while developing their identities as future science educators. Guided by Husserlian descriptive phenomenology, six (6) purposively selected participants took part in in-depth interviews conducted either face-to-face or through Google Meet, and interview transcripts were analyzed using Colaizzi's phenomenological method. Findings revealed that participants experienced initial academic disorientation due to limited prior exposure to science, resulting in difficulties with scientific concepts, computations, and laboratory-based learning. Despite these challenges, students gradually adapted through self-regulated learning, perseverance, faith, and support from teachers and peers, enabling them to build confidence, resilience, and a sense of professional identity. Their experiences demonstrate that becoming a future science educator is a dynamic, transformative process shaped by prior educational background, supportive learning environments, and personal determination. The study underscores the importance of institutional support mechanisms and bridging initiatives that facilitate successful transitions for non-STEM students while contributing a deeper understanding of their academic adjustment, resilience, and professional growth in science teacher education.

Keywords: BSEd-General Science; Cognitive challenges; Colaizzi's method; Husserlian phenomenology; Lived experiences; Non-STEM students; Resilience; Science education.

In a world driven by discovery and innovation, the doors of Science, Technology, Engineering, and Mathematics (STEM) promise opportunity, yet not all students enter with equal footing. Globally, STEM education is widely positioned as a driver of economic development, technological innovation, and national



competitiveness, shaping educational reforms and policy priorities across contexts (Mudaly & Chirikure, 2023; Emelue, 2025). As STEM fields gain institutional prestige, students are increasingly expected to demonstrate early preparation and alignment with science-related pathways. However, transitions into STEM are not experienced equally. Students from non-STEM backgrounds consistently experience greater challenges during transitioning to STEM. Across several studies, researchers agree that these students often report lower science identification, increased anxiety toward STEM subjects, and diminished confidence and engagement in science learning (McBride et al., 2020; Hewagallage et al., 2022; Megreya & Al-Emadi, 2023; Lucas & Vandergon, 2024). These difficulties are further intensified by gaps in foundational content knowledge, particularly in chemistry, which undermine confidence and self-efficacy during STEM transitions (Bulasito, 2025). However, studies also consistently demonstrate that mentorship, a strong sense of belonging, and supportive learning environments can mitigate these challenges by strengthening students' motivation, engagement, and academic self-efficacy (Apriceno et al., 2020; Zahner & Harper, 2022). The shift from secondary to higher education further complicates this process, as students must navigate academic adjustment, person-major fit, and institutional expectations that may magnify preparation gaps (Gomez et al., 2022; Osafo et al., 2025).

In the Philippine context, the K-12 strand tracking system was designed to align senior high school preparation with tertiary pathways (Burgos, 2025), positioning the STEM strand as the primary route to science-related degrees (Andrada & David, 2020). Despite this structural alignment, student trajectories remain fluid. However, these findings are not entirely uniform. Other studies suggest that although non-STEM students initially face academic disadvantages, adaptive study habits, effective coping strategies, motivation, and mentor support enable many to adjust successfully and persist in science-related programs (Barrot et al., 2021; Abata, 2025; Macayana, 2025). At the same time, readiness is mediated by adaptive study habits, coping strategies, and motivation (Barrot et al., 2021; Abata, 2025), as well as career aspirations and mentor influence that draw students toward science education despite non-STEM origins (Macayana, 2025). These transitions occur within broader systemic tensions, including uneven K-12 implementation, persistent science proficiency gaps, and teacher shortages, which have resulted in non-specialist teachers handling STEM subjects, a condition likely to negatively affect future generations of STEM learners and educators (Rogayan et al., 2021; Lumbu-An, 2022; Bernardo et al., 2023; Siason et al., 2025; Thompson-Lee et al., 2025).

While existing literature in the Philippine context has extensively documented strand-based performance disparities, preparation gaps, and structural constraints in STEM pathways, these studies remain largely focused on quantitative academic outcomes rather than the lived experiences of students navigating science-related programs (Bautista et al., 2021; Guo et al., 2025). Limited attention has been given to how non-STEM students experience the transition into science teacher education, particularly regarding identity formation, academic confidence, sense of belonging, and commitment to the profession. As a result, these students' personal struggles, adjustments, and coping mechanisms remain underexplored despite their growing presence in science-related degree programs.

The researchers were motivated by observations within the research group, where one researcher from a non-STEM strand consistently struggled with science concepts, laboratory activities, and academic adjustment compared to peers with STEM preparation. These experiences prompted this study, which explored the lived experiences of non-STEM students enrolled in the Bachelor of Secondary Education major in General Science (BSEd-General Science) program and how they navigated the challenges of transitioning into science teacher education. The findings offer insights into their experiences, challenges, and coping strategies, with implications for developing academic support and bridging initiatives and contributing to a deeper understanding of non-STEM students' transition into science education.

Methodology

Research Design

This study employed Edmund Husserl's descriptive phenomenological design to explore the lived experiences of BSEd-General Science students with non-STEM backgrounds, focusing on their conscious experiences throughout their academic journeys. Grounded in Husserlian phenomenology, this approach aimed to uncover the essence of participants' experiences by describing them as consciously lived, free from preconceived assumptions and external interpretations (Christensen et al., 2017). Data were collected through in-depth interviews to generate rich, first-person narratives, a method widely used in phenomenological research to capture authentic

experiences. Before conducting the interviews, the researchers engaged in bracketing to surface and set aside presuppositions, thereby maintaining a participant-focused stance; this was operationalized through systematic reflexive journaling, a strategy recommended to strengthen reflexivity and rigor in phenomenological studies (Dörfler & Stierand, 2021). The transcripts were analyzed using Colaizzi's method, which involved identifying significant statements, formulating meanings, clustering themes, and validating findings with participants to reveal the shared essence of the phenomenon (Praveena & Sasikumar, 2021).

Research Participants

The research participants were non-STEM students enrolled in the Bachelor of Secondary Education major in General Science (BSEd-General Science) at the tertiary level in Dumaguete City. The study used criterion purposive sampling, in which participants were intentionally selected because they met predetermined criteria directly relevant to the phenomenon under investigation. This sampling strategy was appropriate for the phenomenological study because it enabled the researchers to obtain rich, firsthand accounts from individuals who had transitioned from a non-STEM academic background into the BSEd-General Science program. The inclusion criteria were: (1) currently enrolled in the Bachelor of Secondary Education major in General Science (BSEd-General Science) at Foundation University College of Education; (2) graduated from a non-STEM Senior High School strand or completed secondary education without a STEM background; (3) willing to voluntarily participate in the study and provide informed consent; and (4) able to articulate their lived experiences during the interview. The exclusion criteria included students who graduated from the STEM strand, those not enrolled in the BSEd-General Science program, individuals who declined to participate or provide informed consent, and those unable to complete the interview process. Participants came from diverse academic backgrounds: two from the Humanities and Social Sciences (HUMSS) strand, one from the General Academic Strand (GAS), one from the Technical-Vocational-Livelihood (TVL) strand, and two from the Accountancy, Business, and Management (ABM) strand. One participant did not undergo the Senior High School (SHS) program, providing an additional perspective on the participants' varied educational backgrounds and prior academic exposure.

Data saturation was determined through iterative data collection and analysis, wherein each interview was analyzed before proceeding to subsequent interviews. Saturation was considered achieved after the sixth participant, as successive interviews yielded recurring meanings, similar narratives, and no new significant statements, formulated meanings, or emergent themes. To verify that saturation had been reached, one additional participant was interviewed. As no new insights emerged from the additional interview, the researchers concluded that data saturation had been attained.

Research Instrument

To capture the participants' lived experience as BSEd-General Science students who graduated from a non-STEM strand in K-12 senior high school, the researchers used one-on-one interviews. The interview was composed mainly of open-ended and descriptive questions that probed for clarification and elaboration. Participants were encouraged to use English; however, they could respond in their native language when they felt more comfortable expressing their thoughts and experiences. The participants' answers were voice-recorded throughout the interview, and the researchers kept a reflexive journal to note participants' body language and expressions. The researchers transcribed responses verbatim and analyzed them thematically in an unbiased way. The aim was to accurately explore their experiences, struggles, and identity issues related to learning unfamiliar knowledge.

Data Gathering Procedure

The researchers first secured ethical approval from the University's Ethics Review Committee (Ethics Approval Code F-ORD-RPE-004). They obtained permission from the Dean of the Foundation University College of Education (FUCE) before commencing the study. Eligible participants were identified based on the predetermined inclusion criteria: undergraduate students enrolled in the BSEd-General Science program who graduated from a non-STEM Senior High School strand. Eligible students were invited to participate voluntarily after being informed of the study's purpose and nature. The researchers then conducted one-on-one interviews with six (6) participants using open-ended, descriptive questions aligned with the study's objectives.

Before the interview, each participant provided informed consent, and the researcher explained the study's purpose, interview procedures, voluntary participation, confidentiality measures, potential risks and benefits, and the right to refuse or withdraw at any stage without penalty. Interviews were conducted individually, either face-

to-face in a quiet location or via Google Meet, depending on participants' preferences. Each interview lasted at least 20 minutes, was audio-recorded with permission, supplemented with field notes, and transcribed verbatim. To ensure ethical rigor and credibility, participants were given one (1) month to review their transcripts, clarify responses, or withdraw participation if necessary. Thereafter, all identifying information was replaced with pseudonyms, and research data were securely stored in password-protected electronic files and locked storage accessible only to the researchers.

Data Analysis Procedure

The study utilized Colaizzi's seven-step phenomenological method to analyze the transcribed interview data. Throughout the analysis, the researchers performed all coding and theme development manually, without using qualitative data analysis software, to maintain close engagement with participants' narratives. First, the researchers repeatedly read the verbatim transcripts to become immersed in and develop a holistic understanding of the participants' accounts. During this stage, the researchers practiced bracketing through reflective journaling, allowing them to consciously set aside personal assumptions and biases throughout the analysis. Second, the researchers manually reviewed each transcript and extracted Significant statements (SS) that directly described the participants' lived experiences related to the phenomenon under investigation. The researchers identified and extracted phenomenon-relevant statements from the transcripts, then formulated meanings through careful interpretation while applying bracketing to minimize researcher bias. Third, these formulated meanings (FM) were developed by carefully interpreting each significant statement while remaining faithful to the participants' original narratives and minimizing researcher bias through phenomenological reduction, and were then organized into theme clusters, which were synthesized into emergent themes representing the shared essence of the participants' lived experiences. Fourth, the formulated meanings were manually organized into theme clusters based on conceptual similarities, which were then synthesized into emergent themes. To ensure dependability, each researcher independently reviewed and manually coded significant statements and formulated meanings. Whenever differences in coding or interpretation arose, the researchers discussed the discrepancies, revisited the original transcripts and field notes, and reached a consensus before finalizing the themes. Fifth, the validated theme clusters' findings were integrated into an exhaustive description of the phenomenon. Sixth, the exhaustive description was reduced to a concise statement of the fundamental structure of the participants' lived experience. Finally, member checking was conducted by presenting the interpreted findings to the participants to verify whether the themes accurately reflected their lived experiences. Participants' feedback and clarifications were incorporated into the final analysis to enhance the study's credibility, confirmability, and methodological rigor (Praveena & Sasikumar, 2021).

Researcher Reflexivity and Positionality

Most of the researchers were undergraduate students enrolled in the Bachelor of Secondary Education major in General Science program at Foundation University, working alongside their faculty co-researchers. While most researchers graduated from the STEM strand, one researcher came from a non-STEM academic background, and their experiences of academic adjustment and perceived gaps in scientific knowledge motivated the study. Recognizing that these experiences could influence data interpretation, the researchers practiced reflexivity throughout the research process. As members of the same academic program and institution as the participants, the researchers acknowledged the potential influence of familiarity. However, neither the researchers nor the faculty advisers held any instructional, supervisory, evaluative, or grading authority over the participants. Faculty advisers provided guidance only on the research process and were not involved in participant recruitment, data collection, or data analysis. Participation was entirely voluntary, informed consent was obtained, and confidentiality and anonymity were ensured through pseudonyms and secure data storage. To minimize researcher bias, the researchers practiced Husserlian bracketing (*epoché*) before and throughout data collection and analysis through reflexive journaling and regular peer discussions. These practices helped identify and set aside personal assumptions, ensuring that the findings remained grounded in the participants' lived experiences and enhancing the study's credibility, confirmability, and trustworthiness.

Ethical Considerations

This study on the lived experiences of non-STEM BSEd-General Science students adhered to the Foundation University Ethics Review Board (FUERB) ethical standards for qualitative and phenomenological research. Participation was voluntary, and informed consent was obtained before interviews. Confidentiality and anonymity were strictly maintained by assigning pseudonyms such as Participant 1, Participant 2, and so on, in

place of real names. All audio recordings and transcriptions were securely stored and used solely for academic purposes. Participants were also given the option to skip questions they found uncomfortable in order to minimize potential emotional distress. Furthermore, the researchers practiced bracketing and reflexivity to mitigate researcher bias and ensure that the findings faithfully represented the participants' lived experiences, consistent with established phenomenological principles (Dörfler & Stierand, 2021).

For research support tools, artificial intelligence applications were used responsibly and as supplementary aids. Consensus and Google Scholar Lab were used to help locate and organize relevant literature. ChatGPT was used for language refinement and clarity, while NotebookLM supported verification and cross-checking of summarized sources. All references were properly cited, and the researchers strictly limited AI tools to research assistance. The researchers retained full accountability for the analysis, interpretation, and conclusions presented in the study.

Results and Discussion

Following Colaizzi's (1978) phenomenological method, the researchers analyzed the interview transcripts by extracting significant statements, formulating meanings, and clustering these meanings into themes. Table 1 summarizes this analytical process, showing how participants' lived experiences were transformed into formulated meanings and representative codes that culminated in emergent themes describing the academic adjustment experiences of non-STEM students in the BSEd-General Science program.

Table 1. *Academic Adjustment Challenges of Non-STEM Students in Science Education*

Emergent Theme	Essential Sub-themes	Representative Significant Statements	Formulated Meaning	Representative Codes
Gravitational Forces of Scientific Becoming	The Shock of Entering Science Territory	Well, my experiences in taking this course, I have a lot of experiences. When I was still in first year, I really had difficulty adjusting because I'm a non-STEM graduate. There are computations and scientific topics. Overall, you really struggle to understand. Now that I'm in third year, I am still confused why I chose BSEd Science, and I realized that I still have difficulty comprehending scientific theories and scientific problems. Even if they are simple, I still struggle to comprehend. (P1)	The participant experienced prolonged academic disorientation and persistent difficulty comprehending scientific concepts due to a non-STEM educational background.	• Academic adjustment • Knowledge gap • Difficulty comprehending scientific concepts
	The Quiet Fight Beneath the Weight of Science	So, I overcome those challenges through prayers and by convincing myself that it is okay to move forward slowly, one step at a time. It does not mean that I am behind other students. Since I chose this path, I need to keep up and survive. (P4)	The participant coped with academic pressure by drawing strength from faith, self-acceptance, and perseverance while embracing gradual progress.	• Faith-based coping • Persistence • Emotional resilience • Self-acceptance
	The Bridges That Helped Them Move Forward	Yes, they really helped us during difficult times. They felt like family who never leave you behind. (P2)	Emotional and academic support from peers fostered belonging, encouragement, and perseverance throughout the participants' journey.	• Peer support • Sense of belonging • Emotional support
	The Initial Friction Between Mind and Science	Science was really very difficult at first. But as time passed, that difficulty was gradually replaced with happiness. I began to see the beauty of science. I came to like science and eventually learned to love it, which motivated me to continue the course. (P2)	Continuous exposure to science transformed the participant's perception from fear and difficulty to appreciation, curiosity, and intrinsic motivation.	• Appreciation of science • Positive perception • Intrinsic motivation • Personal growth
	The Metamorphosis of a Future Science Teacher	No. I was very shy before, but entering the education and science program helped me become more confident and mature through the guidance of the faculty. At first, speaking in front of many people made me extremely nervous. However, by my third year, teaching had become natural. We no longer	Through repeated teaching experiences, the participant gradually developed confidence and embraced the identity of a future science teacher.	• Teacher identity formation • Confidence • Professional growth

	relied on scripts because we had already mastered what to say and how to deliver our lessons. (P2)		
The Pressure of Unequal Conditions in Learning Science	That was when I realized that they already had an advanced understanding of the topics compared to us. We came from schools with different qualities of education. In our previous school, what we learned was shallow, and my science teacher was not even a science major. (P4)	Unequal educational opportunities and inadequate prior science preparation created barriers that made adapting to science education more difficult.	• Educational inequality • Limited preparation • Unequal learning opportunities
The Growth into Strength and Independence	Sometimes I feel disappointed because I used to be a consistent awardee in high school. But when I entered college, I became humbled because I realized that the knowledge I gained from high school was not enough. (P6)	Confronting academic limitations fostered humility, resilience, and personal growth as the participant gradually adapted to the demands of science education.	• Self-awareness • Humility • Resilience • Personal growth

Colaizzi's phenomenological analysis revealed one overarching emergent theme encompassing seven essential themes. As summarized in Table 1, participants' significant statements were analyzed, transformed into formulated meanings, coded, and clustered into essential themes that collectively describe their lived experiences as non-STEM students transitioning into science teacher education. The succeeding discussion elaborates on each essential theme and its contribution to the overall essence of the phenomenon.

Emergent Theme: Gravitational Forces of Scientific Becoming

The emergent theme, Gravitational Forces of Scientific Becoming, captures the lived experience of non-STEM students whose journey toward becoming science educators was shaped by multiple forces that continuously influenced their growth. Much like gravity, these forces were often unseen yet constantly present, drawing participants through moments of uncertainty, challenge, adaptation, and transformation. These gravitational forces emerged from participants' previous educational experiences, the demands of science learning, relationships with teachers and peers, institutional conditions, and their own determination to persevere. Together, these forces did not simply influence learning but continually reshaped how participants understood science, viewed themselves, and envisioned their future as science educators. For the participants, becoming a science educator was not a straight path but a continual movement shaped by opposing and supporting forces. They described moments of resistance, self-doubt, encouragement, persistence, and personal growth that gradually transformed unfamiliarity with science into confidence and professional identity.

This emergent theme is composed of seven sub-themes, specifically: a) The Shock of Entering Science Territory; b) The Quiet Fight Beneath the Weight of Science; c) The Bridges That Helped Them Move Forward; d) The Initial Friction Between Mind and Science; e) The Metamorphosis of a Future Science Teacher; f) The Pressure of Unequal Conditions in Learning Science; and g) The Growth into Strength and Independence.

Theme 1: The Shock of Entering Science Territory

Every journey begins with crossing an unfamiliar boundary. For the participants, entering science teacher education meant stepping into a foreign learning environment, where scientific language, mathematical reasoning, and laboratory expectations immediately challenged the knowledge they had previously acquired. Rather than feeling welcomed into a familiar discipline, they described an initial encounter marked by uncertainty, confusion, and the realization that science demanded ways of thinking they had not developed during their earlier educational experiences.

The first subtheme, The Shock of Entering Science Territory, captures the participants' initial encounter with science teacher education as non-STEM students. Rather than describing science as inherently impossible, participants portrayed their entry into the program as an abrupt transition into an unfamiliar academic environment. Entering the BSEd-General Science program meant confronting scientific concepts, technical language, computations, and laboratory-based learning that they perceived as largely absent from their previous educational experiences. Their earliest experiences were therefore characterized by uncertainty, confusion, and the challenge of adjusting to new academic expectations.

Several participants experienced their first encounters with the program as overwhelming because they felt unprepared for the level of scientific knowledge expected of them. One participant shared that the adjustment was immediate and difficult upon entering the program:

Well, in this course, I had a lot of experiences. When I was still in first year, I really had difficulty adjusting because I'm a non-STEM graduate; there are computations and scientific [topics]. Overall, I really struggle to understand. Now that I'm in third year, I am still confused about why I chose BSEd Science, and I've realized I still struggle to understand scientific theories and problems; even when they are simple, I still have difficulty grasping them. (P1)

This struggle becomes more grounded when contrasted with academic background shifts that feel abrupt and unprepared, reflecting a discontinuity in learning trajectory where science is encountered without the gradual scaffolding that typically supports it, leaving students to build understanding in real time rather than from established foundations. Similarly, another participant described entering science education as moving into an academic field that felt entirely unfamiliar because of a previous background outside science.

So, as a non-STEM graduate who took BSEd Science, my experience hasn't been easy. It is very difficult knowing I don't have a science background because I was an ABM graduate before. ABM is more business-focused, and then suddenly I was placed in science; it really isn't relatable... We did not have that in Grade 12. (P2)

The difficulty is further intensified when students compare themselves with peers who already have prior STEM preparation, where academic adjustment becomes relational and shaped not only by content difficulty but by perceived gaps in preparedness within the learning environment itself. As one participant puts it:

It is difficult to keep up with STEM students since they have already tackled calculus... You don't have background... that is really my biggest challenge. (P6)

Across these narratives, participants experienced entering science education as stepping into unfamiliar academic territory marked by confusion, unfamiliar scientific concepts, and the demands of adjusting without prior preparation. Collectively, these experiences reveal that learning science was lived not simply as acquiring new knowledge but as simultaneously reconstructing the foundations participants felt they lacked.

These narratives correspond with previous studies showing that limited prior knowledge may increase cognitive demands during the transition into science-related programs and influence students' early conceptual understanding (Ngu et al., 2023; Hunsu et al., 2024). Likewise, participants' accounts of uncertainty upon entering science education are consistent with research indicating that students from non-STEM backgrounds often experience lower academic confidence and greater apprehension when beginning STEM-related studies (McBride et al., 2020; Lucas & Vandergon, 2024). For participants, entering science education was therefore an unfamiliar beginning marked by uncertainty and adjustment. The "shock" was not merely the difficulty of science itself, but the experience of crossing into an academic world whose expectations, language, and ways of learning initially felt unfamiliar.

Theme 2: The Quiet Fight Beneath the Weight of Science

Science did not become less demanding after participants entered the program. Instead, they described living with its demands through small, deliberate acts of persistence that unfolded in everyday life. Coping emerged not through dramatic breakthroughs but through quiet routines, faith, discipline, and the continual choice to keep moving forward.

The second subtheme, The Quiet Fight Beneath the Weight of Science, reflects this lived experience of enduring the ongoing demands of science education. Here, the "quiet fight" represents the largely unseen process of navigating academic, emotional, and cognitive pressures, while the "weight of science" symbolizes the burden participants carried as they learned to persist. For many participants, this quiet persistence first emerged as an inward process of emotional grounding.

Before coping became a matter of routines or study strategies, it began with stabilizing themselves emotionally through faith, self-talk, and quiet acceptance of the challenges before them. Rather than immediately seeking solutions, participants first tried to steady themselves amid overwhelming academic demands.

So, I overcome those challenges through prayers, and then I convince myself that it's okay to move forward slowly, one step at a time, and it doesn't mean you are behind other students... and since I chose to study, you really have to adjust for survival of the fittest; you need to keep up with the pace of time. (P4)

Others approach the same struggle through structure and discipline, turning time into something that must be actively managed rather than passively experienced. Coping becomes operational, expressed through routine and deliberate organization of academic responsibilities, suggesting that control over time becomes a substitute for control over difficulty itself. As one participant explains:

To overcome obstacles, time management is important: managing your time, making to-do lists, and avoiding procrastination. (P3)

For some students, coping takes the form of proactive learning, where they meet difficulty not now of instruction but ahead of it. This anticipatory strategy reflects an attempt to reduce cognitive overload by transforming unfamiliarity into preparation, where learning is extended beyond classroom boundaries. One participant shares:

What I do is just study, do advanced study, and familiarize myself with that thing... just do advanced study. (P5)

Although participants exercised personal responsibility for learning, they also recognized that understanding sometimes required asking for clarification. Seeking assistance did not replace their own effort; it became another way to work through academic difficulty.

So, I really keep asking Sir B during class and sometimes just to my classmates... No one can help you but yourself. (P6)

Across their accounts, coping was not a single response to academic pressure but an ongoing way of living with the demands of science education. Participants experienced drawing simultaneously on emotional grounding, disciplined routines, proactive learning, and interpersonal support as they continued their journey.

These experiences align with studies identifying self-regulated learning as a key process through which students plan, monitor, and adapt their learning in response to academic challenges (Wolters & Brady, 2020; Chitra et al., 2022; Lourenço & Paiva, 2024). Likewise, participants' emphasis on planning and avoiding procrastination reflects previous findings that effective time management supports academic adjustment and performance (Barrot et al., 2021). Their willingness to seek clarification from teachers and classmates while maintaining responsibility for their own learning is also consistent with research highlighting adaptive help-seeking and self-regulation as important coping behaviors during educational transitions (Hecht et al., 2022; Apriceno et al., 2020; Zahner & Harper, 2022). Although participants also sought support from teachers and classmates, these accounts emphasize that persistence was ultimately experienced as a personal commitment to continue despite ongoing difficulty. While previous studies have identified these coping strategies individually, the present findings show that participants did not experience them as separate responses. Instead, emotional grounding, disciplined routines, proactive preparation, and help-seeking were lived as interconnected ways of sustaining themselves throughout their journey in science education.

What ultimately emerges from these narratives is not simply survival but a quiet process of becoming. Participants did not eliminate difficulty; rather, they gradually organized themselves around it. Within this process lay a quiet strength, where every plan, every repetition, every act of asking, and every moment of self-pacing became part of sustaining their journey through science education. It was a fight that did not shout, but moved steadily beneath the weight of science.

Theme 3: The Bridges That Helped Them Move Forward

The third subtheme, The Bridges That Helped Them Move Forward, describes how teachers, classmates, and supportive learning environments became the connections that enabled participants to navigate academic challenges, build confidence, and continue progressing in science education. A recurring pattern in their accounts shows that the transition into science education was not experienced as an individual journey. Although the challenges of learning science were encountered personally, participants came to experience adjustment through relationships that accompanied them along the way. Support extended beyond academic assistance and was encountered through encouragement, understanding, and shared efforts that made the demands of science education feel more manageable. Among these relationships, peer collaboration emerged as one of the earliest sources of support. Classmates became companions in making sense of unfamiliar concepts, completing academic tasks, and facing the uncertainties of learning science together.

I didn't realize it before, but now I've become more collaborative... we really helped one another, and if someone struggled, we helped them (P1)

For many participants, classmates became more than companions inside the classroom. During moments of exhaustion and discouragement, they became a source of comfort and reassurance:

Yes, they really helped us during difficult times... they felt like family who never left you behind. (P2)

The participant's description of classmates as "family" reveals how belonging gradually became part of learning itself. Support came not only through shared academic tasks but also through feeling accompanied during difficult moments.

Alongside peer relationships, participants also emphasized the role of teachers in shaping how they encountered difficult scientific concepts. Teacher support was experienced through explanations that were perceived as clearer, adjustments in instruction, and approaches that made unfamiliar lessons easier to engage with.

I noticed that teachers adjusted whenever they discussed lessons, like simplifying the definitions and explanations. (P1)

These experiences suggest that participants valued teaching approaches that acknowledged differences in students' academic preparation. The teacher's adjustment was perceived as an effort to bridge the gap between students' existing preparation and the demands of science education. Through these supportive experiences, participants also began recognizing changes in their own confidence and participation in the science classroom.

Participants also said these supportive experiences encouraged greater participation in classroom activities.

During my second year, I tried my best to understand formulas and numbers, and I was no longer shy to report. (P6)

The participant's increased willingness to report reflects more than growing confidence in classroom participation. It reveals a gradual shift in how science learning was encountered, where activities once associated with difficulty and hesitation became opportunities for engagement and self-expression. Taken together, these narratives show that support systems became integral to participants' academic adjustment, accompanying them as they navigated unfamiliar demands rather than removing those challenges altogether.

These experiences align with previous studies emphasizing the importance of social support, mentorship, and collaborative learning in promoting students' academic engagement and sense of belonging in science-related fields (McBride et al., 2020; Ovink et al., 2024; Capanzana, 2021). Likewise, participants' descriptions of teachers who simplified explanations and adjusted instruction correspond with literature highlighting responsive teaching practices as an important factor in supporting diverse learners within science classrooms (Guo et al., 2025; Prananto et al., 2025). Beyond affirming these findings, the present study shows that participants encountered supportive relationships not merely as sources of academic assistance but as companions in navigating uncertainty while gradually developing confidence within science teacher education.

Thus, the "bridges" described in this theme represent the lived experience of moving through uncertainty with others. Support did not remove difficulty; rather, it became part of the journey through which participants gradually learned to persist, participate, and continue forming their identities within science education.

Theme 4: The Initial Friction Between Mind and Science

The fourth subtheme, The Initial Friction Between Mind and Science, reflects the participants' gradual shift from perceiving science as intimidating and unfamiliar to appreciating it as meaningful and personally significant. The "initial friction" represents the resistance participants experienced when confronting unfamiliar scientific concepts before developing understanding, confidence, and interest through continued learning.

What once felt intimidating and unfamiliar gradually became something participants learned to appreciate. As participants described, science was no longer viewed merely as a subject filled with formulas, numbers, and difficult concepts. Through repeated exposure to lessons, experiments, and real-life applications, participants slowly began to discover meaning, relevance, and even enjoyment in science. What started as fear eventually evolved into curiosity and appreciation. One participant recalled how their perception of science changed over time:

It was really very difficult. That was really my first impression of science. Especially because science seemed connected to math. There were numbers and formulas. So, it was really very difficult. But as time went by and I stayed in BSEd, that difficulty gradually gave way to happiness. It felt like there was a certain beauty in science. Like that. You can really see the beauty of science if you truly focus on the subject... Along the way, I started liking science because I learned so many things and gained so much knowledge. That's how I came to like science. I learned to love science. So it somehow motivated me to continue this course. (P2)

For this participant, learning science involved a gradual shift from difficulty to appreciation. Rather than describing science as becoming easier immediately, the narrative reflects how repeated encounters with scientific concepts allowed the participant to recognize aspects of the discipline that were previously obscured by unfamiliarity. Another participant similarly expressed that difficulty and passion could exist simultaneously:

I find science interesting. Science itself is close to my heart since my mom is a science teacher, so science is my everything. But it is difficult in some ways, like in physics and chemistry, but then again, I'm passionate about science. (P3)

The participant's account illustrates that challenges in science did not necessarily remove their interest in the field. Instead, difficulty became part of the process of engaging with science, where appreciation developed alongside continued effort and exposure.

Hands-on activities also played a significant role in reshaping how participants viewed science. By witnessing concepts come to life through experiments, science became more engaging, understandable, and meaningful:

For me, one of the things that motivated me to continue was doing experiments. I really like experiments because we become so amazed by the results and by what happens. As a future science teacher, I think I would focus more on experiments because one of the best ways students can learn is through them. That's what John Dewey said: 'Learning by Doing.' So, I would focus more on experiments so students would stay motivated and not think science is boring. That's really it: experiments. (P5)

For this participant, experiments represented more than a learning strategy; they became meaningful encounters that shaped how science could be understood and later communicated as a future science educator. Through these encounters, science gradually became more than knowledge to acquire; it emerged as something capable of inspiring curiosity and sustained engagement. Within the participants' narratives, their relationship with science gradually transformed through repeated encounters with learning, experimentation, and classroom experiences. Although the discipline remained academically demanding, these continued experiences helped participants move beyond their initial perception of science as merely difficult and unfamiliar. These findings align with previous studies showing that meaningful, sustained engagement with science promotes greater interest,

appreciation, and relevance among learners (Reed et al., 2022; Starr et al., 2020; Mackenzie et al., 2024; Tabat & Daza, 2025). Instead of portraying these experiences as removing difficulty, the narratives suggest that meaningful engagement gradually transformed how participants understood science, allowing them to move beyond their initial perceptions of complexity. Thus, the initial friction between mind and science represents the participants' lived movement from encountering science as an unfamiliar and demanding discipline toward embracing it as a field of learning, discovery, and future professional significance.

Theme 5: The Metamorphosis of a Future Science Teacher

As participants' understanding of science deepened, they also began to see themselves differently within the profession they had chosen. Their experiences went beyond learning scientific knowledge; through demonstrations, laboratory activities, reporting tasks, and classroom discussions, they gradually encountered the responsibilities of teaching. Early encounters were often characterized by hesitation, uncertainty, and self-consciousness, particularly when explaining concepts before classmates or performing teaching-related activities. Over time, however, repeated involvement in these activities allowed participants to become increasingly familiar with the practices expected of future educators. The fifth subtheme, The Metamorphosis of a Future Science Teacher, captures the participants' gradual transformation into future science educators. "Metamorphosis" reflects the progressive development of confidence, teaching competence, and professional identity that emerged through repeated classroom experiences, demonstrations, and reflection. One participant reflected on how repeated teaching experiences gradually changed the way they approached classroom instruction.

No. Before, I was shy. Then, when I entered education or this science program, I gained more confidence. It felt like I also grew and became more mature as a person while the faculty members were shaping us... Then, I became used to isolating myself. Suddenly, you are asked to face many people. It feels like you are trembling, nervous, wanting to pee, and even feeling nauseous. But now that I'm already in third year, teaching already feels basic to me... Before, we really had scripts, and we included everything there. But now, we no longer use them because we already mastered it. We already mastered what to say and how to deliver everything. (P2)

This account reflects a shift in how teaching was lived by the participant. What was once approached with hesitation and dependence on scripts gradually became a familiar and embodied practice. Teaching was no longer experienced as a performance to endure, but as an activity the participant could confidently inhabit as part of becoming a future educator. Another participant similarly described how teacher education experiences gradually shaped their professional development.

Over the past years, I reflected more on myself, my skills, and my capabilities. Since the College of Education encourages us to do demonstrations and reportings, it gave me confidence to speak in front of people. For me, it improved my communication skills, how I handle other people, my time management, and how I treat my classmates. (P3)

For this participant, demonstrations and reporting were experienced as more than academic requirements. These activities became spaces for reflection and self-recognition, allowing the participant to gradually understand their own abilities and capabilities as a future teacher. Through these repeated encounters, professional identity began to emerge alongside the development of instructional skills.

Professional growth was likewise shaped through practical experience, including moments that did not proceed as expected.

Those failed experiments taught me a lot on how to do better next time... as long as I already know what I should do. (P5)

Rather than being experienced as failures that discouraged continuation, unsuccessful experiments became meaningful learning encounters that shaped the participant's preparation as a future science teacher. These moments revealed that mistakes were not interruptions to learning but part of the process through which scientific understanding and professional growth developed.

Another participant described becoming increasingly comfortable participating in classroom teaching activities.

Then, in second year, it feels like we've become more serious and confident. In second year, I really tried my best to understand the formulas and numbers, and I no longer felt shy reporting in front of any classmate. (P6)

Reporting before classmates reflected more than reduced hesitation. It represented a growing willingness to participate in the practices associated with teaching, where communicating scientific ideas gradually became integrated into the participant's understanding of themselves as a future educator.

Taken together, these narratives reveal that becoming a future science teacher was a gradual process shaped by teaching experiences, reflection, participation, and failure. Through these encounters, participants developed not only pedagogical skills but also a growing recognition of themselves as capable science educators. Consistent with studies highlighting the influence of meaningful educational experiences, supportive environments, reflective practice, and teaching self-efficacy on preservice teacher identity formation (Menon & Azam, 2021; Haatainen et al., 2024; Kılıç, 2022), the present findings further illuminate how this process unfolds among non-STEM students. For these participants, becoming science educators involved not only acquiring scientific and pedagogical knowledge but also reshaping their perceptions of themselves as individuals capable of teaching science. Thus, The Metamorphosis of a Future Science Teacher reflects a lived transition from uncertainty and hesitation toward gradually embracing the identity of a science educator through meaningful encounters within teacher education.

Theme 6: The Pressure of Unequal Conditions in Learning Science

Becoming more confident as future science teachers did not erase the realities that shaped the participants' journeys. As they reflected on their experiences, many recognized that their struggles stemmed not only from personal adjustment but also from educational conditions that existed long before they entered college.

The sixth subtheme, The Pressure of Unequal Conditions in Learning Science, captures how participants navigated science education from unequal starting points. Their narratives show how strand background, previous schooling, access to science instruction, and curriculum exposure shaped the knowledge they brought into the program and the conditions under which they learned science. Rather than simply encountering unfamiliar concepts, participants entered a curriculum that often assumed foundational scientific knowledge they believed they had never been given the opportunity to develop. Differences in strand specialization and prior learning experiences became increasingly apparent as they progressed through the program, making their adjustment reflect unequal academic preparation rather than individual ability alone.

These differences were evident in how participants experienced the disconnect between their previous educational backgrounds and the expectations of science teacher education.

Because I was an ABM graduate before. ABM is more into business, and then suddenly shifting into science didn't feel relatable... We did not have those lessons in Grade 12. (P2)

This account reflects how the participant experienced the transition by encountering concepts that had not been part of previous academic preparation. Learning became an ongoing process of adjusting to unfamiliar scientific language and ideas while trying to keep pace with lessons that were already treated as foundational within the program. One participant described this experience of constantly trying to keep up:

...That was when I realized their grasp of the topics was different – they were already more advanced than us.) I also cannot blame them, because we came from different schools with different qualities of education. In my previous school, what we learned was really shallow. In fact, I had a science teacher who was not really a science major, so the topics were not discussed deeply. (P4)

For some students, the sense of disadvantage became more visible when comparisons with STEM peers surfaced within classroom discussions and mathematical requirements. The absence of prior exposure to subjects such as calculus reinforced feelings of being academically behind, where participation in science education became a struggle to compensate for missing foundations rather than simply mastering new lessons. As one participant

explained:

It is difficult to keep up with STEM students since they have already tackled calculus... You do not have background... that is really my biggest challenge. (P6)

The experience reflects how curriculum sequencing created unequal starting points within the same learning environment. While some students extended previously learned concepts, others encountered them for the first time. As reflected in their experiences, participants connected their academic difficulties to differences in prior preparation, learning opportunities, and exposure to science before entering college. This aligns with previous studies showing that educational preparation influences students' readiness for science-related programs, while unequal access to academic resources and institutional support can shape their adjustment and persistence in higher education (Badmus et al., 2024; Kayan-Fadlilmula et al., 2022; Batty & Reilly, 2022; Burkholder et al., 2022; Hansen et al., 2023; Reggiani et al., 2024; Dost, 2024). However, beyond identifying these structural influences, the present findings illuminate how such inequalities were personally experienced by non-STEM students.

For participants, these challenges were not confined to the initial transition into college but became ongoing realities that shaped their learning, classroom participation, and interactions within science education. Their experiences reveal more than academic struggle; they reflect students' ongoing effort to navigate science learning while carrying gaps in preparation and opportunity formed before entering higher education. Despite these barriers, their persistence demonstrates a continuous negotiation between their aspirations of becoming science educators and the unequal conditions shaping their journey.

Theme 7: The Growth into Strength and Independence

The seventh subtheme, The Growth into Strength and Independence, reflects the participants' personal development throughout their academic journey. "Growth into strength and independence" captures how repeated challenges gradually fostered resilience, self-confidence, emotional maturity, and greater responsibility as future science educators. It unfolds the journey of non-STEM students as they gradually develop strength and independence while navigating the demands of science education. Their narratives describe growth not as the absence of struggle, but as something that emerged through repeated encounters with academic difficulties, self-doubt, and unfamiliar learning experiences. Over time, experiences that once discouraged them gradually became opportunities to recognize their own capacity to continue despite setbacks.

One participant described how entering the science program disrupted the confidence developed during high school. Moving from consistent academic achievement to struggling in college science became a lived experience of confronting personal limitations and reassessing past expectations.

Sometimes I feel disappointed, because I used to see myself as someone who was a consistent awardee during high school, but when I reached college, that was where I became humbled because the knowledge I got from high school was not enough. (P6)

Rather than staying stuck in disappointment, participants described gradually accepting that progress did not have to happen at the same pace as others. For one participant, moving forward slowly became a way of continuing despite academic pressure.

So, I overcame those challenges through prayer and by convincing myself that it is okay to move forward slowly, one at a time, and that being behind other students doesn't mean you are already a failure. (P4)

For some students, growth unfolded quietly through repeated exposure to unfamiliar and demanding situations. What began as feelings of shyness and uncertainty slowly transformed into confidence as participants adapted to the expectations and environment of science education.

No. It's more like, before, I was shy. Then when I entered education, especially science, I felt like I gained more confidence. I've grown and become more mature as a person while the faculty helped shape me. (P2)

Participants likewise described failure as gradually becoming part of learning rather than a reason to withdraw.

Laboratory mistakes and unsuccessful activities became experiences from which they adjusted their study habits and preparation.

Those failed experiments taught me how to do better next time. I now know what to do, and I also study more. That was where I really learned during first year that I truly needed to study. (P5)

For another participant, confidence gradually returned through an achievement that challenged earlier feelings of inadequacy.

It felt nice because, despite having low expectations before, I still became an awardee, and after that, I became motivated and realized that I am still capable of achieving more. (P2)

Receiving academic recognition represented more than success in a particular semester. For the participant, it became evidence that persistence and continuous effort could gradually overcome earlier feelings of inadequacy.

As revealed in their accounts, these narratives suggest that growth into strength and independence was experienced as a gradual process rather than an immediate outcome of overcoming challenges. Participants described becoming more patient with their own progress, learning from unsuccessful experiences, and gradually regaining confidence through continued participation in science learning. These findings align with previous studies showing that resilience develops through reflection, self-regulated learning, and continued engagement with academic challenges (Higgins et al., 2021; Foong et al., 2021).

However, while these studies emphasize resilience as an outcome of successful adjustment, the present findings illuminate how participants experienced resilience as part of their everyday journey in science education. Their narratives suggest that resilience was not something they already possessed, but something they gradually recognized in themselves as they continued despite disappointment, uncertainty, and academic challenges. Ultimately, growth into strength and independence was not experienced as reaching a point where challenges disappeared. Instead, participants described gradually relating to those challenges differently. Difficulties that once gave rise to fear, hesitation, and self-doubt became part of how they learned to trust their capacity to continue. Within their lived experiences, becoming stronger did not mean becoming unaffected by struggle, but remaining willing to move forward despite it.

Conclusion

This study reveals that the transition of non-STEM students into BSEd-General Science extends beyond academic adjustment. Rather than simply acquiring scientific knowledge, participants gradually reconstructed their confidence, reshaped their perceptions of science, and developed a professional identity as future science educators. Their lived experiences demonstrate that becoming a science teacher is not determined solely by prior academic preparation but is continuously shaped through persistence, meaningful support systems, and authentic learning experiences. The findings contribute to science teacher education by deepening understanding of how students from non-STEM backgrounds navigate the transition into science education programs. Rather than viewing these students through the lens of academic deficiency, the study highlights their capacity for growth, adaptation, and identity formation when provided with appropriate learning opportunities and institutional support. The findings may guide teacher education institutions in developing responsive academic support mechanisms, including bridging initiatives, structured mentoring, collaborative learning opportunities, and instructional practices that acknowledge students' diverse educational backgrounds. Educationally, the study emphasizes the importance of creating inclusive science learning environments where students are encouraged to build confidence, engage actively in scientific inquiry, and gradually develop competence regardless of their previous academic strand. The findings also support developing institutional policies that promote equitable access to science teacher education through transition support programs, curriculum enhancements, and academic assistance for students entering from non-STEM backgrounds. Such initiatives may strengthen retention, improve student preparedness, and foster more inclusive pathways into science teaching.

Based on this study's findings, teacher education institutions are encouraged to strengthen bridging and transition programs that support students entering science teacher education from non-STEM backgrounds. Institutions may also provide sustained academic assistance, mentoring opportunities, and collaborative learning

environments that foster confidence, resilience, and the gradual development of scientific and professional identities. Such initiatives may help create more equitable learning opportunities while promoting successful adjustment and persistence in science education. Future research may build upon the present study by examining the instructional practices and pedagogical approaches of science educators in supporting non-STEM students throughout their transition into science teacher education. Further studies may also explore these experiences across different institutional contexts and larger participant groups to deepen the understanding of academic adjustment and professional identity formation among non-STEM learners.

Contributions of Authors

Author 1: conceptualization, proposal writing, data collection, data analysis, manuscript writing

Author 2: proposal writing, data collection, data analysis, manuscript writing

Author 3: proposal writing, data collection and analysis, manuscript writing

Author 4: proposal writing, data collection and analysis, manuscript writing

Author 5: proposal writing, data collection and analysis, manuscript writing

Author 6: proposal writing, data collection and analysis, manuscript writing

Author 7: data analysis, manuscript writing, manuscript review

Author 8: manuscript review, language editing, and manuscript polishing

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Conflict of Interests

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