Chapter I

THE PROBLEM AND ITS BACKGROUND

Introduction

In the field of Science, Technology, Engineering, and Mathematics (STEM), Senior High School students frequently encounter substantial learning barriers in Mathematics that hinder their academic progress and engagement. These challenges often stem from weak foundational knowledge, math anxiety, ineffective teaching methods, and limited access to learning resources, particularly in resource-constrained public schools. According to Bandura (1997), low self-efficacy in Mathematics erodes students' confidence and motivation, creating a cycle of avoidance and poor performance essential for STEM success.

Research consistently shows that STEM students struggle with abstract concepts such as calculus, vectors, matrices, and statistics due to gaps in prerequisite skills and procedural overemphasis without conceptual understanding (Hewson, 2011). In the Philippine context, senior high school STEM students face amplified difficulties due to rapid curriculum pacing, inadequate teacher training, and resource scarcity in provincial schools (Ongcoy et al., 2023). These barriers not only affect immediate academic performance but also threaten long-term STEM retention and career readiness.

At Lutucan Integrated National High School in Quezon Province, STEM students report particular difficulties with core Mathematics subjects like Basic Calculus and Pre-Calculus. Local studies highlight how math anxiety and poor scaffolding widen the Zone of Proximal Development gap (Vygotsky, 1978), while environmental constraints like textbook shortages and large class sizes compound instructional challenges (PIDS, 2022). When students cannot overcome these barriers, they experience reduced motivation, confidence, and engagement, perpetuating poor Mathematics proficiency critical for STEM disciplines.

Moreover, these learning barriers have broader implications for students' academic trajectories and well-being. Persistent Mathematics struggles lead to decreased participation in STEM-related activities, heightened stress, and diminished career aspirations in science and technology fields. Understanding these personal, instructional, and environmental factors, along with students' coping strategies, is essential for developing targeted interventions that support STEM success in Philippine public schools.

Therefore, this study focuses on exploring the learning barriers in Mathematics among Senior High School STEM students at Lutucan Integrated National High School, examining their lived experiences, contributing factors, impacts, and coping mechanisms to inform practical solutions for educators and administrators.

Theoretical Framework

This study is anchored on Vygotsky's Zone of Proximal Development (ZPD) and Bandura's Self-Efficacy Theory, which together explain how social support and personal beliefs influence Mathematics learning outcomes.

Vygotsky's Zone of Proximal Development (1978) posits that learning occurs optimally within the ZPD—the space between what students can accomplish independently and what they can achieve with guidance from teachers or peers. In STEM Mathematics, effective scaffolding through collaborative problem-solving, teacher modeling, and peer tutoring helps students master complex concepts like calculus applications. However, inadequate instructional support widens the ZPD gap, leaving students struggling with abstract reasoning without proper guidance.

Bandura's Self-Efficacy Theory (1997) emphasizes that students' beliefs about their Mathematics abilities powerfully predict effort, persistence, and achievement. High self-efficacy fosters resilience against barriers, while math anxiety and repeated failures diminish confidence, leading to disengagement. For

STEM students, building self-efficacy through mastery experiences, vicarious learning, verbal persuasion, and anxiety management is crucial for overcoming learning barriers.

In this framework, Mathematics learning barriers emerge when ZPD scaffolding is insufficient (instructional/environmental factors) and self-efficacy is undermined (personal factors). The study examines how these theoretical constructs manifest in students' lived experiences and coping strategies at Lutucan Integrated National High School.

Research Paradigm

Figure 1.0 Research Paradigm of Exploring Learning Barriers in Mathematics Among SHS STEM Students

Figure 1 illustrates the dynamic interaction of personal factors (math anxiety, self-efficacy, prior knowledge), instructional factors (teaching methods, curriculum design, scaffolding), and environmental factors (resources, class size, support systems) that produce learning barriers in STEM Mathematics. These barriers impact students' motivation, confidence, and engagement (RQ4), while students employ coping strategies (RQ5) to navigate challenges (RQ1-3). The double-headed arrows represent bidirectional influences within the phenomenological framework.

Statement of the Problem

This study aims to explore the learning barriers in Mathematics among Senior High School STEM students at Lutucan Integrated National High School. Specifically, it seeks to answer the following questions:

1)What learning barriers do Senior High School STEM students encounter in studying Mathematics?
2)How do STEM students describe their experiences when facing difficulties in learning Mathematics?
3)What personal, instructional, and environmental factors contribute to the learning barriers in Mathematics among STEM students?
4)How do these learning barriers affect students' motivation, confidence, and engagement in Mathematics learning?
5)What coping strategies or support mechanisms do STEM students use to overcome challenges in learning Mathematics?

Scope and Delimitation of the Study

This study focuses on Grade 11 and 12 STEM students and Mathematics teachers at Lutucan Integrated National High School during School Year 2025–2026. Specifically, it explores learning barriers in core STEM Mathematics subjects (Basic Calculus, Pre-Calculus, Statistics), examining personal, instructional, and environmental factors through students' lived experiences.

Scope: The investigation includes 10 purposively selected STEM students experiencing Mathematics difficulties and 4 Mathematics teachers. Data collection utilizes semi-structured interviews aligned with the five research questions, conducted within school premises during non-class hours.

Delimitations:

Limited to STEM strand students only (excludes other tracks)

Focuses exclusively on Mathematics subjects (excludes other STEM disciplines)

Self-reported qualitative data from interviews (no grades/test scores)

Single-school context (Lutucan Integrated National High School)

Current enrollment during data collection period (February 2026)

The study relies on participants recollections and willingness to share, potentially introducing subjectivity.

Findings may not generalize beyond similar rural public schools in Quezon Province.

Significance of the Study

This study provides valuable insights into Mathematics learning barriers among STEM students, benefiting key stakeholders:

STEM Students.

Identifies specific barriers and coping strategies to improve Mathematics confidence, motivation, and performance through targeted support.

Teachers and Educators.

Informs instructional adjustments, scaffolding techniques, and classroom practices to better address diverse student needs per Vygotsky's ZPD.

School Administrators.

Guides resource allocation, teacher training, and program design to strengthen STEM Mathematics support systems.

Future Researchers.

Serves as reference for similar studies on STEM education challenges in Philippine public schools.

DepEd Officials.

Supports policy development for Mathematics teacher training and STEM curriculum implementation in provincial areas.

Definition of Terms

STEM Education refers to the Senior High School academic strand integrating Science, Technology, Engineering, and Mathematics to develop problem-solving and critical thinking skills (DepEd, 2016).

Learning Barriers are personal, instructional, or environmental factors that hinder students' understanding, engagement, or performance in Mathematics (RQ1, RQ3).

Zone of Proximal Development (ZPD) is the difference between what a learner can accomplish independently and with guidance, emphasizing scaffolding needs (Vygotsky, 1978).

Self-Efficacy refers to students' beliefs in their ability to succeed in Mathematics tasks, influencing motivation and persistence (Bandura, 1997).

Scaffolding involves instructional support (teacher guidance, peer collaboration) that helps students achieve beyond independent capabilities within their ZPD.

Chapter II

REVIEW OF RELATED LITERATURE

This chapter presents a review of related literature and studies relevant to the research entitled Understanding Learning Barriers in STEM Mathematics Among SHS Students at Lutucan Integrated National High School. The literature and studies discussed were obtained from both foreign and local sources. They provide theoretical, empirical, and contextual foundations explaining personal, instructional, and environmental barriers to STEM math learning, along with their impacts and coping strategies. This chapter also highlights research gaps that justify the present qualitative study.

Review of Related Literature

Learning barriers in STEM mathematics encompass personal factors (e.g., math anxiety, self-efficacy), instructional factors (e.g., teaching methods, curriculum), and environmental factors (e.g., resources, support), as framed by Vygotsky's (1978) Zone of Proximal Development and Bandura's (1997) self-efficacy theory. These domains align with the study's research questions on barriers, experiences, contributing factors, effects on motivation/confidence/engagement, and coping mechanisms. Ongcoy et al. (2023) found moderate math anxiety among 101 Philippine SHS STEM students due to teacher interactions and content challenges, leading to avoidance behaviors that erode confidence.

Personal factors like anxiety hinder engagement in abstract topics such as calculus. Bantiling et al. (2025) reported Grade 12 STEM students struggling with foundational gaps and workload in resource-limited settings like Quezon Province, perpetuating low self-efficacy cycles. Arrieta et al. (2021) reinforced this through a review of teachers' STEM practices, noting self-doubt widens the gap between independent and assisted performance per Vygotsky.

Instructional factors, including procedural teaching over scaffolding, exacerbate barriers. Eshaq (2023) demonstrated integrated STEM improves math achievement but falters without teacher training, common in Philippine classes. SciDev.Net (2022) linked national PISA failures to inadequate provincial instruction, while Maskur et al. (2025) and Siller et al. (2024) showed collaborative methods boost outcomes via peer support.

Environmental factors like resource scarcity intensify issues. Barroso (2020) modeled retention drops in pre-calculus from workload and support lacks, mirroring Lutucan constraints. PIDS (2022) highlighted nationwide low STEM interest due to poor readiness and provincial declines.

Local literature, such as Nolasco (2025), qualitatively explored math anxiety cycles tied to Bandura's theory, emphasizing student experiences in Philippine contexts.

Review of Related Studies

Ongcoy et al. (2023) surveyed SHS STEM students, revealing anxiety from pacing and interactions reduces motivation; however, it used quantitative methods without coping strategies. Bantiling et al. (2025) examined Grade 12 struggles quantitatively, noting calculus gaps but lacking Quezon-specific narratives.

Eshaq (2023) experimentally tested STEM integration's math gains, faltering in untrained settings—relevant but not phenomenological. SciDev.Net (2022) analyzed PISA data on instructional shortfalls in provincial schools, supporting curriculum needs without student voices.

Barroso (2020) predicted retention via models, linking resources to efficacy declines; PIDS (2022) surveyed national STEM trends, noting provincial gaps. DepEd Calabarzon (2025) and UP NISMED (2023) urged regional training amid skill deficits, yet overlooked SHS STEM depth.

Internationally, Arrieta et al. (2021) reviewed teacher practices eroding efficacy; Maskur et al. (2025) empirically tied collaboration to creativity; Siller et al. (2024) quantified peer learning's math impacts—useful models but Western-focused, ignoring Philippine scarcity.

Overall, the reviewed literature and studies consistently show barriers like anxiety, poor instruction, and resource limits undermine STEM math engagement. Foreign and local sources emphasize scaffolding and support needs per Vygotsky and Bandura. However, most prior works used quantitative approaches on general populations, with limited focus on SHS STEM students' lived experiences, Quezon contexts, or coping strategies. This gap justifies the present phenomenological study at Lutucan Integrated National High School.

References

Arrieta, G., Dancel, J., & Agbisit, M. J. (2021). Mathematics teachers' practices of STEM education: A systematic literature review. European Journal of Educational Research, 10(3), 1–15. https://doi.org/10.12973/eu-jer.10.3.1

Bandura, A. (1997). Self-efficacy: The exercise of control. W. H. Freeman.

Barroso, C. (2020). Mathematical models in predicting retention of STEM students in pre-calculus. International Journal of Progressive Development and Learning, 3(2), 1–12. https://www.ijpdll.com/article/mathematical-models-in-predicting-retention-of-stem-students-in-pre-calculus-8342

Bantiling, J., et al. (2025). Understanding the struggles of STEM 12 students [Manuscript]. International Journal of All Research in Mathematics, Article IJAMR250565. http://ijeais.org/wp-content/uploads/2025/5/IJAMR250565.pdf

DepEd Calabarzon. (2025). Regional STEM training memos. https://depedcalabarzon.ph/?page_id=33

Eshaq, M. (2023). The effect of using STEM education on students' mathematics achievement. International Journal of Progressive Research in Science. https://www.ijopr.com/article/the-effect-of-using-stem-education-on-students-mathematics-achievement-14030

Maskur, R., et al. (2025). The role of STEM teaching in education: An empirical analysis. PMC Articles. https://pmc.ncbi.nlm.nih.gov/articles/PMC12294923/

Nolasco, J. (2025). Lived math anxiety [Qualitative study]. Journal of Technology and Science Education. https://www.jotse.org/index.php/jotse/article/view/2950/943

Ongcoy, P. J. B., Jasmin, D. R. A., Guiamal, I. P., Guinita, S. S., & Iligan, A. M. M. (2023). Experiences and mathematics anxiety of STEM students. MathsCI Teacher. https://doi.org/10.29333/mathsciteacher/12870

PIDS. (2022). The future of STEM education. https://www.pids.gov.ph/details/news/in-the-news/the-future-of-stem-education

SciDev.Net. (2022). Philippine struggle to make the grade in STEM education. https://www.scidev.net/asia-pacific/scidev-net-investigates/philippine-struggle-to-make-the-grade-in-stem-education/

Siller, H.-S., et al. (2024). Analyzing the impact of collaborative learning approach on grade six students' mathematics achievement. Eurasia Journal of Mathematics, Science and Technology Education. https://www.ejmste.com/download/analyzing-the-impact-of-collaborative-learning-approach-on-grade-six-students-mathematics-14153

UP NISMED. (2023). Local STEM sharing. http://news.nismed.upd.edu.ph/2023/12/up-nismed-director-and-staff-share.html

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Chapter III

METHODOLOGY

This chapter presents the methods and procedures utilized in this study. It includes the research design, research participants and sampling procedures, research instruments, data collection method, data

analysis, and ethical considerations employed to explore the learning barriers in Mathematics among Senior High School STEM students at Lutucan Integrated National High School.

Research Design

This study employed a qualitative research approach, specifically a phenomenological research design. Phenomenology focuses on understanding and describing individuals' lived experiences and the meanings they attach to those experiences. This design was deemed appropriate because the study aimed to explore how STEM students experience, perceive, and cope with learning barriers in Mathematics, including personal, instructional, and environmental factors affecting their motivation, confidence, and engagement. Rather than measuring variables or establishing causal relationships, the phenomenological approach allowed the researchers to gather rich and in-depth descriptions of students' mathematical challenges, contributing factors, impacts, and coping strategies. Data were gathered through semi-structured interviews to capture participants' personal perspectives aligned with the five research questions.

Research Participants and Sampling Procedure

The participants of this study were Senior High School students enrolled in the STEM strand and Mathematics teachers at Lutucan Integrated National High School during School Year 2025–2026. STEM students were selected because they regularly encounter rigorous Mathematics coursework such as Basic Calculus, Pre-Calculus, and Statistics, which are central to the phenomenon being explored. Teachers were included to provide instructional perspectives on observed learning barriers.

The study employed purposive sampling to select 10 random STEM students who had experienced difficulties in Mathematics and 4 Mathematics teachers with at least two years of STEM teaching experience. Participants were chosen based on their strand, reported academic challenges (for students), teaching expertise (for teachers), and willingness to share their experiences. A limited number of participants were included to allow for in-depth exploration of responses, and data collection continued until data saturation was achieved.

Participation in the study was voluntary, and the identities of the participants were kept confidential to ensure ethical standards and protect their privacy.

Research Instrument

The primary data-gathering instrument employed in this study is a researcher-developed semi-structured interview guide. This instrument was constructed to obtain comprehensive and in-depth information from STEM students and teachers regarding their experiences with Mathematics learning barriers. The development of the interview guide was informed by an extensive review of related literature, prior studies, the theoretical framework (Vygotsky and Bandura), and the specific objectives of the research.

To ensure the appropriateness and rigor of the instrument, the interview guide underwent a formal validation process. It was reviewed by designated validators who examined the structure, clarity, and relevance of each question. Following this evaluation, necessary revisions were incorporated based on validators' feedback.

Student Interview Questions:

1).What learning barriers do you encounter in studying Mathematics as a Senior High School STEM student?

2).How do you describe your experiences when facing difficulties in learning Mathematics as a Senior High School STEM student?

3).What personal, instructional, and environmental factors contribute to the learning barriers in Mathematics as a STEM student?

4).How do these learning barriers affect your motivation, confidence, and engagement in Mathematics learning as a STEM student?

5).What coping strategies or support mechanisms do you use as a STEM student to overcome challenges in learning Mathematics?

Tagalog Translation:

1).Anu-ano ang mga hadlang sa pagkatuto na iyong nararanasan sa pag-aaral ng Matematika bilang isang mag-aaral na STEM sa Senior High School?

2).Paano mo ilalarawan ang iyong mga karanasan noong nahihirapan kang matuto ng Matematika bilang isang mag-aaral ng STEM sa Senior High School?

3).Anong mga personal, instruksyonal, at pangkapaligiran na salik ang nakakatulong sa mga hadlang sa pagkatuto sa Matematika bilang isang mag-aaral ng STEM?

4).Paano nakakaapekto sa iyo ang mga hadlang sa pagkatuto na ito bilang isang mag-aaral ng STEM sa larangan ng matematika?

5).Anong mga estratehiya sa pagharap o mekanismo ng suporta ang ginagamit mo bilang isang mag-aaral ng STEM upang malampasan ang mga hamon sa pag-aaral ng Matematika?

Data Collection Method

The study required data which examined how students and teachers experienced Mathematics learning barriers and their contributing factors, impacts, and coping mechanisms. The researchers used purposive sampling to select STEM students and teachers for conducting in-depth individual interviews which provided essential study information.

Data collection was conducted at school facilities (library/resource room) during non-class hours. Individual interviews were audio-recorded with permission and supplemented with field notes.

Data Analysis

The collected data were analyzed using thematic analysis adapted from Braun and Clarke (2006). After transcribing the interview responses, the researchers carefully reviewed the transcripts multiple times to gain familiarity with the data. Initial coding was conducted to identify significant statements, phrases, and recurring ideas related to learning barriers, contributing factors, impacts on motivation/confidence/engagement, and coping strategies.

The codes were then grouped into categories and organized into themes that represented the shared experiences of the participants across personal, instructional, and environmental domains. These themes served as the basis for interpreting the findings and answering the research questions. The analysis aimed

to present an accurate and comprehensive description of the participants' lived experiences, supported by direct quotations and linked to the conceptual framework.

Member checking was conducted with selected participants to verify interpretations, ensuring trustworthiness of the findings.

Ethical Considerations

Ethical standards were strictly observed throughout the conduct of the study. Participation was voluntary, and participants were informed of their right to withdraw from the study at any time without any consequences. Informed consent was obtained from all participants prior to data collection (parental consent for minor students).

The purpose of the study was clearly explained to the participants, and confidentiality of their identities was ensured through the use of pseudonyms or codes. All information gathered was treated with confidentiality and used solely for academic purposes. The researchers ensured respect, privacy, and integrity in all stages of the research process. Data were securely stored with password protection and will be deleted after study completion.