

Analyzing Cognitive and Affective Factors on the Performance in Pre-Calculus Among Stem Grade 11 Students of St. Vincent College of Cabuyao

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Abstract—This study analyzed the cognitive and affective factors that correlate with the Pre-calculus performance of 203 Grade 11 STEM students at St. Vincent College of Cabuyao. In terms of research design, this study employed a quantitative, descriptive-correlational design to analyze and determine the effects of certain factors on performance outcomes. Stratified random sampling was used to ensure a valid representation in data collection. To conduct this study, two research tools were used: a Likert-scale questionnaire to measure cognitive and affective factors, and an achievement test with 20 items to assess academic performance. The statistical analysis techniques included calculating weighted mean values and performing correlational analyses to establish relationships between variables. From a descriptive standpoint, problem-solving difficulty emerged as the most common cognitive factor (WM=2.01), whereas mathematical anxiety represented the most common affective variable (WM=2.09). As for the findings of the correlational analysis, all studied cognitive and affective factors positively correlated with student performance, and the relationships were found to be significant at $p < 0.05$. Specifically, learning gaps in prior knowledge demonstrated a strong correlation with performance results ($Rho = 0.690$). Consequently, this study concludes that cognitive limitations and learning gaps remain the main reasons for difficulties in studying, and that mathematical anxiety serves as a psychological barrier that masks students' abilities.

Index Terms—Affective Factors, Cognitive Factors, Mathematical Anxiety, Pre-calculus Performance, Prior Knowledge Gaps, Problem-Solving Difficulty.

1. The Problem and its Background

A. Introduction

Teaching mathematics remains a challenge in educational institutions worldwide, especially when reasoning and abstraction are involved. Results of large-scale international assessments like Programmed for International Student Assessment and Trends in International Mathematics and Science Studies regularly point out that high percentages of students cannot achieve minimum levels of competency in mathematics. Recently reported studies by the Organization for Economic Co-operation and Development (2023) show that around 33% of 15-year-old students in participating nations lack even basic mathematical competence. This percentage suggests there may be problems with the educational system in

basic math, reasoning, and problem-solving. These skills are important for studying more advanced courses, such as pre-calculus.

The same problem can be seen in the Philippines, where national and international assessments have found that Philippine students underperform the international average in mathematics, highlighting the lack of basic competencies needed to study more advanced mathematical subjects.

One of the subjects required for success in Science, Technology, Engineering, and Mathematics (STEM), namely Pre-calculus, requires mastery of algebra, trigonometry, and conceptualization. Previous studies and personal observation have revealed that various factors hinder students enrolled in senior high schools from fully understanding pre-calculus concepts. Factors affecting mathematics performance in this context are not only cognitive but also emotional and motivational aspects.

Current literature on achievement in mathematics includes both cognitive and affective factors. Nonetheless, little empirical research has examined how the interaction between cognitive and affective variables affects achievement in pre-calculus among Grade 11 STEM students in their respective senior high schools. There is still a lack of information about the impact of pre-calculus achievement on the interaction between these two domains of factors in local settings.

This study attempts to fill the research gap by investigating the relationship between cognitive and affective variables and performance in pre-calculus among Grade 11 STEM students of St. Vincent College of Cabuyao.

B. Theoretical Framework

The study adopts a three-pronged approach using constructivist learning theory by Piaget (1952), Vygotsky (1978), and Bruner (1960), the affective filter hypothesis of Krashen (1985), and Sweller's (2003) cognitive load theory. Rather than examining each theory in isolation, the framework integrates the concepts of these theories, highlighting the interaction between the effects of cognitive structures and emotions on the acquisition of pre-calculus.

Constructivist principles espoused by theorists like Jean

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Piaget, Lev Vygotsky, and Jerome Bruner emphasize that learning occurs through the construction of knowledge. The application of constructivist theory to pre-calculus implies that new mathematical concepts, such as conic sections, nonlinear equations, and the unit circle, are interpreted using existing knowledge schemas in the areas of algebra and trigonometry. In situations where the schemas are fragmented and distorted, errors occur that impede cognitive processing of higher levels of reasoning.

Additionally, Stephen Krashen's Affective Filter Hypothesis is relevant to the consideration of psychological influences on learning effectiveness. Although proposed within the context of second language acquisition, the ideas behind this hypothesis are applicable to the field of mathematics education as well. An increased level of anxiety, a lack of motivation, and negative emotions may increase an internal "affective filter" and thus decrease the capability of students to receive information through their working memory channels.

Expanding the cognitive perspective even further, one can consider the application of John Sweller's Cognitive Load Theory. According to the latter, the constraints imposed on working memory significantly shape the processing of complex material. Problem solving in Pre-calculus classes requires performing multiple cognitive operations related to symbol manipulation, graphs, and procedures. If the load imposed on the learner exceeds his or her capacity, he or she is at risk of cognitive overload.

The combination of these theories implies that Pre-calculus achievement depends on the synergy of cognitive preparation and emotional management. Constructivism offers an explanation for knowledge assimilation, Cognitive Load Theory provides insights into cognitive constraints, and the Affective Filter Hypothesis explains the impact of emotions.

C. Research Paradigm

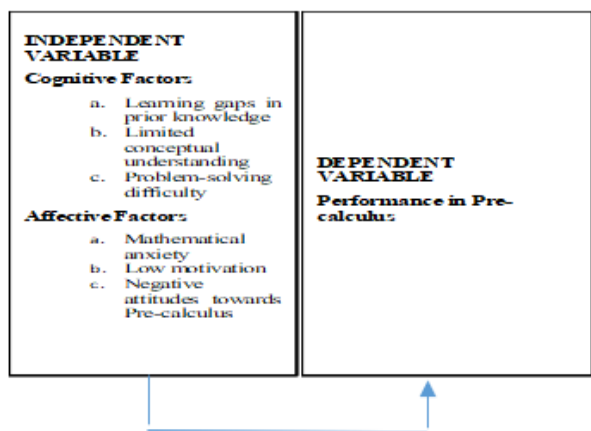


Fig. 1. Research paradigm

As shown in figure 1, the research was based on the interrelationship between the cognitive and affective factors (independent variables) and the academic performance of students in Pre-calculus (dependent variable). The diagram shows how various cognitive factors like learning gaps in prior knowledge, limited conceptual understanding, and problem-

solving difficulty could impede the success of students in Pre-calculus. Likewise, affective factors such as mathematics anxiety, low motivation, and negative attitude towards Pre-calculus would significantly affect their academic achievement.

The independent variables were the internal and external circumstances that could prevent or enhance students' learning. The cognitive variables concentrate on students' thought processes and comprehension skills. In contrast, the affective variables focus on their emotions and motivation that could influence their engagement. Both sets of variables work together and affect the dependent variable, which is the academic performance of students in Pre-calculus.

The arrow in the paradigm indicates the direct interrelation of cognitive and affective factors on academic performance. Through the examination of these variables' relationships, the research intends to identify which ones have the highest contribution to the challenges encountered by senior high school students in studying Pre-calculus.

D. Research Question

This study aims to analyze cognitive and affective factors on the performance in Pre-calculus among STEM grade 11 students of St. Vincent College of Cabuyao. Specifically, it pursued to answer the following questions:

1. What is the level of cognitive factors that contribute to the difficulty of Pre-calculus among SHS students in terms of:
 - a. Learning gaps in prior knowledge
 - b. Limited conceptual understanding
 - c. Problem-solving difficulty
2. What are the level affective factors that influence students' learning experiences in Pre-calculus?
 - a. Mathematical anxiety
 - b. Low motivation
 - c. Negative attitudes towards Pre-calculus
3. Is there a significant relationship between cognitive factors and students' performance in Pre-calculus?
4. Is there a significant relationship between affective factors and students' performance in Pre-calculus?
5. What action plan may be proposed based on the findings of the study to improve students' performance in Pre-calculus?

E. Null Hypothesis

HO1. There is no significant relationship between cognitive factors and students' performance in Pre-calculus.

HO2. There is no significant relationship between affective factors and students' performance in Pre-calculus.

F. Scope and Delimitation

This research aims to investigate the cognitive and affective variables in relation to the academic performance of Pre-calculus of STEM grade 11 students at St. Vincent College of Cabuyao. The study highlights the following three cognitive variables: learning gaps in previous learning, limited conceptual understanding, and problem-solving difficulty and three affective variables: math anxiety, low motivation, and negative attitude towards Pre-Calculus. The respondents of this

study will be Grade 11 students who are chosen using stratified random sampling method.

It should be noted that the study confines itself to the senior high school students enrolled at St. Vincent College of Cabuyao and not from elsewhere or another educational level and setting. There are no other variables that are taken into account by the researchers.

G. Significance of the Study

In this study, the importance lies within the cognitive and affective factors in the performance of students in Pre-calculus among Senior High students from Cabuyao City, Laguna, and the following are the benefits of conducting this study:

For the Senior High School students: This study will make the students aware of the factors why they have difficulties in their learning and how to deal with those in order to enhance their ability to learn Pre-calculus. Through this study, awareness of their learning habit can be gained through their self-reflection, which can provide them awareness of what they need to do in order for them to be able to use calculus in the real world.

For the Pre-calculus teachers: From the results of this study, the pre-calculus teachers will understand the reasons behind the difficulties of their students in Pre-calculus, thus providing them information regarding ways to teach pre-calculus that would not make students feel uncomfortable.

For the school administrators: In this case, the school administrators could formulate programs that could resolve the difficulties of the students encountered during their learning process.

For the researcher: This study offers a chance for the researcher to contribute to the present body of literature through the application of theoretical concepts to a certain and localized scenario. As a consequence, a vast contribution to the present body of literature through our findings in this study.

For future researchers: This study acts as a basis for future researchers who wish to conduct studies relating to the cognitive and affective factors influencing the performance of STEM grade 11 senior high school students in Pre-calculus in St. Vincent College of Cabuyao. It is because it offers a baseline knowledge of the strategies that are applied in order to solve problems in Pre-calculus.

H. Definition of Terms

In order to achieve clarity and mutual understanding of the concepts that will be utilized in this research, important terms must be operationally and conceptually defined. Through defining these terms, an appropriate basis for understanding the variables and concepts upon which this research is based will be provided. This study is entitled "Analyzing Cognitive and Affective Factors on the Performance in Pre-calculus among STEM Grade 11 Students of St. Vincent College of Cabuyao." Considering that cognitive, affective factors, and student performance are multi-dimensional concepts whose meanings may differ from discipline to discipline and from context to context, it becomes necessary to define them in relation to how they are being used in this particular study.

The following terms are defined in relation to how they are relevant to the study's cognitive factors, affective factors on student performance, and research design.

Affective Factors. The conceptual definition of affective factors is the use of emotional factors like attitudes, motivation, and anxiety on learning and academics (Ormrod, 2020). For this study, affective factors refer to emotional factors such as mathematical anxiety, motivation level, and attitudes towards Pre-calculus through a Likert-scale questionnaire survey for Grade 11 STEM students.

Cognitive Factors. The conceptual definition of cognitive factors is the psychological aspect of mental processes in acquiring and applying knowledge. For this study, cognitive factors refer to the indicators of learning gaps in prior knowledge, concept deficiency, and problem-solving difficulties through the structured questionnaire survey.

Learning Gaps in Prior Knowledge. The conceptual definition of prior knowledge is the existing knowledge and skills of a learner before participating in new learning activities (Bransford et al., 2000). For this study, learning gaps in prior knowledge refer to the students' reported lack of knowledge and skills in algebraic and trigonometric principles essential for Pre-calculus.

Limited Conceptual Understanding. From a conceptual point of view, the notion of conceptual understanding implies comprehension of mathematical concepts, principles, and relationships apart from procedure performance (Kilpatrick et al., 2001). For the purpose of this paper, the term limited conceptual understanding means students' inability to explain the underlying Pre-calculus concepts and relate mathematical concepts apart from doing computations.

Low Motivation. According to Schunk and DiBenedetto (2020), from a conceptual perspective, the term motivation implies a set of processes that make individuals initiate the activity, direct them about what and how to accomplish the task, and encourage learners to continue with the task regardless of its difficulties. From a conceptual point of view, low motivation implies students' poor effort, engagement, and interest in Pre-calculus activities.

Mathematical Anxiety. Conceptually as the pressure or fear that interferes with an individual's ability to solve mathematical problems (Ashcraft & Krause, 2007). Conceptually, mathematical anxiety implies the level of fear and pressure that students experience when solving Pre-calculus problems.

Negative Attitudes Toward Pre-calculus. Conceptually, attitude towards mathematics is considered the learned disposition to react in a positive or negative manner towards mathematical tasks (Ma & Kishor, 1997). Negative attitudes towards Pre-calculus, for the purpose of this study, involve negative perceptions or beliefs held by students on the level of difficulty, significance, and applicability of the subject.

Pre-calculus Performance According to Ormrod (2020), the definition of academic achievement pertains to the degree of success attained by a student in meeting the set learning goals using formal evaluations. For this research, pre-calculus achievement pertains to the sum of scores earned by Grade 11 STEM students from the validation of the 20-item researcher-

made test of Pre-calculus skills, involving conic sections, sequences, systems of nonlinear equations, and unit circle trigonometry.

Problem-Solving Difficulty. Problem-solving may be described as the mental activity of recognizing, comprehending, and resolving novel and challenging tasks (Polya, 1957). For the purpose of this study, problem-solving difficulty entails the perceived difficulties encountered by students in analyzing and solving multistep Pre-calculus problems.

2. Review of Literature and Studies

This section highlights the appropriate literature and study materials which were analyzed by a researcher during his search for the significance of the research carried out in this study. This chapter also provides the literature review in order to provide a full understanding of the research so as to give a thorough understanding of the research conducted. A literature review is basically an analysis and classification of the literature produced by various scholars and researchers on a certain topic. The main purpose of conducting literature review is usually to analyze a certain piece of research conducted in order to avail information to other researchers.

A. Cognitive Factors

1) Learning gaps in Prior Knowledge

Amalina (2023) pointed out that the presence of prior knowledge on the subject can be one of the best predictors of students' problem-solving skills. While parental education had an indirect effect through family income, the lack of prior knowledge constrained student performance. On the other hand, Mahadewsing (2024) found that mistakes usually happen when the foundational knowledge in algebra and trigonometry was not established. Furthermore, Aloyod (2024) disclosed that students' average performance in calculus means that they lacked knowledge on algebra and trigonometry. Sulistyarningsih (2025) indicated that students have problems with translating real-life issues into math without sufficient prerequisite knowledge.

According to Regina Mahadewsing (2024), the problem faced by students in calculus lies in the lack of prior knowledge, particularly regarding algebra and trigonometry. The findings from Ancheta (2022) also concluded that the reason for the problem with pre-calculus among students lay in their misconception about algebra and trigonometric functions as prerequisites for the course. Besides, misconceptions were rooted in the absence of knowledge retention, teaching techniques and extracurricular activities at schools.

According to Zheng (2020), learners with sufficient prior knowledge gain more when provided with partially complete examples than those without much information, who benefit more when presented with fully worked-out examples. According to Alabdulaziz (2025), misconceptions on limits and continuity impede higher order thinking in both flipped classes and GeoGebra. Sulistyowati (2024) showed that flipped classes lessen the difference between underachievers and overachievers through scaffolding of learning. Ramli (2025) concluded that active and student-oriented teaching boosted

post-test achievement to offset poor prior knowledge.

Karnita (2025) pointed out that technology alone cannot enhance mathematical competencies; however, interactive media boosts motivation and engagement. Teacher-parent cooperation with technological aids may indirectly help learners with poor foundations. As stated by Alabdulaziz (2025), scaffolding is necessary to compensate for deficiencies in basic calculus concepts. Sulistyowati (2024) noted that active learning techniques facilitate comprehension among students lacking prior knowledge.

Furthermore, Ramli (2025) emphasized that flipped classrooms facilitate collaborative learning, critical thinking, and enhanced understanding. Active learning approaches ensure that any lack of prior knowledge is addressed. As stated by Zheng (2020), learning outcomes are affected by task difficulty and learner background. By adopting such methods, it becomes possible for underperforming learners to succeed in calculus courses.

a. Limited Conceptual Understanding

According to Usman (2025), learners with high levels of mathematical beliefs developed conceptual understanding by linking concepts, procedures, and graphs. Learners with low levels of beliefs utilized procedural knowledge alone, hindering conceptual comprehension. Misconceptions included confusions between derivative and function and wrong interpretations of the rate of change, according to Jameson (2025). Torres-Peña (2024) found that AI-assisted instruction improved conceptual comprehension through instant feedback and interactive simulations.

The cause of the difficulty of basic calculus among learners was due to weak language and arithmetic skills, Tambis (2021) identified. Language sub-skills involved difficulty comprehending the purpose of the topic, while arithmetic sub-skills involved errors in procedural knowledge. Moreover, this limitation of conceptual understanding was significant to the difficulty of the course.

Sulistyowati (2024) found that flipped classroom and problem-based learning strategies increased understanding through learner participation in the teaching process. According to Kramer (2023), modeling practices in calculus (MPC) curricula develop conceptual understanding through collaboration, metacognition, and culturally responsive instruction. Alabdulaziz (2025) pointed out that scaffolding techniques were necessary for correcting misconceptions in limits and continuity. According to Ramli (2025), flipped classroom teaching methods improved conceptual understanding and creativity but needed more assistance to increase idea fluency.

As Sulistyowati (2024) observed, active learning narrows the gap between high-performing and low-performing students. According to Torres-Peña (2024), interactive aids aid concept formation. Jameson (2025) suggested that clarifying misconceptions might help change attitudes towards calculus. MPC-based learning promotes reasoning, problem-solving skills, and knowledge of fundamental concepts (Kramer, 2023).

Alabdulaziz (2025) argued that scaffolding would facilitate the move from procedural to conceptual knowledge. Ramli

(2025) reported that engaging classroom discussions and problem-solving activities enhance comprehension. As Sulistyowati (2024) found, inquiry learning improves conceptual comprehension in math. As Usman (2025) stated, belief systems are integral to conceptual comprehension.

2) *Problem-Solving Difficulty*

According to Oktaviyanthi (2024), high cognitive load stimulates alpha and beta waves but inhibits theta waves. Ruslimin (2025) reported that working memory capacity explains 74.5 percent of variation in calculus problem-solving skills. Guo (2023) concluded that solving complex word problems demands working memory resources, with the central executive system being more important. Berger *et al.* (2025) found that working memory training positively influences problem-solving and educational achievements.

Sankalaite *et al.* (2025) discovered that short, goal-directed teacher guidance minimizes cognitive load and improves behaviors. Ugpo, Tubo, and Yurango (2025) indicated that planning, monitoring, and regulation of cognition help develop problem-solving persistence. Stanton (2021) proposed fostering metacognitive learning techniques, including study skills, monitoring, and social metacognition, to enhance educational achievements. Toikka *et al.* (2024) noted that students' metacognitive knowledge increases across grades, leading to efficient problem-solving.

Zheng (2020) argued that task difficulty interacts with previous knowledge to affect cognitive load. Oktaviyanthi (2024) advised designing individualized interventions based on cognitive profile assessments to optimize problem-solving processes. Ruslimin (2025) stressed the need for instructional designs minimizing cognitive load. Guo (2023) proved that encouraging students' working memory is essential for resolving complex tasks.

Berger *et al.* (2025) noted that working-memory interventions implemented at an early stage can bring about lasting positive outcomes in academic performance. Sankalaite *et al.* (2025) proved that scaffolding on the part of teachers could help solve problems associated with cognitive load. Ugpo *et al.* (2025) reported that teaching strategies for developing metacognitive skills could improve students' resiliency and efforts.

B. *Affective Factors*

1) *Mathematical Anxiety*

According to Esposito (2025), math anxiety hinders the ability to perform well by limiting working memory capacity. Anxious individuals have low cognitive processing capabilities and limited ability to solve problems. Torres-Peña (2024) showed that AI technologies offer instant feedback and simulation techniques that help limit anxiety and boost confidence. Ramli (2025) reported that flipped classes help limit anxiety through collaborative and active learning.

Kramer (2023) stated that lecture-based instruction is a cause of math anxiety, particularly for women and minority groups. The MPC curriculum helps reduce anxiety due to collaborative learning processes and culturally responsive instruction. Asare (2025) argued that self-efficacy facilitates engagement and

limits affective barriers. Usman (2025) stated that a good mathematical belief system can limit anxiety.

Torres-Peña (2024) stated that interactive simulations lead to mastery experiences and improved confidence levels. Ramli (2025) explained that interactive discussions help anxious individuals participate in learning activities without fear. Esposito (2025) proposed some interventions that could be implemented to reduce anxiety levels and improve learning outcomes. Kramer (2023) concluded that evidence-based instructions facilitate a positive environment.

Confidence was identified by Asare (2025) as essential in fostering persistence. Usman (2025) stressed the importance of belief systems in breaking down barriers caused by anxiety. The flipped classroom and the use of artificial intelligence technology in teaching create an enabling environment for students struggling with anxiety (Torres-Peña, 2024; Ramli, 2025).

2) *Low Motivation*

Asare (2025) pointed out that low motivation is linked to poor problem-solving and creativity skills. To increase self-efficacy through collaborative and project-based learning, Asare (2025) recommended using flipped classrooms to improve motivation. Karnita (2025) found that interactive digital media increases motivation when used alongside teacher-parent collaboration. Sulistyowati (2024) showed that flipped classrooms lead to higher engagement and ownership, especially among low-motivation students.

Ugpo, Tubo, and Yurango (2025) argued that students who regulate their thoughts persevere through difficulties. Sulistyowati (2024) stated that active problem-solving enhances comprehension, especially among low-motivation students. Ramli (2025) pointed out that flipped classrooms provide more time for idea generation, resulting in increased engagement. Karnita (2025) proposed that digital resources promote sustained interest in learning.

Asare (2025) pointed out that motivation increases the correlation between self-efficacy and mathematical creativity. Ugpo, Tubo, and Yurango (2025) concluded that teaching metacognitive strategies promotes perseverance and resilience. Sulistyowati (2024) pointed out that low-motivation students benefit from structured and collaborative learning. Ramli (2025) confirmed that interactive classrooms increase motivation and engagement.

According to Karnita (2025), a combination of technological instruments with active approaches should be used in order to improve students' involvement. Asare (2025) stressed the significance of working on projects to build up self-confidence. Ugpo, Tubo, and Yurango (2025) advised implementing metacognitive approaches to sustain motivation. According to Sulistyowati (2024),

3) *Negative Attitude Towards Calculus*

Usman (2025) stated that those with strong mathematical beliefs adopt positive attitudes and deep understanding. Weak beliefs may lead to negative attitudes and procedural knowledge. According to Jameson (2025), misconceptions cause frustration and avoidance in calculus. Mostafa (2025) added that explicit teaching of learning strategies could not alter

negative attitudes without prior preparation.

Kramer (2023) stressed that evidence-based and culturally appropriate teaching lowers negative attitudes. MPC curriculum promotes cooperation, critical thinking, and participation. Torres-Peña (2024) revealed that AI-assisted feedback increases comprehension and prevents negative perceptions. Asare (2025) proposed self-efficacy construction to enhance students' disposition towards calculus.

Jameson (2025) found that eliminating misconceptions increased confidence and improved attitudes. Mostafa (2025) emphasized the need for growth mindset and self-regulation skills. Usman (2025) pointed out that positive beliefs lead to concept exploration. Kramer (2023) pointed out that inclusive teaching fosters a more positive experience in calculus.

Torres-Peña (2024) noted that interactive media boost enthusiasm and interest. Asare (2025) encouraged problem-solving tasks to promote positive attitudes. MPC courses decrease frustration and strengthen confidence (Kramer, 2023). Jameson (2025) suggested linking calculus to applications in practice to change perceptions.

C. Synthesis

According to the review of the literature, cognitive and affective variables contribute to the effectiveness of students in solving calculus problems. Cognitive variables such as a lack of prior knowledge, conceptual understanding, and problem-solving skills consistently emerge as crucial contributors to success in calculus. Prior knowledge of algebra, trigonometry, and other pre-requisite mathematical concepts plays a significant role in the effective resolution of calculus problems (Amalina, 2023; Mahadewsing, 2024; Sulistyaningsih, 2025). Besides, learners with high working memory capacity and strong metacognitive abilities demonstrate greater competence in problem-solving, while poor working memory and poor metacognitive knowledge lead to increased cognitive load and ineffective learning (Ruslimin, 2025; Oktaviyanthi, 2024; Guo, 2023; Sankalaite et al., 2025).

In addition, the deficiency in conceptual understanding negatively affects students' ability to tackle calculus problems. Derivative, limit, continuity, and the concept of rates of change misconceptions prevent learners from engaging in higher-order thinking activities (Jameson, 2025; Alabdulaziz, 2025; Torres-Peña, 2024). Pedagogical approaches, including flipped classrooms, problem-based learning, Artificial Intelligence-based solutions, and Modeling Practices in Calculus (MPC), have proven to be useful in improving conceptual understanding and addressing deficiencies in conceptual and procedural knowledge (Sulistiyowati, 2024; Ramli, 2025; Kramer, 2023).

In terms of affective factors, mathematical anxiety, low motivation, and negative attitudes towards calculus have a significant impact on student engagement and performance. High mathematical anxiety hampers cognitive functions and decreases working memory capacity, thus reducing problem-solving effectiveness (Esposito, 2025; Torres-Peña, 2024). On the other hand, low motivation and negative attitudes decrease perseverance and engagement, while self-efficacy and positive

attitudes enhance performance and mathematical creativity (Asare, 2025; Usman, 2025; Karnita, 2025). Research indicates that an active approach to teaching calculus, as well as incorporating metacognition and learning strategies, may alleviate some of these affective barriers.

Thus, successful calculus instruction should take into account both cognitive preparedness and affective engagement of students. The use of various combinations of teaching methods, such as flipped classrooms, AI-enhanced learning, metacognitive approaches, and culturally responsive pedagogies, seems promising. Nonetheless, even though there is substantial evidence regarding various strategies that contribute to improved student performance, very few studies offer comprehensive frameworks that incorporate both cognitive and affective factors. Furthermore, despite numerous studies exploring cognitive and affective factors individually, their interaction in calculus learning remains underexplored.

D. Research Gap

While many researchers have conducted various studies on the academic achievements of students in Calculus, previous researches are often conducted by studying cognitive and affective variables separately, thus providing an incomplete explanation about why senior high school students find it difficult to learn Calculus. The existing literature usually centers on isolated problems such as misunderstandings regarding concepts in integration, inadequate background knowledge, insufficient working memory capacity, and high mathematics anxiety. Nevertheless, the connection between the different cognitive and affective problems is never considered when explaining the difficulty of Calculus among students.

Furthermore, there are more studies that were conducted among college/university students compared to senior high school students. There is little research that talks about the struggles of senior high school students, especially those enrolled in STEM tracks since they are expected to be knowledgeable about Pre-calculus. Previous international research has considered metacognitive beliefs, motivational orientations, self-efficacy, and mathematics anxiety, but local studies are few.

There is also an absence of scholarly work on the integration of various theoretical frameworks, including the Constructivist Learning Theory, the Affective Filter Hypothesis, and the Cognitive Load Theory, to shed light on the complexities surrounding the difficulties encountered in calculus. Current studies tend to apply only one theoretical framework at a time, making it difficult to address the cumulative effect of the factors mentioned above.

Moreover, there is also a lack of relevant scholarly work conducted among the students in Cabuyao City, Laguna. Such studies would allow researchers to determine whether there are any specific local influences that could affect their learning process.

3. Research Methodology

This section discusses the methodology adopted in the study entitled "Analysing Cognitive and Affective Factors on the

Performance in Pre-calculus among Grade 11 STEM Senior High School Students.” The discussion entails a detailed overview of the processes employed in determining how the cognitive and affective aspects of Grade 11 STEM Senior High School students affect their performance in Calculus. First, an introduction to the general methodology applied in conducting the study will be presented.

By using the methodology, this research was guided through various processes, which will lead to the establishment of a sound explanation behind the varying performances experienced by Grade 11 STEM Senior High School students in Pre-calculus classes. The study was focus on identifying the cognitive and affective factors that might impact their learning process. Among other things, the factors included were the students’ prior knowledge, concepts and problem-solving skills, motivational aspect, attitude towards math, and math anxiety.

Moreover, the participants of this research study, along with the sampling strategies employed to make sure that the chosen subjects are indeed the proper representative of the target population, are presented in this chapter. Furthermore, the instruments utilized for collecting the necessary data, along with details regarding their validity, reliability, and appropriateness for assessing student performance in Pre-calculus, are also highlighted.

Finally, the chapter discusses the data-gathering procedures employed for obtaining the necessary data, along with the analytical techniques employed for processing the gathered information. Both the gathering and analysis of data can greatly affect the quality of the findings, which is why careful consideration is required when dealing with this aspect.

A. Research Design

The research adopted a quantitative research design with the descriptive-correlational research design method. According to Hasson (2024), the quantitative research design refers to the process whereby the researcher collects and analyzes numerical data in order to solve a research problem or test a hypothesis. This involves the employment of a scientific approach, whereby the data gathered is systematically and rigorously analyzed in order to generate dependable information. The results are communicated in an open manner such that other researchers can be able to reproduce the methodology. In addition, the researcher made use of descriptive correlation as per the definition given by Creswell (2023), which is concerned with the degree to which two or more variables correlate or co-vary.

B. Research Locale

The study was conducted at the St. Vincent College of Cabuyao, an institution of higher learning situated in Cabuyao City, Laguna Province. St. Vincent College of Cabuyao offers an extensive Senior High School Program inclusive of the STEM strand, thus making the college suitable for researching on the performance of the learners in Calculus. Being a learning institution focused on achieving excellence, there is a great likelihood that students at St. Vincent College of Cabuyao will have different cognitive and affective dispositions, which

would make it suitable to conduct the study.

St. Vincent College of Cabuyao is well-equipped with classrooms, up-to-date learning resources and ICT infrastructure, which would facilitate the effective teaching of Mathematics lessons. These will ensure the authenticity of the academic context in the sense that learners will be involved in many mathematical activities and tasks through which cognitive and affective factors influencing their performance in Pre-calculus can be identified.

The school was chosen based on its location, presence of Grade 11 STEM students, and administration’s interest in participating in the study. It is also a good source of subjects due to the fact that it offers an ideal sampling of Grade 11 STEM students to examine the relationship between cognitive and affective factors affecting their success in Calculus, specifically their existing knowledge, problem-solving abilities, motivations, and attitudes towards the subject, and mathematics anxiety. In addition, the location makes it easier to comply with ethical considerations such as getting permissions and ensuring the protection of student participants during the data collection process.

In summary, St. Vincent College of Cabuyao is a suitable setting for studying the relationship between cognitive and affective factors; and Grade 11 STEM students’ performance.

C. Respondents of the Study

The study comprised 203 grade 11 STEM students of St. Vincent College of Cabuyao in the school year 2025-2026 among 427 entire population. These students were considered as respondents due to the reason that they are currently enrolled, or have been enrolled not so long ago, to Pre-Calculus class under their STEM program. These students had already been exposed to the said subject matter, thereby providing them with adequate academic background regarding the factors affecting their performance in Calculus as well.

As shown in Table 1, in order to provide fair treatment and accurate sampling procedures, the stratified sampling technique was utilized by the researchers in selecting the respondents. Stratified sampling refers to the process wherein students belonging to the Grade 11 STEM class were divided into sections, or strata, and respondents were selected according to their proportion. The utilization of stratified sampling would increase the accuracy of the results and guarantee that each stratum of the STEM class will be proportionately represented in the research.

Criteria for selecting participants to include in the study were clearly defined in terms of inclusion criteria. The respondents in this study comprised those officially enrolled Grade 11 STEM students during the School Year 2025–2026. They should either be currently enrolled in or have finished their Pre-calculus course. Besides, they should also be willing to take part in the study through completing the survey instrument in good faith. The inclusion criteria allowed for only participants who have sufficient exposure academically to provide valid and pertinent data.

Exclusion criteria, on the other hand, were used to maintain reliability and validity of the research findings.

Excluded from the study were students belonging to non-STEM strands and Grade 11 learners not enrolled in Pre-calculus during the School Year 2025–2026. Moreover, those who happened to be absent on the day of conducting the survey and those who refused to be surveyed also excluded from the study.

Table 1
Frequency and percentage distribution of population of the respondents

Respondents	Frequency	Percentage
STEM Aquarius	20	9.85
STEM Aries	20	9.85
STEM Cancer	21	10.34
STEM Capricorn	20	9.85
STEM Gemini	21	10.34
STEM Leo	20	9.85
STEM Libra	21	10.34
STEM Pisces	20	9.85
STEM Scorpio	20	9.85
STEM Sagittarius	20	9.85
Total	203	100

D. Sampling Technique

A stratified sampling procedure was used to identify a sample of respondents among the four-hundred twenty-seven Grade 11 STEM students of St. Vincent College of Cabuyao during the School Year 2025-2026. The rationale for this sampling procedure is the fact that the STEM track is composed of various class sections wherein each section may differ in learning experiences and academic achievements. The process involved in conducting a stratified sampling procedure is the stratification of the sample respondents in terms of their respective sections.

Once the total number of participants was established, the researchers used the Raosoft sample size calculator to compute for the recommended number of respondents. The calculation involved four-hundred twenty-seven students, 95 percent confidence level, and 5 percent margin of error, resulting in a required sample size of about two-hundred-three students. It became the scientific foundation that would dictate the number of respondents to include in the research, which eliminated guesswork during the selection process and made it a lot more objective. Finally, once the number of respondents needed was computed, the researchers distributed the quota among all classes proportionate to their respective number of students.

This became important in light of the fact that each of the sections in the Grade 11 STEM group might have its own learning environment, depending on their teaching style, schedule, peers, and other factors that might have an impact on the way students think and perform in Pre-calculus. Thus, by taking into account these differences between sections, the researchers sought to make their analysis more accurate.

Stratified Sampling method also ensured that data gathering was convenient. The researchers worked hand-in-hand with class advisers to find out eligible students to participate in the

survey process. Ethics were practiced when researchers informed the students about the purpose of the study and ensured their voluntary participation. On the whole, it can be stated that the use of stratified sampling along with the sample size recommended by Raosoft increased the study’s validity by making the participants both representative and suitable for analysis.

E. Instrumentation

The researcher used a structured survey questionnaire designed to identify the cognitive and affective factors on the performance of Grade 11 STEM students in Pre-calculus. The questionnaire consists of multiple sections addressing both cognitive and affective domains: (1) Learning Gaps in Prior Knowledge, (2) Limited Conceptual Understanding, (3) Problem-Solving Difficulty, (4) Mathematical Anxiety, (5) Low Motivation, and (6) Negative Attitudes Toward Pre-calculus.

The first three sections measure cognitive factors, while the last three measure affective factors. Each section contains 10 items rated using a four-point Likert scale as shown in the table below.

Moreover, the researcher used a researcher-develop test to determine the performance of Grade 11 STEM students in Pre-calculus. This test contains 20 item multiple choice rated as shown in the table 3.

Table 3
Pre-Calculus performance test scores by Mapula (2026)

Score Range	Verbal Interpretation
Below 9	Poor
9-11	Needs Improvement
12-14	Satisfactory
15-17	Very Good
18-20	Excellent

F. Reliability Test Result

The questionnaire items were constructed based on existing literature on mathematics learning difficulties, affective factors, and cognitive processes in calculus learning. To ensure content validity, the instrument underwent expert evaluation by five specialists in Mathematics Education and Educational Research. All recommendations from the validators were incorporated into the final version.

A pilot test was conducted with 40 Senior High School students from Citi Global College who were not part of the main study. As shown in Table 4 on page 23, reliability was measured using Cronbach’s Alpha, which yielded coefficient values ranging from 0.72 to 0.93 across the sections, indicating high internal consistency. Cronbach’s Alpha revealed that cognitive factors such as learning gaps in prior knowledge and limited conceptual understanding have acceptable reliability indicative statements with 0.72 and 0.75 Cronbach’s alpha values, respectively and problem-solving difficulty have good

Table 2
4-Point Likert scale and verbal interpretation for level of cognitive and affective factors contribute on the performance in Pre-calculus

Assigned Points	Scale Range	Categorical Response	Verbal Interpretation
4	3.26-4.00	Strongly Disagree	Not Experienced
3	2.51-3.25	Disagree	Rarely Experienced
2	1.76-2.50	Agree	Often Experienced
1	1.00-1.75	Strongly Agree	Consistently Experienced

Table 4
Results of Cronbach alpha reliability test

Variables	Cronbach alpha	Verbal Interpretation
Learning gaps in prior knowledge	0.72	Acceptable
Limited conceptual understanding	0.75	Acceptable
Problem-solving difficulty	0.87	Good
Mathematical anxiety	0.81	Good
Low motivation	0.93	Excellent
Negative attitudes towards pre-calculus	0.83	Good

Legend: 0 .01-0.049: Not Acceptable, 0.50-0.59: Poor reliability, 0.60-0.69: Questionable reliability, 0.70-0.79: Acceptable, 0.80-0.89: Good, 0.90 -1.00: Excellent (Bobitt, 2021)

Table 6
4- Point Likert scale and verbal interpretation for level of cognitive and affective factors contribute on the performance in Pre-calculus

Assigned Points	Scale Range	Categorical Response	Verbal Interpretation
4	3.26-4.00	Strongly Disagree	Not Experienced
3	2.51-3.25	Disagree	Rarely Experienced
2	1.76-2.50	Agree	Often Experienced
1	1.00-1.75	Strongly Agree	Consistently Experienced

reliability indicative statements with 0.87 Cronbach alpha value. While affective factors such mathematical anxiety and negative attitudes towards pre- calculus have good reliability indicative statements with 0.81 and 0.83 Cronbach alpha value respectively, and low motivation have excellent reliability indicative statements with 0.93 Cronbach alpha value. Thus, all statements from the 6 variables passed the reliability test results and therefore allowed to be used as research instrument survey questionnaire for quantitative data gathering.

The entire instrument is self-administered, allowing respondents to answer independently within a designated time. The data collected from the questionnaire were analyzed to determine the level of cognitive and affective factors influencing students' difficulty in learning Pre-calculus.

The researcher also used the Kuder-Richardson formula 20 (KR-20) reliability test to assess students' performance, as shown in Table 5. KR-20 analyzed the dichotomous score, with a performance result of 0.72, interpreted as acceptable. This implies that the questions for performance passed the reliability test and it to use for the assessment of the performance of pre-calculus.

G. Data Gathering Procedure

In the collection of data for the study, a systematic and ethical process was applied in order to guarantee that the data collected was reliable. In this regard, the researcher started by drafting a letter formally written to the VPASS in order to acquire consent to perform the research among Grade 11 STEM students. After obtaining the consent, the researcher determined the sample size to be used through the application of Raosoft Sample Size Calculator. Further, clearance was obtained from the Research Review Ethics Committee. After the acquisition of all consents, the researcher prepared the needed materials for data collection.

After preparing all the required documents, the questionnaire survey was then conducted through the application of Google Forms. The link for the survey was shared with the selected respondents through the application of a stratified sampling method. Prior to completing the questionnaire, it was necessary that the participants affixed their e-signature. Instructions were clearly provided to guide the students throughout the completion of the questionnaire. Sufficient time was allocated for the students to fill the survey.

After the completion of the survey, the researcher waited for the submissions until he/she has received the desired number of participants. After the collection of data, all submissions were collected, recorded, and arranged accordingly. Then, the researcher analyzed the gathered data by using proper analysis methods to find out the cognitive and affective elements that affect students' performance in Pre-Calculus.

All the above procedures for gathering information were done with strict observance of ethical considerations. Firstly, participation in the study was optional and secondly, the students were kept anonymous. The last but not least consideration was that the students had the freedom to leave the study whenever they wanted. This way, the study was successful in collecting accurate data on the issue under discussion.

H. Treatment of Data

Data gathered from the study were analyzed through systematic processes following the quantitative research methodology. First, the survey questionnaire and researcher-prepared Pre-Calculus performance test responses were coded then processed through statistical software in order to analyze the data.

To identify the levels of cognitive factors leading to the difficult learning experience in Pre-Calculus, such as lack of prerequisite knowledge and skills, incomplete conceptual understanding, and difficult problem solving, the researcher obtained the median and weighted mean for these variables. In addition, to identify the levels of affective factors like math anxiety, low motivation, and negative attitudes toward Pre-Calculus, medians and weighted means were calculated, as shown in Table 6 on page 25. Descriptive statistics helped in identifying the frequency of occurrence of such cognitive and affective factors.

To determine whether cognitive and affective factors had significant correlation with the level of achievement in Pre-Calculus, correlational analysis was used, as shown in 8 on page 26. Through inferential statistics, the extent of correlations of these factors with students' performances was revealed.

Through a systematic application of these statistical techniques, it was possible for this study to come up with results that were both valid and reliable. It is worth noting that it would

not require anything else apart from numbers since these statistics techniques can detect trends, patterns, and relationships.

I. Ethical Consideration

1) Data Privacy Act of 2012 (RA 10173)

It is worthy to note that the researcher strictly observed the Data Privacy Act of 2012 guidelines when conducting an inquiry on the reasons behind the difficulty encountered by senior high school students from Cabuyao City, Laguna in solving problems in calculus. Personal and private details obtained during the process were handled with utmost confidentiality. It was made known to respondents the scope of the study, the kind of information that would be acquired, and how these details would be utilized and secured.

Furthermore, before engaging in the study, the researcher asked for informed consent to assure participants that they had the right to access, modify, or delete their personal details at any point during the experiment, which is guaranteed under Republic Act 10173. In order to ensure anonymity, personal identifiers were never included in any document or report prepared. Hard copies were kept in locked file cabinets, whereas digital files will be stored in encrypted folders accessible solely to the research group.

Honesty and integrity were key factors that determined how the research was conducted. The researcher was impartial in handling any possible conflicts of interest. Sensitivity to cultures and societies were taken into consideration.

Prior to collecting data, the research was reviewed and approved by the Research Ethics Review Committee. Respondents were briefed appropriately after participating in the research. They were told about the purpose, importance, and impact of the research.

4. Results and Discussion

This section presents the data collected from the two hundred and three (203) respondents through the administered survey questionnaires. The gathered information is systematically analyzed, interpreted, and presented in order to provide a clear and comprehensive account of the research findings. This chapter encompasses all data derived from the survey and pertinent observations, organized to emphasize significant patterns, relationships, and implications relevant to the objectives of the study.

The purpose of this study is to analyze cognitive and affective factors contributing to the performance of the senior high school students. This specifically seeks to respond to the following questions:

1. The level of cognitive factors that contribute to the difficulty of Pre-calculus among SHS students in terms of Learning gaps in prior knowledge, Limited conceptual understanding, and Problem-solving difficulty.

As shown in Table 8, a consistent median of 2.00 across all indicators. This indicates that the middle respondent consistently rated their experience in learning gap in prior knowledge at the level 2 in a scale. Table 9 also shown the general assessment is 2.03, which falls under “Agree or Often Experience”. This indicates that most of the respondents perceive that the learning gaps in prior knowledge contribute to the difficulty of Pre-calculus among senior high school students. Furthermore, the indicator “I was not adequately prepared in earlier grade levels to handle advanced math like Pre-calculus” had the highest computed mean of 2.38, which

Table 7

Interpretation of spearman rho correlation by Andres-Sanchez (2021)

Size of correlation	Verbal Interpretation
1.00 or -1.00	Perfect positive (negative) correlation
.90 to .99 (-.90 to -0.99)	Very high positive (negative) correlation
.70 to .90 (-.70 to -.90)	High positive (negative) correlation
.50 to .70 (-.50 to -.70)	Moderate positive (negative) correlation
.30 to .50 (-.30 to -.50)	Low positive (negative) correlation
.01 to .30 (-.01 to -.30)	Negligible correlation
0.00	No correlation

2) General Ethical Protocols

Ethical considerations were strictly adhered to in the research in order to guarantee the safety, integrity, and well-being of the research participants. Participation in the research was purely voluntary and without coercion or any kind of influence. No physical, emotional, or psychological harm was inflicted on the respondents during the course of conducting the research.

Table 8

The level of cognitive factors that contribute to the difficulty of Pre-calculus among SHS students in terms of Learning gaps in prior knowledge

Indicator	Median	Weighted Mean	Verbal Interpretation	Rank
My performance in Pre-calculus would improve if my prior knowledge were stronger.	2.0	1.62	Consistently Experienced	10
I find it difficult to connect previous math lessons to Pre-calculus concepts	2.0	2.18	Often Experienced	3
Missing prior knowledge makes it hard for me to understand new Pre-calculus topics.	2.0	1.75	Consistently Experienced	9
I often struggle in Pre-calculus because I lack mastery of basic algebraic concepts.	2.0	2.10	Often Experienced	5
My difficulties in Pre-calculus come from weak foundational skills learned in previous math subjects.	2.0	2.16	Often Experienced	4
I struggle with Pre-calculus because I easily forget previously learned math rules or formulas.	2.0	1.79	Often Experienced	8
Gaps in my past math learning reduce my confidence when facing new Pre-calculus problems.	2.0	1.97	Often Experienced	8
I was not adequately prepared in earlier grade levels to handle advanced math like Pre-calculus.	2.0	2.38	Often Experienced	1
I find Pre-calculus challenging because I cannot recall important prerequisite lessons (e.g., functions, exponents, equations).	2.0	2.08	Often Experienced	6
I have difficulty understanding Pre-calculus examples because I do not fully understand the underlying concepts from earlier math subjects.	2.0	2.26	Often Experienced	2
General Assessment		2.03	Often Experienced	

Table 9
The level of cognitive factors that contribute to the difficulty of Pre-calculus among SHS students in terms of Limited conceptual understanding

Indicator	Median	Weighted Mean	Verbal Interpretation	Rank
I have difficulty relating Pre-calculus concepts to real-life situations.	2.0	2.04	Often Experienced	7
I struggle to explain Pre-calculus concepts using my own words.	2.0	2.06	Often Experienced	6
I find it difficult to understand the underlying concepts behind Pre-calculus formulas.	2.0	1.75	Often Experienced	2
I often get confused about when to apply certain Pre-calculus rules or techniques.	2.0	2.10	Often Experienced	10
My lack of deep understanding affects my ability to solve more complex Pre-calculus problems.	2.0	2.16	Often Experienced	9
I can solve problems mechanically, but I do not fully understand why the solutions work.	2.0	1.79	Often Experienced	1
Even after studying, I still feel unsure if I truly understand the meaning behind Pre-calculus operations.	2.0	1.97	Often Experienced	8
I find it hard to visualize the concepts of conic sections, system of nonlinear equation and trigonometric	2.0	2.38	Often Experienced	3
I feel confused when Pre-Calculus lessons involve abstract concepts such as functions, conic sections, or trigonometric relationships	2.0	2.08	Often Experienced	4
I struggle to connect one Pre-calculus concept to another (e.g., how conic section relates to system of nonlinear equation).	2.0	2.26	Often Experienced	5
General Assessment		2.03	Often Experienced	

Table 10
The level of cognitive factors that contribute to the difficulty of pre-calculus among SHS students in terms of problem-solving difficulty

Indicator	Median	Weighted Mean	Verbal Interpretation	Rank
I often get confused when solving multi-step Pre-calculus problems.	2.0	2.04	Often Experienced	6
I easily make mistakes in computation when solving Pre-calculus problems.	2.0	1.98	Often Experienced	7
I have difficulty translating word problems into mathematical expressions or equations.	2.0	1.99	Often Experienced	6
I struggle to apply Pre-calculus concepts to unfamiliar or non-routine problems.	2.0	1.89	Often Experienced	8
I feel overwhelmed when Pre-calculus problems require several steps to complete.	2.0	2.02	Often Experienced	5
My difficulty in solving Pre-calculus problems lowers my confidence in the subject.	2.0	1.98	Often Experienced	7
I struggle to identify the appropriate method or strategy to solve Pre-calculus problems.	2.0	2.05	Often Experienced	3
I find it hard to check or verify if my solution is correct.	2.0	2.09	Often Experienced	2
I often cannot decide which formula or rule to use when solving problems.	2.0	2.10	Often Experienced	1
I find it challenging to understand what a Pre-calculus problem is asking me to do.	2.0	2.04	Often Experienced	4
General Assessment		2.01	Often Experienced	

was verbally interpreted as Agree or Often Experienced; meanwhile, the indicator “My performance in Pre-calculus would improve if my prior knowledge were stronger” had the lowest mean of 1.62, which was verbally interpreted as Strongly Agree of Constantly Experienced.

Thus, it may be argued that lack of learning in previous knowledge plays a vital role in making pre-calculus difficult for senior high school students, and since the scores were very high, it suggests that there is adequate prior knowledge before starting a new lesson. It should be noted that this result is reinforced by the findings of Amalia (2023) who found that prior knowledge is significantly correlates student's performance. According to Mahadewsing (2024), there are some mistakes in learning due to poor previous knowledge of mathematics. According to Ramli (2025), the solution is to engage the students actively through students-centered instructions.

1) *Limited Conceptual Understanding*

As shown in Table 9, a consistent median of 2.00 across all indicators. This indicates that the middle respondent consistently rated their experience in limited conceptual understanding at the level 2 in a scale. Table 10 also shown the general assessment is 2.08, which falls under “Agree or Often Experience”. This indicates that most of the respondents perceive that the limited conceptual understanding contribute to the difficulty of Pre-calculus among senior high school students. Furthermore, the indicator I can solve problems mechanically, but I do not fully understand why the solutions work.” had the highest computed mean of 2.21, which was verbally interpreted as Agree or Often Experienced;

meanwhile, the indicator “I often get confused about when to apply certain Pre-calculus rules or techniques” had the lowest mean of 1.92, which was verbally interpreted as Agree or Often Experienced.

It can be concluded that limited conceptual understanding significantly contribute to the difficulty of pre-calculus among senior high school students, and the high scores suggest consistently connecting concepts in real life or model practices for the students understand the concept. For example, instead of discussing the graph of conic section, show them how graph changes whenever the values increase of decrease.

This conclusion has been proven by the study of Usman (2025) which showed that students had the feeling that high level of mathematics was obtained when conceptual knowledge was more profound. According to Jameson (2025), misconceptions of calculus are caused by low conceptual knowledge. The modeling of practices in calculus curricula proved that conceptual knowledge can be improved by students.

2) *Problem-solving Difficulty*

As shown in Table 10, a consistent median of 2.00 across all indicators. This indicates that the middle respondent consistently rated their experience in problem-solving difficulty at the level 2 in a scale. Table 10 also shown the general assessment is 2.01, which falls under “Agree or Often Experience”. This indicates that most of the respondents perceive that the problem solving difficulty contribute to the difficulty of Pre-calculus among senior high school students. Furthermore, the indicator “I often cannot decide which formula or rule to use when solving problems” had the highest computed mean of 2.10, which was verbally interpreted as

Agree or Often Experienced; meanwhile, the indicator “I struggle to apply Pre-calculus concepts to unfamiliar or non-routine problems” had the lowest mean of 1.89, which was verbally interpreted as Agree or Often Experienced.

It can be concluded that problem-solving difficulty significantly contribute to the difficulty of pre-calculus among senior high school students. This is supported by the study of Ruslimin (2025), who demonstrated that working memory capacity accounts for 74.5% of variance in calculus problem-solving performance. Guo (2023) confirmed that complex word problems require higher working-memory resources, with the central executive being most crucial. The high scores also suggest consistently providing real-life problem for the students relate and understand the problem, and letting students practice solving problem as their training in solving mathematical problem.

This conclusion is also reinforced by the findings by Berger et al. (2025), who concluded that working memory training positively contributes to problem-solving and academic results. Oktaviyanthi (2024) recommended personalized approaches depending on individual cognitive characteristics for maximizing problem-solving success. Ruslimin (2025) underlined the significance of minimizing cognitive load during instruction. Guo (2023) reaffirmed the necessity of supporting working memory to solve problems.

2. The level affective factors that influence students’ learning experiences in Pre-calculus among with Mathematical anxiety; Low motivation; and Negative attitudes towards Pre-calculus.

3) *Mathematical anxiety*

As shown in Table 11, the median shifts across three distinct levels (1.00, 2.00 and 3.00), showing exactly where the middle respondent group sits for each level of anxiety. The indicator “I worry a lot about failing Pre-calculus” had the median 1.00

which indicates the 50% of the respondents chose the Strongly Agree or Consistently Experienced. This implies students fear about failing Pre-calculus. Additionally, the indicator “I avoid practicing Pre-calculus because it makes me feel uneasy” had the median of 3.00 which indicates the center of the data shifted to Disagree or Rarely Experienced. This implies at least half of the respondents are resisting to avoid the subject. Moreover, the rest of the indicators had the median of 2.00, this indicates strong consensus in Agree or Often Experienced. This implies that the respondents consistently experienced the anxiety.

Table 11 also shown the general assessment is 2.09, which falls under “Agree or Often Experience”. This indicates that most of the respondents perceive that the mathematical anxiety contribute to the difficulty of Pre-calculus among senior high school students. Furthermore, the indicator “I avoid practicing Pre-calculus because it makes me feel uneasy” had the highest computed mean of 2.72, which was verbally interpreted as Disagree or Rarely Experienced; meanwhile, the indicator “I worry a lot about failing Pre-calculus” had the lowest mean of 1.46, which was verbally interpreted as Strongly Agree or Consistently Experienced.

Thus, one can state that mathematical anxiety plays a critical role in making the pre-calculus course complicated for senior high school students. The results show that providing constant positive feedback will help alleviate anxiety in students.

According to Esposito (2025), math anxiety has a negative influence on students' performance since it affects their working memory. Those who experience higher levels of anxiety have poorer cognitive functions and cannot solve problems. As noted by Torres-Peña (2024), using artificial intelligence technologies enables students to receive prompt feedback and participate in simulations, which decreases anxiety and increases self-confidence.

Table 11
The level affective factors that influence students’ learning experiences in pre-calculus among SHS students with Mathematical anxiety

Indicator	Median	Weighted Mean	Verbal Interpretation	Rank
I worry a lot about failing Pre-calculus.	1.0	1.46	Consistently Experienced	10
I avoid practicing Pre-calculus because it makes me feel uneasy.	3.0	2.72	Rarely Experienced	1
I experience tension or nervousness during Pre-calculus quizzes or exams.	2.0	1.93	Often Experienced	8
Anxiety affects my ability to think clearly when solving Pre-calculus tasks.	2.0	1.99	Often Experienced	7
I feel overwhelmed when Pre-calculus problems require several steps to complete.	2.0	2.49	Often Experienced	2
My mind goes blank when I try to solve difficult Pre-calculus problems.	2.0	2.06	Often Experienced	5
I feel stressed when I do not immediately understand a Pre-calculus lesson.	2.0	1.80	Often Experienced	9
I get anxious when I compare my performance in Pre-calculus with my classmates	2.0	2.05	Often Experienced	6
I feel anxious when the teacher calls on me to answer a Pre-calculus question.	2.0	2.09	Often Experienced	4
My hands get sweaty or I feel physical discomfort when dealing with Pre-calculus problems.	2.0	2.30	Often Experienced	3
General Assessment		2.09	Often Experienced	

Table 12
The level affective factors that influence students’ learning experiences in pre-calculus among SHS students with low motivation

Indicator	Median	Weighted Mean	Verbal Interpretation	Rank
I feel unmotivated to improve my performance in Pre-calculus.	3.0	2.64	Rarely Experienced	3
I easily give up when I encounter difficult Pre-calculus problems.	3.0	2.54	Rarely Experienced	5
I find it difficult to stay focused during Pre-calculus lessons.	2.0	2.35	Often Experienced	9
I rarely participate in Pre-calculus discussions because I am not motivated	3.0	2.50	Often Experienced	6
I find it hard to push myself to complete Pre-calculus tasks.	2.0	2.41	Often Experienced	8
I only study Pre-calculus when required, not because I want to learn.	3.0	2.62	Rarely Experienced	4
I do not feel excited or eager to learn new Pre-calculus topics.	3.0	2.65	Rarely Experienced	2
My lack of motivation affects the effort I put into learning Pre-calculus.	2.0	2.23	Often Experienced	10
I feel lazy or uninterested when it is time to review Pre-calculus lessons.	3.0	2.66	Rarely Experienced	1
I often lack the motivation to study Pre-calculus even when I know I should.	2.0	2.47	Often Experienced	7
General Assessment		2.51	Rarely Experienced	

4) *Low motivation*

As shown in Table 12, the medians vary across levels (2.00 and 3.00) which interpreted as Agree or Often Experience and Disagree or Rarely Experienced respectively. Majority or 60% of the indicator had median of 3.00 which implies that the respondents as a whole are motivated. While Minority or 40% of the indicator had median of 2.00 which implies that there are areas where respondents felt consistent struggles. Table 13 also shown the general assessment is 2.51, which falls under “Disagree or Rarely Experience”. This indicates that only a few respondents perceive that low motivation contributes to the difficulty of Pre-calculus among senior high school students. Furthermore, the indicator “I feel lazy or uninterested when it is time to review Pre-calculus lessons.” had the highest computed mean of 2.66, which was verbally interpreted as Disagree or Rarely Experienced; meanwhile, the indicator “My lack of motivation affects the effort I put into learning Pre-calculus” had the lowest mean of 2.23, which was verbally interpreted as Agree or often Experienced.

It can be deduced that lack of motivation does not seem to be seen as an important factor that leads to the challenges encountered in Pre-Calculus among the respondents. Asare (2025) determined that low motivation is associated with poor problem-solving skills and creativity. The high results indicate the consistent provision of positive reinforcement and engaging activities to reduce the stress and increase their interest.

Enhancing self-efficacy through collaborative and project-based learning enhances engagement. According to Karnita (2025), interactive multimedia enhances motivation in conjunction with parental involvement and teacher collaboration. Sulistyowati (2024) showed that the flipped classroom strategy increases ownership and engagement among students, especially those who lack motivation.

5) *Negative attitudes toward Pre-calculus*

As shown in Table 13, the medians vary across levels (2.00 and 3.00) which interpreted as Agree or Often Experience and Disagree or Rarely Experienced respectively. Majority or 70% of the indicator had median of 3.00 which implies that the respondents as a whole had positive attitudes towards Precalculus. While Minority or 20% of the indicator had

median of 2.00 which implies that there are areas where respondents felt specific negative sentiments about Pre-calculus. Table 13 also shown the general assessment is 2.63, which falls under “Disagree or Rarely Experience”. This indicates that only a few respondents perceive that negative attitudes contribute to the difficulty of Pre-calculus among senior high school students. Furthermore, the indicator “I feel that Pre-calculus is not useful for my future career” had the highest computed mean of 2.96, which was verbally interpreted as Disagree or Rarely Experienced; meanwhile, the indicator “I believe Pre-calculus is a subject that is too difficult for most students” had the lowest mean of 2.03, which was verbally interpreted as Agree or often Experienced.

Negative attitude is not considered by most of the respondents as a contributory factor that causes difficulty in Pre-calculus classes. According to Mostafa (2025), mere learning strategy instruction alone cannot help change negative attitudes before preparation. High results reveal that attitudes towards Pre-calculus are not perceived as a subject that is hard for most students to learn.

According to Kramer (2023), evidence-based and culturally responsive education minimizes negative attitudes. MPC instruction promotes cooperation, problem-solving skills, and engagement of learners. Torres-Peña (2024) found out that AI technology provides feedback on learning, which eliminates negative perception. Asare (2025) believes that self-confidence builds students' disposition to study calculus.

The researcher found out that interactive techniques boost motivation and interest of students. Problem solving was mentioned as one of the factors that create positive attitudes to Pre-calculus. MPC instruction does not cause frustration of students and promotes their confidence (Kramer, 2023).

3. A significant relationship between cognitive factors and students' performance in Pre-calculus.

The table 14 shown the correlational analysis between cognitive factors and students' performance. The rho value between students' performance and learning gaps in prior knowledge is 0.69 interpreted as moderate positive correlation. For the correlation between students' performance and limited conceptual understanding, the rho value is 0.511 interpreted as

Table 13

The level affective factors that influence students' learning experiences in pre-calculus among SHS students with negative attitudes toward pre-calculus

Indicator	Median	Weighted Mean	Verbal Interpretation	Rank
I dislike solving Pre-calculus problems	3.0	2.73	Rarely Experienced	5
I often feel that Pre-calculus is boring or uninteresting.	3.0	2.87	Rarely Experienced	2
I feel discouraged whenever I think about learning Pre-calculus.	3.0	2.74	Rarely Experienced	4
I think Pre-calculus is only for very intelligent students.	3.0	2.64	Rarely Experienced	7
I think Pre-calculus has little relevance to my daily life.	2.0	2.40	Often Experienced	9
I prefer other subjects because I do not like Pre-calculus.	3.0	2.67	Rarely Experienced	6
I feel that Pre-calculus is not useful for my future career.	3.0	2.96	Rarely Experienced	1
My negative view of Pre-calculus affects my willingness to learn it.	3.0	2.53	Rarely Experienced	8
I believe Pre-calculus is a subject that is too difficult for most students.	2.0	2.03	Often Experienced	10
I avoid studying Pre-calculus because I already think I will not understand it.	3.0	2.76	Rarely Experienced	3
General Assessment		2.63	Rarely Experienced	

Table 14

Test of significant relationship between cognitive factors and students' performance in pre-calculus

Cognitive Factor	Digital Citizenship competence	Rho	P-value	Conclusion	Decision
Learning gaps in prior knowledge	Performance	0.69	0.000	Significant	Reject H ₀
Limited conceptual understanding		0.511	0.000	Significant	Reject H ₀
Problem-solving difficulty		0.432	0.000	Significant	Reject H ₀

**Correlational at the level 0.05

moderate positive correlation. While the correlation between problem students' performance and solving difficulty, the rho value is 0.432 interpreted as low positive correlation.

All cognitive factors correlates the students' performance, with the computed probability values 0.000 were less than the level of significant ($p < 0.05$); thus the null hypothesis is rejected. The result shows that there is significant between the dependent and independent variable. This is to conclude that the decision to Reject H_0 for all cases means there is significant relationship on cognitive factors on the students' performance in pre-calculus.

According to Guo (2023), complex word problems demand high working-memory capacity, especially for the central executive process. Working memory can improve problem-solving skills and promote long-term educational achievement according to Berger et al. (2025).

Amalina (2023) noted that domain-specific prior knowledge serves as an excellent predictor of mathematics problem-solving proficiency. Family education level had an indirect effect on outcomes through family income, but inadequate prior knowledge was a barrier to student achievement. Weaknesses in basic knowledge in algebra and trigonometry led to mistakes according to Mahadewsing (2024). Sulistyarningsih (2025) noted that students had difficulties translating real-life scenarios into mathematical expressions without sufficient prior knowledge.

Usman (2025) found that students with robust mathematical beliefs developed deep concept knowledge by linking ideas, processes, and graphical representation. In contrast, students with poor mathematical beliefs depended on procedures and lacked a deeper understanding of concepts. According to Jameson (2025), some common misconceptions include equating derivatives with functions and misunderstanding rates of change. Artificial intelligence enhanced conceptual learning by providing instant feedback and interactive simulations according to Torres-Peña (2024).

4. A significant relationship between affective factors and students' performance in Pre-calculus.

Table 15 shown the correlational analysis between affective factors and students' performance. The rho value between students' performance and mathematical anxiety is 0.430 interpreted as low positive correlation. For the correlation between students' performance and low motivation, the rho value is 0.445 interpreted as low positive correlation. While the correlation between problem students' performance and negative attitudes towards pre-calculus, the rho value is 0.526 interpreted as moderate positive correlation,

All affective factors correlates the students' performance, as the computed p-values (0.000) were less than the level of significant ($p < 0.05$); thus the null hypothesis is rejected. The findings indicate that there is significant relationship between

the dependent and independent variable.

This is to conclude that the decision to Reject H_0 for all cases means there is significant effects on affective factors on the students' performance in pre-calculus.

According to Esposito (2025), math anxiety is one of the negative effects that impact the performance of students since it impairs working memory. The students suffering from anxiety are characterized by poor cognitive functions and low problem-solving skills. Torres-Peña (2024) indicated that the use of artificial intelligence tools enables the students to receive feedback instantly, thus reducing their anxiety levels and boosting their confidence.

The studies by Asare (2025) revealed that low motivation is related to low problem-solving and creativity among the learners. Self-efficacy can be enhanced through collaborative and project-based learning and thus increases the level of motivation. It was argued by Karnita (2025) that interactive digital media increased the motivation when combined with teacher-parent collaboration.

5. What action plan may be proposed based on the findings of the study to improve students' performance in Pre-calculus?

This finding implies that the correlation between Cognitive factors and students' achievement in pre-calculus is significant. The factors associated with emotions, such as mathematics anxiety, have also proven to be significant correlating factors. Low motivation and negative attitude are less severe but still present. Thus, the intervention strategy will lay a foundation for knowledge acquisition, concept comprehension, and problem-solving skills by minimizing the students' mathematics anxiety. This intervention strategy is based on theoretical foundations of Constructivist Learning Theory (Piaget, 1952; Vygotsky, 1978; Bruner); Affective Filter Hypothesis: Foundation for Motivation and Work Performance (Krashen, 1985); ET-CRS Cognitive Load Theory (Sweller, 2003).

6) Framework

These complementary learning theories on which the intervention program is based are Constructivist Learning Theory, Affect Filter Hypothesis, and Cognitive Load Theory. The frameworks align with an overall perspective of supporting improved student performance in Pre-Calculus by addressing cognition, affect and instruction.

7) Constructivist Learning Theory

The intervention is based on the model of Constructivist Learning theory proposed by Jean Piaget (1952), Lev Vygotsky (1978) and Jerome Bruner (1960). Constructivism This theory claims that learning takes place as the students construct knowledge directly themselves through experience, interaction and reflection. In this program, constructivism is applied through:

Table 15

Test of significant relationship between affective factors and students' performance in pre-calculus

Cognitive Factor	Digital Citizenship competence	Rho	P-value	Conclusion	Decision
Mathematical Anxiety	Performance	0.43	0.000	Significant	Reject H_0
Low Motivation		0.445	0.000	Significant	Reject H_0
Negative Attitudes Towards Pre-Calculus		0.526	0.000	Significant	Reject H_0

**Correlational at the level 0.05

- Collaborative learning (Think-Pair-Share, group work)
- Guided discovery and problem-solving activities
- Use of multiple representations (graphs, algebraic models, real-life contexts)

These strategies allow students to build deeper conceptual understanding rather than relying on rote procedures.

8) *Affective Filter Hypothesis*

The Affective Filter Hypothesis by Stephen Krashen, (2003) expound that psychological factors such as anxiety, motivation, and attitudes significantly influence learning. A high affective filter can obstruct students' capability to process information. This framework supports the inclusion of:

- Low-stakes assessments
- Positive reinforcement and feedback
- Supportive and non-threatening classroom environment

These strategies aim to reduce mathematical anxiety and increase students' confidence and motivation.

9) *Cognitive Load Theory*

Cognitive Load Theory explains that learning is most effective when instructional design does not overload students' working memory. This theory is applied through:

- Scaffolded instruction (step-by-step problem solving)
- Chunking of complex Pre-Calculus concepts
- Gradual progression from simple to complex tasks

These strategies assist in processing the information effectively and boosting performance on problem-solving efforts.

These frameworks are integrated together so that the specific intervention program not only addresses how students learn (constructivism), but also how they feel when learning (affective filter) and how information is processed cognitively (cognitive load). So the program is a Holistic approach to enhancing students in Pre-Calculus.

All elements of the intervention directly follow from the framework. Teaching practices are guided by constructivism, Affective Filter allows teachers to help regulate students' anxiety and motivation for these lessons, and Cognitive Load Theory helps in the structuring of a lesson that will be doable for students.

10) *Implementation Guidelines*

To ensure effective execution, the following guidelines should be observed:

11) *Conduct Baseline Assessment*

1. Administer a diagnostic test to identify learning gaps
2. Group students based on level of difficulty

12) *Follow Structured Progression*

1. Week 1–2: Cognitive factor focus (remediation and conceptual learning)
2. Week 3: Problem-solving development
3. Week 4–5: Affective factors and behavioral interventions
4. Week 6: Evaluation

13) *Adopt Student-Centered Strategies*

1. Use collaborative learning, guided discovery, and

interactive tools

2. Encourage student participation and peer support

14) *Create a Supportive Environment*

1. Provide positive feedback
2. Minimize fear of failure through low-stakes assessments

15) *Ensure Continuous Monitoring*

1. Use formative assessments weekly
2. Adjust strategies based on student progress

16) *Objectives*

At the end of the program, students should be able to:

1. Demonstrate improved mastery of prerequisite skills
2. Develop deeper conceptual understanding in Pre-calculus
3. Apply appropriate strategies in solving problems
4. Exhibit reduced mathematical anxiety.
5. Show improved performance in the 20-item test

Monitoring and Evaluation: The implementation of PCEP will be continuously monitored to ensure its effectiveness.

5. Summary of Findings, Conclusions and Recommendations

This section provided a summary of the findings, conclusions, and recommendations based on the results of the study.

A. *Summary of Findings*

Based from the results and discussion of the study, the following summary of findings were drawn:

1) *Level of Cognitive Factors that Contribute to the Difficulty of Pre-Calculus Among SHS Students*

The study found that cognitive factors contribute to the difficulty of Pre-calculus among senior high school students, but their contributions vary across factors. Problem-solving difficulty (WM=2.01) was identified as the most experienced by the senior high school students in pre-calculus, where students got confused about the formula to use in a mathematical problem, followed by learning gaps in prior knowledge (WM=2.03), indicating that prior knowledge contributes to the difficulty of pre-calculus. The limited conceptual (MW=2.08) understanding received the highest rating, which implies that limited conceptual understanding confuses students about Pre-calculus rules or techniques. Additionally, the result also shown consistent median of 2.00 which implies that the respondents consistently experienced these cognitive factors that contribute to the difficulty of Pre-calculus Overall, the difficulty in cognitive factors influences students' level of difficulty in Pre-calculus.

2) *The Level Affective Factors that Influence Students' Learning Experiences in Pre-Calculus Among with Mathematical Anxiety; Low Motivation; and Negative Attitudes Towards Pre-Calculus*

The study found that affective factors contribute to the difficulty of Pre-calculus among senior high school students, but their contributions vary across factors. Mathematical anxiety (WM=2.09) was identified as "Often Experienced,"

with students reporting significant worry about failing the subject. In contrast, Low motivation ($WM=2.51$) and Negative attitudes ($WM=2.63$) were interpreted as "Rarely Experienced". Additionally, the median vary across factors, majority of the indicator of Mathematical anxiety had median 2.00 interpreted as Agree or Often Experienced, while majority of the indicator for Low motivation and Negative attitudes had median of 3.00 interpreted as Disagree or Rarely Experienced. In conclusion, while students do not generally lack interest or view the subject as useless, they still experience high levels of tension and stress during tasks and exams.

3) *A Significant Effect of Cognitive Factors on Students' Performance in Pre-Calculus*

The correlational analysis revealed that all cognitive factors have a significant relationship on Pre-calculus performance ($p < 0.05$), leading to the rejection of the null hypothesis. Learning gaps in prior knowledge showed the strongest relationship with a moderate positive correlation ($Rho=0.690$), followed by limited conceptual understanding ($Rho=0.511$) and problem-solving difficulty ($Rho=0.432$).

4) *A Significant Effect of Affective Factors on Students' Performance in Pre-Calculus*

All affective factors were found to have a significant relationship on performance ($p < 0.05$), and the null hypothesis was rejected. Negative attitudes showed a moderate positive correlation ($Rho=0.526$) with performance, while low motivation ($Rho=0.445$) and mathematical anxiety ($Rho=0.430$) demonstrated low positive correlations.

5) *What Action Plan May Be Proposed Based on the Findings of the Study to Improve Students' Performance in Pre-Calculus?*

The researcher proposed the Pre-calculus Enhancement program, a six weeks targeted intervention design to help teachers address the difficulty encounter by the students in the Pre-calculus subject. This program aims to improve the conceptual understanding of students towards calculus, enhance their problem solving skills and address the learning gap in prior knowledge. Moreover, this program also aims to lessen the anxiety caused by Pre-calculus subject.

B. Conclusion

Based from the results and discussion of the study, the following conclusions are drafted:

1. The difficulty of Pre-calculus was determined by the cognitive demands placed on students. Lacks adequate knowledge of the fundamentals can create mental blocks, making it impossible for the student to relate previous knowledge of mathematics to new ideas. Moreover, the inability of students to do this hinders their ability to integrate their elementary understanding with the advanced thinking required for learning.
2. Affective factors prevent students from performing up to their potential, regardless of their competency in mathematics. Math anxiety hinders students from concentrating on solving problem sets, despite their positive attitude towards Pre-calculus.
3. The significance on cognitive factors confirms that Pre-calculus success hinges on having the appropriate background knowledge because any deficiency will set off a chain reaction of learning problems called a "domino effect." The course syllabus builds cumulatively; therefore, any weaknesses that are not corrected jeopardize the student's capacity to cope with more difficult subjects.
4. The significance on affective domains confirms that improving student performance requires a comprehensive, holistic approach, as addressing only the procedural "how-to" of mathematics without managing a student's emotional response and anxiety is insufficient for long-term success. Because learning is a dual process involving both intellectual mastery and emotional stability, focusing exclusively on technical knowledge neglects the psychological barriers that often prevent that knowledge from being effectively applied.
5. Pre-calculus failure is driven by the combined weight of missing foundational skills and the paralyzing effects of math anxiety, which often masks a student's true ability during exams. By blending "spiral reviews" of basic math with low-stakes engagement, the PCEP builds the confidence needed for students to master complex concepts and solve problems without fear.

C. Recommendations

Based from the results and discussion of the study, the following recommendations are suggested:

1. To Grade 11 STEM Students: Students must allocate sufficient time for reviewing previous lessons concerning algebra and trigonometry. By doing so, students can find answers to the questions that appear in Pre-calculus and be confident in answering difficult mathematical equations. In addition, students can participate in the intervention program to fill the gaps in learning core algebra and functional analysis. With the assistance of the intervention program, students will not only gain additional confidence but also improve academic performance due to having a leveled playground.
2. To Pre-calculus Teachers: Instructional paradigm should move beyond the framework of purely procedural or mechanical learning, which makes students see math as an algorithmic process that should be learned through repetition. Under such conditions, students fail to use critical thinking in order to apply previously acquired knowledge to non-routine tasks or even realize the logic behind certain formulas. Educators need to introduce visual manipulations to enable students to change particular variables and analyze corresponding changes using the graphs produced by visualizers

like Desmos or GeoGebra. Combining this visual approach with practical examples, such as solving projectile movement problems or financial mathematics, enables students to learn math as a language of the world, rather than an abstract process. Such an approach focuses more on conceptual understanding rather than memorization skills and ensures that students do not just calculate the final outcome, but also have the chance to understand why this mathematical relationship appears at all.

3. To School administrator: Curriculum planners need to be more proactive in their efforts to adapt the Grade 10 mathematics curriculum framework to the high standards required by the Senior High School STEM strands by placing emphasis on algebra and trigonometry lessons. At present, many of those who go to specialized STEM courses lack enough background because of the inadequate curriculum in Junior High. Consequently, there is a cognitive overload when they have to face advanced concepts like those covered in Pre-calculus or Differential Calculus. To prevent this kind of situation, the Grade 10 curriculum needs to move from covering many topics superficially to mastering advanced algebraic concepts such as factoring higher-order polynomials and simplifying complicated rational equations along with a solid grasp of trigonometric identities and functions. As a result of this, planners can be sure that by the time the students finish junior high, they will have gained sufficient skills to deal with more challenging tasks, which can be considered essential for analyzing higher-order problems in any STEM field.
4. To class adviser: In order to maintain psychological well-being and good mood at the students who study Pre-calculus class, you need to keep a close eye on how they progress in this course. If there are signs that one or more students have been psychologically damaged due to Pre-calculus course and experience negative symptoms like anxiety, introversion or frustration, then it is advisable for you to have a conversation with the Pre-calculus teacher to see what actions can be taken regarding the matter.
5. To Future Researcher: For a more complete analysis of the developmental journey of a learner, future research must go past short-term impacts and focus on long-term effectiveness and sustainability. Studying the development of learners as they progress from their foundation-building module into advanced STEM courses will yield valuable information as to whether early interventions will continue to positively impact their ability to perform calculations and solve problems or if the effects will fade away. In addition, future research must widen its horizons by investigating the role played by

external ecological factors, namely the involvement of parents in homeschooling and the nature of the teacher-student interaction style. Both variables greatly influence the educational atmosphere and will play a pivotal role in determining the efficacy of learning in students. Studying how external factors interact with the internal cognitive loads and affective states (mathematics anxiety, math self-efficacy) will result in a comprehensive portrait of successful learning and help refine effective pedagogical approaches to make sure that the PCEP remains effective among diverse learners.

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