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Predictors in Understanding Polynomials and Functions Among Grade 9 and Grade 10 Students in Daram I District: Basis for Extension Support Program

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Abstract

Aim: This study aimed to assess Grade 9 and Grade 10 students' understanding of polynomials and functions by measuring their proficiency in foundational mathematics and analyzing the relationships among these skills to inform instructional support.
Methodology: A quantitative descriptive-correlational design was utilized, with 200 students selected through stratified random sampling. Data were gathered using a 120-item mathematics proficiency test covering foundational and advanced concepts, and analyzed using descriptive statistics and gamma correlation.
Results: Findings revealed that many students had low proficiency in foundational mathematics, particularly in patterns and algebra (M = 42%, SD = 19) and geometry (M = 38%, SD = 17), while performance in number and number sense was nearly proficient (M = 51%, SD = 18). Proficiency in polynomials and functions was low (M = 35%, SD = 12). Gamma correlation analysis showed that algebra ($\Upsilon = 0.622$, $p = 0.025$) and geometry ($\Upsilon = 0.681$, $p = 0.013$) were significantly associated with success in advanced mathematics, whereas number sense ($\Upsilon = 0.168$, $p = 0.16$) was not.
Conclusions: Weak foundations in algebra and geometry were found to hinder mastery of polynomials and functions. The study recommends strengthening these areas through scaffolded and spiral approaches, problem-based learning, and the integration of digital tools such as GeoGebra and Desmos. Remediation programs and targeted teacher professional development are also advised to enhance instructional effectiveness and students' readiness for advanced mathematics.
Keywords: *Foundational Mathematics, Polynomials and Functions, Algebra, Geometry, Number Sense, Instructional Support*

INTRODUCTION

Mathematics is widely recognized as a cornerstone of education and human development. Beyond its role as a school subject, it equips learners with logical reasoning, problem-solving, and analytical skills that are essential in the workforce and in navigating everyday life. Just as buildings, bridges, and technological innovations rely on precision and structure, students' intellectual growth depends on mastering foundational mathematical concepts that serve as the scaffolding for higher-order thinking and advanced studies (Warren, 2024). Proficiency in mathematics is therefore not only a prerequisite for success in STEM-related fields but also a fundamental skill for lifelong learning and global competitiveness (Sanchez, 2023).

Foundational knowledge is crucial for STEM (Science, Technology, Engineering, and Mathematics) education, as it provides students with the necessary skills and understanding to succeed in complex, rapidly changing fields and the modern workforce. Similarly, enhancing STEM performance is essential for fostering economic competitiveness and technological innovation, preparing the 21st-century workforce, and cultivating a skilled population capable of addressing complex global challenges. Research indicates that the implementation of

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integrated STEM education, rather than separate disciplinary approaches, can lead to improved student outcomes (Roehrig et al., 2021). Students engaged in STEM curricula exhibited superior mathematics scores compared to their counterparts receiving traditional instruction. Thus, when students have a solid foundation in science, technology, engineering, and mathematics, it equips them to succeed in a rapidly changing world driven by technology and innovation (Khan, 2024). This underscores the efficacy of STEM education in improving academic performance across all subjects (Carvajal et al., 2025).

Despite its importance, evidence from local and international assessments reveals persistent challenges in mathematics education. In the Performance Implementation Review (PIR 2024) of Samar Division, results indicate that 20.42% of the students enrolled in Grade 9 and Grade 10 in Daram I District were low proficient in mathematics. These results are evident at Daram National High School, where Grade 9 and Grade 10 students consistently struggle with solving problems in algebra and geometry. Premesti and Retnawati (2019) explained that students' difficulties in learning algebra include understanding problems, interpreting the meaning of variables, and operating on algebraic expressions. Results from the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) show that Filipino learners consistently score below the global average, performing only at the level of average students in neighboring countries such as Malaysia and Thailand, and far behind their peers in Singapore (EDCOM 2, 2024). The World Bank and other education specialists emphasize that these performance gaps are rooted in weak mastery of foundational numeracy, which hinders students' ability to transition successfully to higher-level mathematical concepts. Locally, similar patterns are observed, where many junior high school students remain at a low proficiency level in mathematics, limiting their capacity to cope with the demands of advanced learning (Pangilinan, 2025).

Among the critical areas in mathematics, polynomials and functions are particularly important because they serve as a bridge between arithmetic and advanced algebra. By thoroughly learning the basics, learners not only progress in their studies but also gain the ability to tackle complex challenges with ease. Ultimately, a solid foundation is key to long-term success (Kumon Philippines, 2025). However, research shows that students often struggle with these concepts due to weak foundations in number sense, algebraic manipulation, geometric reasoning, and initial perceptions of mathematics (Waswa & Al-kassab, 2023). Without targeted interventions, such gaps in understanding create cumulative difficulties that persist throughout students' academic journeys and restrict their future opportunities in STEM education and careers (Bontuyan, 2025).

Given these concerns, this study addresses a critical research gap by examining the predictors of student performance in understanding polynomials and functions, with particular focus on their relationship to foundational mathematical skills such as number sense, patterns, algebra, and geometry. While prior studies (e.g., Aunio et al., 2015) have established the importance of early numeracy for long-term achievement, few have explored how specific foundational domains influence mastery of advanced topics at the junior high school level in the Philippine context. By generating empirical evidence on these linkages, this study contributes to the global discourse on mathematics education while offering practical insights for curriculum development, teacher training, and support programs. Ultimately, it provides a basis for designing an extension support program aimed at strengthening students' understanding of polynomials and functions and improving their readiness for advanced mathematics.

Theoretical Framework

The study was anchored in three interrelated learning theories—Constructivist Theory of Learning, Bruner's Spiral Curriculum Theory, and Cognitive Load Theory—which together provide a strong foundation for understanding the relationship between foundational mathematics concepts and advanced mathematical knowledge among junior high school students. These perspectives collectively emphasize the significance of prior knowledge, structured learning progression, and cognitive capacity in shaping students' mastery of mathematics.

Constructivist learning theory suggests that learners actively build their knowledge through experiences and interactions. Learners use their prior knowledge as a foundation and build upon it as they acquire new information. According to this theory, education should focus on problem-solving and critical thinking, encouraging learners to connect new information with prior knowledge (McLeod, 2025). In the context of mathematics, mastering fundamentals is crucial for effective problem-solving. This process starts with basic operations such as addition, subtraction, multiplication, and division (Lakha, 2025). Thus, gaps in foundational learning can hinder the construction of deeper mathematical understanding, making this theory highly relevant to the present study (Amihan et al., 2023).

Jerome Bruner, a well-known psychologist who made significant contributions to the field of education, developed the concept of a spiral curriculum (Borkala, 2022), a type of curriculum that emphasizes revisiting and

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building upon previously taught content cyclically. In mathematics, the spiral approach promotes better student retention, problem-solving skills, a deep understanding of concepts, and flexible thinking by revisiting topics repeatedly, such as foundational mathematics and fundamental operations (Baez et al., 2025). While Bruner's Spiral Curriculum Theory (1960) complements this by stressing the value of revisiting fundamental concepts at increasing levels of complexity, mathematics learning is developmental, and by reintroducing ideas such as patterns, algebra, and geometry at progressively advanced stages, learners can connect earlier knowledge to more complex representations like functions and equations. This cyclical reinforcement not only strengthens retention but also facilitates the transition from foundational to advanced mathematics, aligning directly with the research objectives (Sanchez et al., 2023).

Finally, Cognitive Load Theory (CLT), developed by John Sweller, posits that learning effectiveness is constrained by working memory's limited capacity. This theory revolves around the idea that human cognitive capacity is limited, and this limitation plays a crucial role in how learners absorb and retain new information. Sweller's work has been foundational in shaping the principles of instructional design and e-learning strategies (Sweller, 2023). In mathematics, cognitive load plays a key role in learners' abilities to solve complex problems like polynomials and functions. Many factors affect cognitive load in learning, including instructional strategy, task difficulty, and prior knowledge. In this study, the theory provides a rationale for investigating how foundational proficiency influences students' ability to engage with higher-order mathematical concepts.

The three theories create a coherent framework that justifies the current study, which focuses on predictors of students' proficiency in polynomials and functions. Constructivism explains the necessity of strong prior knowledge, Bruner's theory underscores the structured revisiting of mathematical ideas, and Cognitive Load Theory stresses the importance of managing cognitive demands in learning. Based on the cited theories, the study situates its investigation within established theoretical traditions, ensuring that the findings contribute not only to local instructional practices but also to the broader discourse on effective mathematics education.

Conceptual Framework

The conceptual framework of this study illustrates the relationships between foundational mathematics concepts—such as number and number sense, patterns and algebra, and geometry—and students' advanced mathematical knowledge in polynomials and functions. It provides a systematic understanding of how proficiency in fundamental skills influences the ability of Grade 9 and 10 students to grasp more complex concepts, thereby informing instructional practices and interventions aimed at enhancing mathematical proficiency.

The independent variable consists of foundational mathematics concepts that serve as the building blocks for advanced learning. These include number and number sense (measured through test scores on arithmetic operations and numerical fluency), patterns and algebra (assessed through quizzes on algebraic manipulation and problem-solving), and geometry (evaluated through exercises on spatial reasoning and geometric relationships). Mastery of these areas equips students with essential tools for reasoning, computation, and problem-solving. For instance, strong number sense enables accurate calculations required in algebraic expressions, while solid geometry fundamentals foster spatial awareness necessary for higher-level mathematics.

The dependent variable is students' advanced mathematical knowledge, specifically in polynomials and functions. This is assessed through performance tasks, quizzes, and written tests that are aligned with the learning competencies outlined in the curriculum. Proficiency in these areas reflects not only the successful transfer of foundational skills to more complex contexts but also the development of critical thinking, generalization, and application of mathematics in real-world problem-solving. Students who performed well in polynomials and functions demonstrate both conceptual understanding and procedural fluency, indicating stronger readiness for higher mathematics.

This framework is grounded in the study's theoretical foundations. The Constructivist Theory of Learning explains how students build new knowledge upon prior understanding, highlighting why gaps in number sense or algebraic concepts hinder success in functions. Bruner's Spiral Curriculum Theory justifies the progressive link between foundational and advanced concepts, as ideas are revisited and deepened across levels of complexity. Cognitive Load Theory emphasizes the importance of secure foundational knowledge to prevent learning overload when tackling advanced topics. Together, these theories support the framework's assumption that proficiency in foundational mathematics significantly predicts success in advanced concepts and justify the development of targeted extension support programs (Carvajal et al., 2024).

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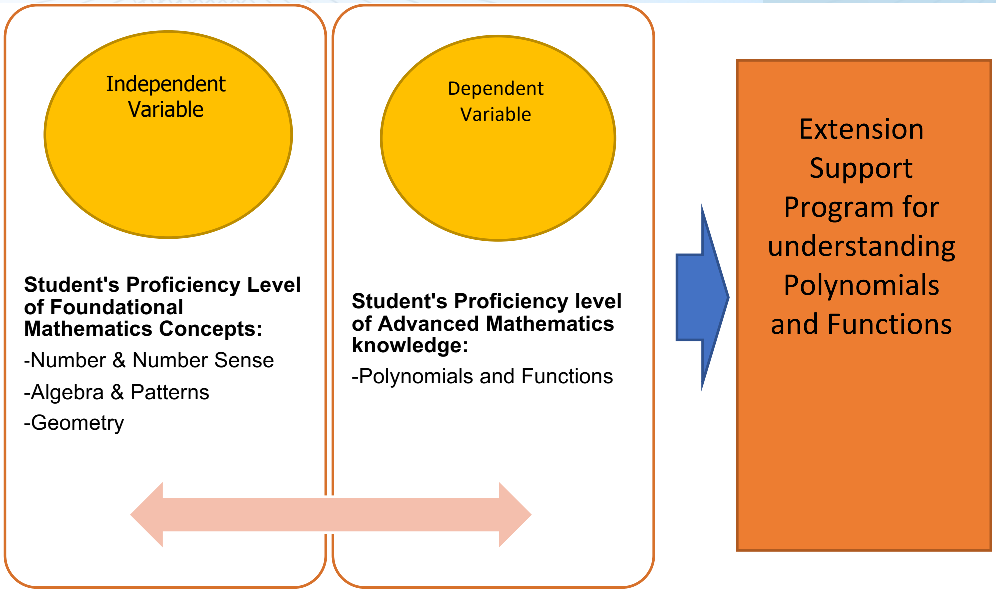

Figure 1. Conceptual Framework of the Study

Statement of the Problem

Students' persistent difficulties in mathematics, particularly in polynomials and functions, hinder their mastery of advanced topics in junior high school. Despite the recognized importance of strong foundations in number sense, algebra, and geometry, many learners continue to perform below proficiency levels, as evidenced by PIR, TIMSS, and PISA results. In Daram I District, Grade 9 and 10 students show low proficiency in foundational mathematics, limiting their readiness for advanced concepts. Addressing these gaps is crucial to improving student outcomes and supporting future STEM readiness. This study sought to determine which foundational skills significantly predict understanding of polynomials and functions, thereby providing a basis for an extension support program.

Research Objectives

General Objective:

- To examine the predictors of Grade 9 and 10 students' understanding of polynomials and functions in Daram I District as basis for an extension support program.

Specific Objectives:

1. To determine the proficiency level of Grade 9 and Grade 10 students in foundational mathematics concepts (number and number sense, patterns and algebra, and geometry) and in advanced concepts (polynomials and functions).
2. To analyze the relationship between students' levels of proficiency in foundational mathematics and their performance in polynomials and functions.
3. To identify which foundational mathematics skills significantly predict students' understanding of polynomials and functions.
4. To design an extension support program for Grade 9 and 10 students in Daram I District based on the study's findings.

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Research Questions

1. What is the level of proficiency of Grade 9 and Grade 10 students in foundational mathematics concepts (number and number sense, patterns and algebra, and geometry) and in advanced concepts (polynomials and functions)?
2. Are the students' levels of proficiency in foundational mathematics significantly related to their performance in polynomials and functions?
3. Which foundational mathematics skills significantly predict students' understanding of polynomials and functions?
4. How can the findings be used to develop an extension support program for Grade 9 and 10 students in Daram I District?

Hypothesis

Based on the objectives of the study, the hypothesis was formulated as follows:

- There is no significant relationship between the student's level of proficiency in foundational mathematics and advanced mathematical concepts. among Grade 9 and 10 students in Daram National High School.

METHODS

Research Design

This study employed a quantitative descriptive-correlational design, which was appropriate for evaluating both the proficiency levels of students in foundational mathematics and their performance in advanced topics, specifically polynomials and functions. The descriptive aspect provided a clear picture of students' competencies, while the correlational aspect examined the strength of relationships between foundational knowledge and advanced mathematical understanding. This design directly supported the study's aim of identifying predictors that can guide the development of an extension support program. Similar approaches have been effectively applied in previous studies that measured relationships between learner competencies and performance outcomes (Amihan & Sanchez, 2023; Pangilinan, 2025).

Population and Sampling

The study population included all Grade 9 and Grade 10 students at Daram I District for the school year 2024–2025. Using stratified random sampling with proportional allocation, 200 students were selected from the total population of 364, with 116 drawn from Grade 9 and 84 from Grade 10. This ensured fair representation of both grade levels while maintaining reliability within a 5% margin of error. Participation was voluntary, requiring parental consent and student assent. Employing systematic sampling and clear ethical safeguards has been recognized as vital in enhancing research credibility and validity (Sanchez, 2025; Salendab & Sanchez, 2023).

Instrument

A structured test questionnaire served as the main research instrument. It was composed of 120 items, with Part I covering foundational mathematics concepts—number and number sense, patterns and algebra, and geometry—and Part II focusing on advanced concepts of polynomials and functions. It underwent pilot testing and was validated by mathematics experts to ensure clarity, reliability, and alignment with learning standards. Cronbach's alpha was utilized to analyze the reliability of the instrument, and no necessary modifications were made. Scores were converted into proficiency levels based on DepEd benchmarks. Establishing content validity and ensuring alignment with learning outcomes are essential practices that strengthen instrument reliability (Carvajal et al., 2025; Abenojar et al., 2025).

Data Collection

Data collection was carried out over three weeks, with the researcher coordinating with school administrators to administer the tests during students' free periods. Standardized instructions were given, and completed questionnaires were anonymized by assigning unique codes to protect respondents' identities. Clear coordination with institutional stakeholders and structured protocols have been emphasized in prior research as important to minimizing bias and maximizing data quality (Muñoz & Sanchez, 2023).

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Treatment of Data

Descriptive statistics such as mean, frequency percentage, and standard deviation were utilized to describe the proficiency level of the learners. To assess the relationship and the predictors between foundational mathematics concepts and advanced topics in polynomials and functions with a large number of tied ranks, gamma correlation was used. The data were systematically presented through tables, charts, and graphs to enhance clarity and emphasize the significance of the findings. Prior studies highlight the importance of using both descriptive and inferential statistics to provide comprehensive and interpretable insights into student learning outcomes (Bontuyan, 2025).

Ethical Considerations

Ethical considerations were strictly observed throughout the study. Informed consent and assent ensured voluntary participation, while confidentiality was maintained by de-identifying responses and reporting only aggregated results. All collected data were securely stored and assigned unique identification codes to ensure that individual responses remained confidential and could not be traced back to the students. Upon completion of the research, data were destroyed in accordance with institutional policies. These measures safeguarded participants' welfare and reinforced the integrity of the research process. Upholding ethical safeguards and transparency in data management has been consistently emphasized as integral to research integrity (Carvajal & Sanchez, 2023).

RESULTS and DISCUSSION

This section provides an overview of the student's level of proficiency in foundational concepts in number and number sense, algebra and pattern, and geometry, and their advanced mathematical concepts, particularly on polynomials and functions, are highlighted.

Level of Proficiency in Foundational Mathematics Concepts

The table below reflects the student's proficiency level in foundational mathematics concepts for understanding polynomials and functions.

Table 1. Students' Level of Proficiency in Number and Number Sense

Proficiency Level		No. of Responses	Percent
90 - 100	Highly Proficient	5	2.5
75 - 89	Proficient	13	6.5
50 - 74	Nearly Proficient	81	40.5
25 - 49	Low Proficient	94	47.0
0 - 24	Not Proficient	7	3.5
Total		200	100.0
Mean		51	-
SD		18	-

Source: Proficiency Level Based on the DepED Order No.21, Series of 2019

The findings show that 87.5% of Grade 9 and 10 students have weak proficiency in Number and Number Sense, with very few reaching Proficient or Highly Proficient levels. This gap suggests that many rely on rote procedures rather than conceptual understanding, which limits their ability to engage with algebra and advanced topics. Possible causes include teacher-centered strategies that emphasize rules over reasoning, curriculum pacing that leaves little room for remediation, and learner factors such as math anxiety. The wide variation in scores indicates significant disparities in classroom learning, which aligns with studies that note these gaps hinder both instruction and student engagement. Literature confirms that number sense is foundational to algebraic reasoning and future STEM readiness. Therefore, these results highlight an urgent need for targeted interventions—such as concept-based instruction, scaffolding, and extension programs—to strengthen numerical fluency and prepare students for polynomials, functions, and beyond.

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Level of Proficiency in Algebra and Pattern Concepts

This section shows the students' level of proficiency in Patterns and Algebra.

Table 2. Students' Level of Proficiency in Algebra and Pattern Concepts

Proficiency Level		No. of Responses	Percent
90 - 100	Highly Proficient	3	1.5
75 - 89	Proficient	17	8.5
50 - 74	Nearly Proficient	45	22.5
25 - 49	Low Proficient	109	54.5
0 - 24	Not Proficient	26	13
Total		200	100
Mean	Low Proficient	42	-
SD		19	-

Source: Proficiency Level Based on the DepED Order No.21, Series of 2019

The data reveal that most students have weak algebra skills, with 54.5% classified as Low Proficient and 22.5% as Nearly Proficient, leaving 77% with insufficient preparation for higher-level mathematics. Only 10% reached Proficient or Highly Proficient levels, while 13% showed severe difficulties. The mean proficiency score of 42 (Low Proficient) and a wide standard deviation of 19 highlight both generally weak foundations and wide performance gaps. Since algebra underpins abstract reasoning and functions, low competency threatens students' progression in more advanced topics.

Furthermore, the results have implications for students' readiness for Polynomials and Functions, which require strong algebraic manipulation skills. Blanton and Kaput (2011) stress that algebra serves as the foundation for understanding functions, and students with weak algebraic skills are likely to encounter difficulties in higher mathematical concepts. This suggests that current proficiency levels indicate a need for targeted interventions, curriculum modifications, and instructional innovations.

Level of Proficiency in Geometry Concepts

This section showcased the level of students' proficiency in Geometry Concepts.

Table 3. Students' Level of Proficiency in Geometry Concepts

Proficiency Level		No. of Responses	Percent
90 - 100	Highly Proficient	1	.5
75 - 89	Proficient	10	5.0
50 - 74	Nearly Proficient	32	16.0
25 - 49	Low Proficient	123	61.5
0 - 24	Not Proficient	34	17.0
Total		200	100.0
Mean	Low Proficient	38	-
SD		17	-

Source: Proficiency Level Based on the DepED Order No.21, Series of 2019

The data show that most students have weak geometric skills, with 61.5% rated Low Proficient and 17% Not Proficient, meaning 78.5% struggle with Geometry—an essential foundation for higher mathematics. Only 5.5%

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reached Proficient or Highly Proficient levels. The mean score of 38 (Low Proficient) and a standard deviation of 17 highlight generally poor performance with some variability. Since geometry underpins spatial reasoning, transformations, and function analysis, these gaps may hinder success in algebra, polynomials, and calculus. Researchers emphasize that difficulties often stem from weak transitions between visual, analytic, and algebraic representations. Exhibiting negative attitudes toward learning geometry is identified as the factor leading to difficulty in learning geometry (Butterworth, 2005; Gogo et al., 2021).

The results imply that weak geometric foundations may limit students' readiness for advanced mathematics courses, consequently affecting their academic trajectory in STEM-related disciplines. Low proficiency in geometry also suggests broader challenges in critical thinking, problem-solving, and spatial reasoning—skills that are not only vital in mathematics but also in fields such as engineering, architecture, and the sciences..

Level of Proficiency in Advanced Mathematical Concepts

This section shows the level of students' proficiency in Advanced Mathematical Concepts

Table 4. Students' Level of Proficiency in Advanced Mathematical Concepts

Proficiency Level		No. of Responses	Percent
75 - 89	Proficient	2	1.0
50 - 74	Nearly Proficient	16	8.0
25 - 49	Low Proficient	136	68.0
0 - 24	Not Proficient	46	23.0
Total		200	100.0
Mean	Low Proficient	35	-
SD		12	-

Source: Proficiency Level Based on the DepED Order No.21, Series of 2019

The results indicate that students demonstrate very weak proficiency in advanced mathematical skills related to polynomials and functions. A large majority (68% Low Proficient and 23% Not Proficient) show insufficient competency, meaning 91% of students struggle with these critical concepts, while only 9% reached Nearly Proficient or higher. The mean score of 35, with a relatively small standard deviation of 12, highlights consistently low performance across the group. Since proficiency in polynomials and functions is vital for mathematical fluency and progression in STEM fields, these findings point to serious learning gaps. Research suggests that such weaknesses stem from underdeveloped algebraic manipulation, poor pattern recognition, and difficulty connecting abstract concepts to real-world applications.

The findings are critical for both instruction and curriculum development. Students' inability to master polynomials and functions limits their readiness for advanced courses in calculus, statistics, and higher-level STEM subjects, potentially narrowing their career pathways in science, technology, and engineering fields. Beyond academics, weak skills in functional reasoning may hinder problem-solving and logical thinking in everyday contexts. Kaput (2008) and Blanton et al. (2011) emphasize the importance of concept-based learning, problem-solving strategies, and technology-enhanced instruction to improve students' understanding of functions and polynomials. The use of graphing software, interactive algebraic tools, and real-world problem-solving activities can help students develop a deeper and more intuitive grasp of polynomial behavior and functional relationships.The findings are critical for both instruction and curriculum development. Students' inability to master polynomials and functions limits their readiness for advanced courses in calculus, statistics, and higher-level STEM subjects, potentially narrowing their career pathways in science, technology, and engineering fields. Beyond academics, weak skills in functional reasoning may hinder problem-solving and logical thinking in everyday contexts. Kaput (2008) and Blanton et al. (2011) emphasize the importance of concept-based learning, problem-solving strategies, and technology-enhanced instruction to improve students' understanding of functions and polynomials. The use of graphing software, interactive algebraic tools, and real-world problem-solving activities can help students develop a deeper and more intuitive grasp of polynomial behavior and functional relationships.

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Relationship Between Students' Level of Proficiency in Foundational Mathematics and Advanced Mathematical Concepts

This final section shows the relationship between students' level of proficiency in foundational mathematics and their level of advanced mathematical concepts.

Table 5. Relationship Between Students' Level of Proficiency in Foundational Mathematics and Advanced Mathematical Concepts

Foundational Math	*ϒ-value*	p-value	Evaluation
Number Sense	-.016	0.168	Not Significant
Algebra and Pattern	.622	0.025	Significant
Geometry	.681	0.013	Significant

Significant at 0.05 significance level

The results show that while number sense does not significantly predict success in advanced topics like polynomials and functions (ϒ = –0.016, p = 0.168), both algebra and patterns (ϒ = 0.622, p = 0.025) and geometry (ϒ = 0.681, p = 0.013) have significant positive relationships. This underlines that strong algebraic and geometric foundations are essential for mastering higher-level mathematics, whereas number sense primarily supports early arithmetic rather than abstract algebraic reasoning.

The findings indicate the need to embed algebraic thinking throughout earlier grade levels, rather than treating algebra as a single isolated subject. Kaput, Carraher, and Blanton (2017) emphasize that introducing algebraic reasoning in the early grades and reinforcing it across the curriculum fosters deeper symbolic reasoning and problem-solving skills. Second, the strong relationship between geometry and advanced mathematics underscores the importance of spatial reasoning and visualization in instruction. Thus, it is also important to consider the level of geometric thinking students achieve. Geometric thinking skills can help students develop critical thinking skills (Hassan et al. 2020), while more recent work by Desai, Hart, and Sherard (2021) shows that digital tools such as GeoGebra enhance students' ability to make connections between algebraic and geometric representations.
Additionally, Duval (2006) stresses that one major challenge students face in mathematics is the difficulty of coordinating different semiotic representations—visual, analytic, and algebraic—which are crucial for mastering polynomials and functions.

Conclusions

The study concludes that Grade 9 and Grade 10 students demonstrate low proficiency in foundational mathematics—particularly in algebra and geometry—which significantly affects their ability to master polynomials and functions. Number sense does not predict success in advanced topics, while competence in algebra and geometry showed strong positive relationships with achievement in higher-level mathematics.

The implementation of the extension support program (MATH+) was a direct response to the decline in students' performance on advanced subjects related to polynomials and functions. This extension support initiative will pinpoint schools in Samar Division with underperforming students across three cognitive areas and advanced subjects in polynomials and functions. The extension support program will emphasize teachers' pedagogical methods and practices, thus enhancing and improving teachers' skills.

Recommendations

It is recommended that schools prioritize strengthening algebra and geometry through scaffolded instruction, spiral progression of concepts, and problem-based learning activities. Teachers should integrate digital tools such as GeoGebra and Desmos to enhance visualization and conceptual understanding. Regular remediation sessions should also be conducted for struggling students, while professional development programs should equip teachers with innovative strategies for teaching algebraic and geometric concepts effectively.

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THE PROPOSED EXTENSION PROGRAM

This part presents the proposed extension program as a mechanism for intervention. These include the proposed program title, the implementing institution, the program beneficiaries, the program component, the budgetary proposal, and the overall mechanism procedures of the proposed extension program.

Program Title: MATH+ (Mastery, Application, Technology, and Holistic Learning for Mathematical Excellence)
Implementing Institution: Samar State University – Master of Arts in Teaching Major in Mathematics Program

Program Beneficiaries

• Primary Beneficiaries: Grade 9 and Grade 10 students from partner secondary schools in Samar with low proficiency in foundational mathematics.

• Secondary Beneficiaries: Mathematics teachers and pre-service mathematics educators who will serve as facilitators, mentors, and researchers.

Rationale

Mathematics proficiency is crucial for students' success in higher education and future careers, yet research findings indicate that many Grade 9 and Grade 10 students in Samar struggle with foundational mathematics concepts such as Number and Number Sense, Algebra, and Geometry, which are essential for mastering Polynomials and Functions. Moreover, the study revealed that students with strong foundational skills in algebra and geometry are more likely to excel in advanced mathematical topics like polynomials and functions. However, many students struggle with these areas due to gaps in their early mathematics education.

As a community extension initiative of the Master of Arts in Teaching Major in Mathematics program at Samar State University, the MATH+ Program aims to bridge learning gaps by providing targeted interventions, hands-on learning experiences, and technology-enhanced instruction to improve students' algebraic and geometric reasoning.

Objectives

1. To enhance students' algebraic problem-solving skills through structured tutorials and activities.
2. To improve students' geometric visualization and spatial reasoning using hands-on learning and digital tools.
3. To integrate interactive learning strategies, such as gamification, real-life applications, and project-based learning, to make math more engaging and accessible.
4. To provide teacher training and resources to improve instructional approaches in algebra and geometry.

Program Components

A. Algebra Strengthening Workshops

• Conceptual Approach to Algebra: Sessions on equation solving, pattern recognition, and algebraic manipulation.

• Polynomial Mastery Classes: Activities focused on factoring, simplifying, and solving polynomials through real-life applications.

• Interactive Algebra Games and Simulations: Use of technology (GeoGebra, Desmos) for dynamic algebra learning.

B. Geometry Enrichment Sessions

•Visualization and Spatial Reasoning Training: Hands-on workshops using models, interactive geometry software, and graphing tools.

• Linking Geometry to Functions: Activities demonstrating how transformations in geometry relate to polynomial functions.

• Project-Based Learning: Real-world applications, such as designing structures using geometric principles.

C. Teacher Training and Capacity Building

- Professional development workshops on effective algebra and geometry teaching strategies.
- Integration of technology and multimedia resources in teaching.
- Sharing of best practices through learning communities and collaboration.

D. Student Support and Mentoring

- Peer tutoring and mentoring programs to provide continuous academic support.
- Math Clinics and Help Desks to assist students struggling with algebra and geometry concepts.
- Online Learning Modules and Self-Paced Tutorials to allow flexible learning opportunities.

Implementation Strategy

The MATH+ Program will be implemented in collaboration with partner secondary schools in Samar. The faculty and graduate students of the MAT Mathematics program will serve as facilitators, trainers, and researchers.

Phase	Activity	Timeline	Implementing Body
Phase 1	Partnership with schools and universities to implement the program in underperforming communities.	First Quarter	SSU MAT Mathematics
Phase 2	Regular assessment and progress tracking to measure student improvements	Second -Fourth Quarter	SSU, Partner Schools
Phase 3	Community involvement by including parents and stakeholders in supporting students' math learning.	Second – Fourth Quarter	SSU, Partner Schools
Phase 4	Evaluation, research dissemination, and expansion	Fourth Quarter	SSU MAT Mathematics

Expected Outcomes

1. Improved algebraic and geometric proficiency, leading to better performance in advanced math.
2. Increased student engagement and confidence in learning mathematics.
3. Enhanced teacher competencies in delivering effective math instruction.
4. Greater success rates in higher-level mathematics, reducing math anxiety and dropout rates.
5. Research-based insights to improve mathematics instruction and curriculum development.

Sustainability Plan

To ensure the long-term impact and sustainability of the MATH+ Program, the following strategies will be employed:

1. Institutionalization within the SSU MAT Mathematics program – Integrate MATH+ as a regular extension program for graduate students to apply research-based teaching methodologies.
2. Partnership development – Establish long-term collaborations with DepEd, local government units, and private sector organizations for continued support and funding.
3. Training of trainers (ToT) model – Train teachers and graduate students to replicate the program in other schools.

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4. Integration of findings into teacher education – Use program research to inform and improve mathematics education policies and curricula.

Estimated Expenses for the MATH+ Extension Program

1. Program Implementation Expenses

Item	Quantity/Unit	Estimated Cost (PHP)
Printing of instructional materials (modules, worksheets)	500 copies	15,000
Office supplies (folders, pens, markers, bond paper)	Bulk purchase	5,000
Learning kits for students (notebooks, calculators, rulers, etc.)	200 sets	30,000
Math manipulatives (flashcards, number tiles, algebra tiles)	Bulk purchase	10,000
Transportation expenses for facilitators	Per semester	15,000
Meals and snacks for workshops and training	5 sessions	25,000
Venue rental (if not available in partner schools)	5 sessions	10,000
Subtotal:		PHP 110,000

2. Teacher Training & Development Expenses

Item	Quantity/Unit	Estimated Cost (PHP)
Training materials (handouts, manuals, teaching guides)	100 copies	10,000
Projector rental or purchase	1 unit	20,000
Training certificates and kits	100 sets	10,000
Speaker/facilitator honoraria	3 sessions	15,000
Meals and snacks for participants	3 sessions	15,000
Subtotal:		PHP 70,000

3**. Research & Evaluation Expenses**

Item	Quantity/Unit	Estimated Cost (PHP)
Pre- and post-test materials (printing & distribution)	200 copies	5,000
Data collection tools (survey forms, assessment booklets)	Bulk purchase	7,000
Research presentation and publication	2 conferences	30,000
Subtotal:		PHP 57,000

4. Miscellaneous & Contingency Expenses

Item	Estimated Cost (PHP)
Emergency fund (for unexpected expenses)	20,000
Communication and coordination expenses	10,000
Subtotal:	PHP 30,000
Total Estimated Budget:	PHP 307,000

This budget covers a one-year implementation of the MATH+ Extension Program. Funding may be sourced from university support or partnerships with DepEd and local government units to ensure sustainability.

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