

Original Article

Mathematics Readiness of Grade 10 Students: Evidence from Least-Learned Prerequisite Competencies

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Abstract

This study assessed the mathematics readiness of Grade 10 students at Manuel V. Gallego Foundation Colleges by identifying their least-learned mathematics competencies and prerequisite competencies for Senior High School (SHS). Employing a descriptive-correlational research design, the study utilized total enumeration sampling to include all Grade 10 students enrolled during the 2022–2023 school year. Data were gathered through a researcher-developed mathematics achievement test aligned with the Department of Education's Mathematics Curriculum. Competencies were categorized according to the percentage of correct responses as Most-Learned (75%–100%), Average (50%–74%), and Least-Learned (below 50%). The relationship between students' academic performance and achievement test scores was also examined. The findings revealed a mean academic performance of 81.79 (SD = 4.82) and a mean achievement test score of 21 out of 48 (SD = 6.00). A total of 25 competencies were identified as least-learned, seven of which were determined to be essential prerequisites for SHS mathematics core subjects. A significant positive correlation was found between academic performance and achievement test scores, indicating that higher achievement test performance was associated with better overall academic outcomes. These findings provide evidence of gaps in foundational mathematical competencies among Grade 10 students, particularly in prerequisite skills needed for SHS mathematics. The

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identified least-learned and prerequisite competencies highlight areas that require focused instructional attention to strengthen students' mathematical foundations and improve their readiness for the demands of SHS mathematics.

Keywords: academic performance, achievement test, least-learned competencies, pre-requisite least-learned learning competencies

1. Introduction

The Philippine educational system has undergone substantial curricular transformation over the past decade, most notably through the implementation of the K–12 Basic Education Program under Republic Act No. 10533, or the Enhanced Basic Education Act of 2013. The reform extended basic education by adding two years of Senior High School (SHS) to strengthen learners' preparation for higher education, employment, entrepreneurship, and technical skills development (Republic Act No. 10533, 2013). The introduction of SHS represented a significant structural change from the former Basic Education Curriculum (BEC), requiring learners to acquire competencies that are increasingly specialized, conceptually demanding, and aligned with their intended academic and career pathways. The reform therefore placed new demands not only on schools and teachers but also on learners who must transition from the foundational competencies developed in Junior High School (JHS) to the more complex expectations of SHS.

The transition from JHS to SHS is particularly important in mathematics because learning in the discipline is cumulative and hierarchical. The K–12 Mathematics Curriculum for Grades 1–10 develops competencies across number and number sense, measurement, geometry, patterns and algebra, and statistics and probability, providing the conceptual and procedural foundation for subsequent mathematics learning (Department of Education, 2013). At the SHS level, mathematics subjects require learners to use and extend these prerequisite competencies in more complex contexts. The General Mathematics curriculum, for example, requires learners to work with functions, business mathematics, logic, and mathematical applications, while other SHS mathematics subjects build on algebraic, functional, statistical, and analytical concepts developed during earlier grades (DepEd, 2016). Thus, successful participation in SHS mathematics is not solely a matter of learning new content; it also depends on whether learners enter SHS with sufficient mastery of prerequisite knowledge and skills.

This issue is especially significant in the Philippine context, where evidence continues to point to substantial weaknesses in foundational mathematics. Using nationally representative data from 2003, 2013, and 2019, Albert et al. (2023) found a continuing decline in foundational mathematics skills among Filipino learners and

reported that not all students in higher grades had mastered skills expected to have been acquired as early as Grade 3. The findings are particularly important for the present study because they suggest that progression through the basic education system does not necessarily guarantee mastery of prerequisite mathematical competencies. In other words, students may advance to higher grade levels while carrying unresolved learning gaps that can subsequently affect their ability to engage successfully with more advanced mathematics.

More recent international evidence reinforces this concern. Results from the Programme for International Student Assessment (PISA) 2022 showed that Filipino 15-year-old students obtained an average mathematics score of 344, substantially below the OECD average. Moreover, 84% of Filipino students performed below Level 2 in mathematics, indicating that a large proportion had difficulty demonstrating even basic mathematical competencies in unfamiliar or moderately demanding contexts (OECD, 2023). A related analysis by the Philippine Institute for Development Studies likewise reported that Filipino students' mathematics performance remained considerably below international benchmarks, with the majority of students classified at the lowest proficiency level (Albert et al., 2024). Although PISA results should not be interpreted as a direct measure of SHS readiness, they provide important national evidence of persistent weaknesses in mathematical knowledge and problem-solving that may carry implications for students' transition to more demanding levels of education.

The problem is also evident in studies focusing specifically on mathematics learning within the Philippine secondary education system. A study of Grade 12 students by Paet (2024) found that many students demonstrated a "Beginning" level of proficiency and were not adequately prepared for college-level mathematics. Similarly, research on the implementation of the SHS Mathematics curriculum in Calbayog City by Ignacio and Bajet (2025) reported that teachers and students experienced difficulties related to foundational knowledge, learner preparedness, and the increased academic demands of SHS mathematics. These findings suggest that the issue is not simply the difficulty of individual SHS mathematics subjects but also the extent to which learners possess the prerequisite competencies necessary to meet those demands.

An important distinction in this context is the difference between academic performance and mathematics readiness. Academic performance generally reflects students' demonstrated achievement within a particular course or grading period. In contrast, readiness refers to the extent to which learners possess the knowledge, skills, and competencies required to engage successfully in subsequent learning. A student may obtain a satisfactory grade in Grade 10 Mathematics while still having weaknesses in specific prerequisite skills that become essential in SHS. Consequently, grades alone may not provide sufficiently detailed information about which mathematical competencies have been mastered and which require remediation. This distinction is supported by Morata (2024), who examined the readiness of Grade 10 students in prerequisite skills for STEM mathematics. Although many students

demonstrated satisfactory overall performance, the study identified specific weaknesses in areas such as the laws of exponents and logarithmic and exponential functions. The findings further indicated that readiness was associated with performance on some competencies but could not be inferred solely from general academic performance.

The identification of specific prerequisite competencies is therefore critical in determining students' readiness for SHS mathematics. Readiness assessment and competency-based assessment can provide more specific information than conventional achievement measures because they reveal the particular knowledge and skills that learners have or have not mastered before encountering more advanced content. Such assessment information can help teachers determine which competencies require review, remediation, enrichment, or differentiated instruction before or during subsequent mathematics instruction. In this sense, examining students' performance at the competency level provides a more detailed basis for understanding mathematics readiness than relying solely on overall grades or aggregate achievement scores.

Recent Philippine research demonstrates the value of prerequisite-based assessment. In developing a readiness test for Statistics and Probability, researchers first mapped the prerequisite concepts and skills in the JHS Mathematics curriculum necessary for understanding SHS Statistics and Probability. The resulting assessment underwent validation and item analysis to determine students' proficiency in prerequisite competencies, with the results intended to inform remediation and the development of learning materials. Such work illustrates the potential of curriculum-aligned readiness assessments to facilitate the transition from JHS to SHS mathematics. It also demonstrates that readiness is best examined through the specific competencies required for subsequent learning rather than through broad measures of mathematics achievement alone.

Likewise, research on learning gaps among Filipino secondary learners continues to emphasize the importance of identifying specific competencies rather than treating mathematics difficulty as a generalized problem. Gonzalvo and Palomares (2025), for example, reported persistent deficiencies among Grade 7 learners in several mathematics competencies, particularly in basic operations and problem-solving. Canillo et al. (2024) also found substantial knowledge and skills gaps among academic-track SHS learners and emphasized the need for targeted interventions. These studies collectively indicate that mathematical difficulties may persist across grade levels and that interventions are more likely to be meaningful when informed by evidence of the specific competencies learners have yet to master.

The need for such evidence is particularly timely given the continuing evolution of the Philippine SHS curriculum. The Department of Education has begun implementing the Strengthened Senior High School Curriculum, which seeks to make SHS education more focused, relevant, flexible, and responsive to learners' educational and career aspirations. The pilot implementation for Grade 11 began in School Year 2025–2026, with the reform emphasizing the identification of

implementation challenges, support mechanisms, and learner needs that can inform subsequent policy refinement (DepEd, 2025a). The revised structure also emphasizes alignment between learners' competencies and the demands of higher education, employment, middle-skills development, and entrepreneurship (DepEd, 2025b). In this evolving educational context, accurately determining students' mathematical preparedness remains important because curriculum reform cannot achieve its intended outcomes if learners enter more advanced courses without adequate prerequisite competencies.

Despite the numerous literature and studies on mathematics achievement, learning gaps, and readiness, an important research gap remains. Existing Philippine studies have examined mathematics performance at different grade levels, identified learning gaps, investigated students' readiness for particular mathematics subjects, and developed assessment instruments for specific content areas. However, there remains a need for localized, curriculum-aligned evidence that systematically identifies which Grade 10 Mathematics competencies are least learned and which serve as prerequisites for subsequent SHS mathematics learning. In particular, evidence is needed to determine which competencies should be prioritized when students transition from JHS to SHS and to clarify the extent to which students' general academic performance corresponds to their demonstrated mastery of these competencies. This gap is consequential because generalized achievement scores may conceal specific weaknesses that can interfere with students' subsequent learning.

Addressing this gap has both theoretical and practical significance. From a research perspective, the study contributes to the growing literature on mathematics readiness by examining the relationship between prior mathematics achievement, demonstrated competency, and the prerequisite skills required for SHS mathematics. It also provides evidence of the transition between educational levels, a period during which unresolved learning gaps may become more pronounced as mathematical concepts become more abstract and complex. From an instructional perspective, identifying least-learned prerequisite competencies can help teachers design targeted remediation, bridging activities, and transition support rather than relying solely on broad review lessons. The identification of specific competency gaps may also help schools prioritize foundational skills that require reinforcement before students engage with more advanced SHS mathematics content.

Based on the foregoing, this study focused on the mathematics readiness of Grade 10 students by examining their academic performance and mathematics achievement, identifying their least-learned mathematics competencies, determining which of these competencies serve as prerequisites for selected SHS mathematics subjects, and examining the relationship between academic performance and achievement-test performance. In doing so, the study moves beyond determining whether students are generally "ready" or "not ready" and instead seeks to answer the more instructionally useful question of which specific mathematical competencies students have not yet adequately mastered and which of these competencies are important for their transition to SHS mathematics.

2. Methodology

This study employed a quantitative, descriptive-correlational research design to describe the mathematics readiness of incoming Grade 11 students and examine the relationship between their prior academic performance and mathematics achievement. A descriptive-correlational design is appropriate for studies that describe naturally occurring variables and determine the degree and direction of relationships among them without manipulating the variables or claiming a cause-and-effect relationship (Creswell & Creswell, 2018).

The descriptive component of the study focused on determining students' current level of mathematics achievement and identifying areas of strength and learning gaps in their performance. These findings provided a baseline description of the participants' mathematics readiness as they transitioned to Senior High School. The correlational component, on the other hand, examined whether a statistically significant relationship existed between the students' prior academic performance and their mathematics achievement. Since the variables were observed as they naturally occurred and were not manipulated by the researcher, the results were interpreted in terms of association rather than causation.

The identification and classification of prerequisite least-learned competencies followed a two-stage curriculum-based procedure. The first stage involved determining which Grade 10 Mathematics learning competencies were least learned by the participants based on their performance in the researcher-developed mathematics achievement test. The second stage involved establishing whether the identified least-learned competencies were prerequisites for specific learning competencies in the Senior High School core subjects of General Mathematics and Statistics and Probability.

The curriculum basis for the Grade 10 competencies was the Department of Education's K to 12 Mathematics Curriculum Guide for Grades 1–10. The Grade 10 Mathematics curriculum includes learning competencies under Patterns and Algebra and Statistics and Probability that are foundational to subsequent mathematical learning. Among these are performing division of polynomials using long division and synthetic division, proving the Remainder and Factor Theorems and the Rational Root Theorem, factoring polynomials, illustrating and solving polynomial functions, and solving problems involving probability and the probability of the union of two events.

The corresponding Senior High School curriculum competencies were obtained from the Department of Education's curriculum guides for General Mathematics and Statistics and Probability. The General Mathematics curriculum includes competencies in rational, inverse, exponential, and logarithmic functions, their representations, and determining domain and range. The Statistics and Probability curriculum includes competencies in random variables, their possible values, probability distributions, and the computation of probabilities, means, and variances.

The first stage of classification was performance-based. Each item in the 48-item achievement test was matched to its corresponding Grade 10 Mathematics learning

competency through the Table of Specifications (TOS). For each competency, the proportion of students who answered the corresponding item or items correctly was determined. A competency was classified as least-learned when fewer than 50% of participating students answered the item (s) representing that competency correctly. Thus, the classification was based on demonstrated mastery rather than on students' classroom grades alone. This procedure identified 41 test questions representing 25 distinct Grade 10 Mathematics learning competencies that met the criterion for least-learned competencies.

The second stage of classification involved curriculum mapping. The 25 least-learned Grade 10 competencies were systematically compared with the learning competencies of SHS General Mathematics and Statistics and Probability. A least-learned Grade 10 competency was classified as a prerequisite learning competency when its knowledge or skill was required to understand, perform, represent, or solve a corresponding SHS competency identified in the curriculum guides. The determination was therefore based on the logical and curricular dependency between the earlier Grade 10 competency and the subsequent SHS competency, rather than solely on similarity of terminology.

To establish this relationship, the researcher conducted a vertical curriculum alignment analysis. First, the Grade 10 least-learned competency was identified from the achievement test results. Second, the corresponding Grade 10 curriculum competency was verified against the DepEd Mathematics Curriculum Guide. Third, the researcher examined the SHS General Mathematics and Statistics and Probability curriculum guides to identify competencies requiring the knowledge or skills represented by the Grade 10 competency. Finally, the identified relationships were organized into a curriculum-mapping matrix showing the Grade 10 prerequisite least-learned competency alongside the corresponding SHS learning competencies.

The curriculum mapping showed that these competencies have direct or foundational connections with subsequent SHS competencies. For example, polynomial division, factoring, polynomial functions, and related algebraic reasoning provide foundational knowledge for General Mathematics competencies involving rational functions, equations and inequalities, and functions. Similarly, the ability to interpret functions and their graphs supports SHS competencies in rational, inverse, exponential, and logarithmic functions, as well as the representation of functions through tables and graphs. In Statistics and Probability, Grade 10 competencies involving the probability of the union of events and solving probability problems provide foundational knowledge for SHS competencies in random variables, their possible values, probability distributions, and corresponding probability computations.

Accordingly, the term "prerequisite least-learned competency" in this study refers specifically to a Grade 10 Mathematics learning competency that satisfied both criteria: (a) fewer than 50% of the participants demonstrated correct performance on the corresponding achievement-test item or items, and (b) the competency was determined through curriculum alignment to provide foundational knowledge or skills

for one or more identified SHS General Mathematics or Statistics and Probability competencies. This operational definition ensured that the selection of prerequisite competencies was based on both empirical evidence of insufficient mastery and curricular evidence of subsequent learning dependency.

To establish the methodological soundness of the teacher-made achievement test, a development and validation process was undertaken. First, a Table of Specifications (TOS) was constructed prior to test item generation, comprising 48 items, with each target competency represented by at least one question. The TOS ensured that the test items were systematically distributed across the cognitive domains of Bloom's Taxonomy; remembering, understanding, applying, analyzing, evaluating, and creating, and proportionally represented the target learning competencies of the DepEd Grade 10 Mathematics curriculum.

The test items were developed based on the identified Grade 10 Mathematics learning competencies and their corresponding content and cognitive requirements. Particular attention was given to competencies that could serve as prerequisites for subsequent SHS mathematics learning. This ensured that the assessment was curriculum-based and that students' performance could subsequently be interpreted in relation to specific learning competencies rather than merely as an overall mathematics score.

Following the drafting of the test items, the instrument underwent expert content validation. Six (6) subject matter experts, comprising mathematics teachers, master teachers, and subject coordinators, evaluated the instrument for content relevance, clarity, and structural alignment. The experts used a validation checklist to determine whether the items were appropriately aligned with the Table of Specifications (TOS) and the intended learning competencies. Based on their comments and recommendations, the necessary revisions were made to improve the clarity, relevance, and alignment of the items, thereby establishing the instrument's content validity prior to its administration. However, item analysis procedures, particularly the determination of the difficulty index and discrimination index, were not conducted. This limitation is acknowledged, as these indices could have provided additional empirical evidence regarding the quality and effectiveness of individual test items.

The participants included the entire Grade 10 population of Manuel V. Gallego Foundation Colleges, Inc., for the 2022–2023 school year. The study used total enumeration sampling, a quantitative technique in which the entire population is included to ensure complete representation of the defined local population and to eliminate sampling error arising from selecting only a portion of the population.

However, it is important to note that the total number of respondents was limited to 38 students because the institution had only one Grade 10 section enrolled during the said school year. While total enumeration successfully captured the entire local population, the small sample size ($n = 38$) is a major limitation of the study. Consequently, the findings, achievement-test results, and identified competency gaps are specific to the participating cohort and institution, and caution is warranted when generalizing the findings to a broader population.

To process the collected data, several quantitative statistical tools were employed. For the first three research problems, descriptive statistics were used, including frequency counts to categorize students by academic performance and test scores, and percentages to determine the proportion of students reaching specific proficiency levels and to identify the least- and most-learned competencies. The percentage of correct responses for each competency served as the primary empirical basis for determining whether it met the operational criterion of being a least-learned competency.

Ranking was also used to prioritize competencies according to students' performance, thereby highlighting areas requiring immediate instructional attention. The ranking results were subsequently considered alongside the curriculum-mapping procedure to determine which of the least-learned competencies should be classified as prerequisites for SHS Mathematics. Thus, the identification of a prerequisite least-learned competency was not based on ranking alone; it required the competency to satisfy both the empirical performance criterion and the curriculum-alignment criterion described above.

Finally, to address the fourth research problem regarding the relationship between academic performance and achievement-test results, the Pearson Product-Moment Correlation Coefficient (Pearson r) was employed. This inferential statistic determined the strength and direction of the relationship between students' prior academic performance and their mathematics achievement-test scores, providing an empirical basis for examining whether classroom academic performance was associated with demonstrated mathematics achievement.

3. Results

Table 1 shows the academic performance of grade 10 students in the 2022 – 2023 school year. It revealed that the grade 10 students have a mean grade of 81.79, with a standard deviation of 4.82. Based on the Department of Education (DepEd) descriptors, grading scale, and remarks, a grade of 80–84 is considered passed and satisfactory; thus, the performance of the grade 10 students is satisfactory. Moreover, there were five (5) students, or 13.16% who have an average of 80; four (4) students, or 10.53% who have 79, 81, 82, and 84; three (3), or 7.89% with an average of 77; two (2) students or 5.26% with an average of 75, 76, 78, and 89; and lastly, one (1) student or 2.63% with an average of 85, 86, 90, 91, 93, and 94.

Table 2 shows the scores of Grade 10 students in the administered achievement test in mathematics. It revealed that fourteen (14) or 36.84% of the students scored ranging from 18 – 22; twelve (12) or 31.59% scored ranging from 13 – 17; eight (8) or 21.05% scored 23 – 27; two (2) or 5.26% scored 33 – 37; and there were one (1) each or 2.63% scored 28 – 32 and 38 – 42, respectively. Moreover, the overall mean

score on the grade 10 achievement test in mathematics is 21, which is below average, with a standard deviation of 6.0045.

Table 1. Academic performance of Grade 10 students.

Grade	Frequency (n)	Percentage (%)	Rank
75	2	5.26	8.5
76	2	5.26	8.5
77	3	7.89	6
78	2	5.26	8.5
79	4	10.53	3.5
80	5	13.16	1
81	4	10.53	3.5
82	4	10.53	3.5
84	4	10.53	3.5
85	1	2.63%	13.5
86	1	2.6	13.5
88	2	5.26	8.5
90	1	2.63	13.5
91	1	2.63	13.5
93	1	2.63	13.5
94	1	2.63	13.5
TOTAL	38	100%	
Mean			81.79
Standard Deviation			4.82

Table 2. Scores of the Grade 10 students in the achievement test in Mathematics.

Scores	Frequency (n)	Percentage (%)	Rank
13 – 17	12	31.59	2
18 – 22	14	36.84	1
23 – 27	8	21.05	3
28 – 32	1	2.63	5.5
33 – 37	2	5.26	4
38 – 42	1	2.63	5.5
Total	38	100%	
Mean Score			21
Standard Deviation			6.0045

Table 3 presents the results of the mathematics achievement test for grade 10 students in terms of the least-learned competencies as indicated in the mathematics curriculum guide. Based on the results, there were twenty-five (25) learning competencies in grade 10 mathematics where less than 50% of the students who took the said test got them correctly. The basis of determining the least-learned learning competencies was from the Department of Education guidelines on “Item Analysis with Most Learned and Least Learned”, where 75% - 100% is interpreted as “Most Learned”, 50% - 74% is “Average”, and 50% below is “Least Learned”.

Table 3. Least-learned learning competencies in Mathematics.

Learning Competencies	Question in Mathematics Achievement Test	Percent Correct	Rank
1. Illustrate an arithmetic sequence. 2. Determine arithmetic means, nth term of an arithmetic sequence, and sum of the terms of a given arithmetic sequence.	The next three terms in the arithmetic sequence $-2/3, -1/3, 0, 1/3, \dots$ are	42.11%	36
	What is the 15 th term in the sequence $-8, -1, 6, 13, \dots$?	28.95%	19.5
	What is the tenth term in the arithmetic progression $2/3, 7/6, 5/3, \dots$?	26.32%	14.5
3. Illustrate a geometric sequence.	Which of the following forms a geometric sequence?	18.42%	3
	Among the geometric sequences shown below, which is considered infinite geometric sequence?	39.47%	32.5
4. Differentiate a geometric sequence from an arithmetic sequence.	Which of the following is true about the first and the second sequences shown above?	31.58%	23.5
5. Determine the geometric means, nth term of a geometric sequence and sum of the terms of a given finite or infinite geometric sequence.	In a geometric sequence, the second term is $15/2$ and the fifth term is $15/16$, what is tenth term?	36.84%	30
	What is the sum of the infinite geometric sequence shown above?	18.42%	3
6. Perform division of polynomials using long division and synthetic division.	In the polynomial function $5x^3 - 3x - 12$, what would be the remainder if $x - 2$ is a divisor?	42.11%	36
	Which synthetic division give the correct quotient and remainder when $(2x^4 + 3x^2 - 5)$ is divided by $(x + 2)$?	28.95%	19.5
	A rectangular rug has an area of $3x^2 + 19x + 20$. What is its width if its length is $3x + 4$?	21.05%	7.5
7. Prove the Remainder Theorem, Factor Theorem, and the Rational Root Theorem	In the polynomial function $5x^3 - 3x - 12$, what would be the remainder if $x - 2$ is a divisor?	42.11%	36
	Given: $f(x) = 2x^3 - x^2 - x - 3$. Which statement is true?	21.05%	7.5
	What are all the solutions of the equation of $x^3 = 4x$?	23.68%	11.5
8. Factor polynomials.	What is the complete factored form of $x(x + y) - y(x + y)$?	10.53%	1
	Given: $f(x) = 2x^3 - x^2 - x - 3$. Which statement is true?	21.05%	7.5
	By factoring, the solution set of the equation $4x^2 - 100 = 0$ is	21.05%	7.5
9. Illustrate polynomial equations.	Which of the following is NOT a polynomial equation?	28.95%	19.5
10. Solve problems involving polynomials and polynomial equations.	A rectangular rug has an area of $3x^2 + 19x + 20$. What is its width if its length is $3x + 4$?	21.05%	7.5

11. Understand, describe, and interpret the graphs of polynomial functions.	Which of the following is NOT a function?	26.32%	14.5
12. Solve problems involving polynomial functions.	Miguel will use 100 meters of barbed wire to fence his rectangular lot. If the length of the lot is represented by x , how do you express the area of the lot in square meters as a function of x ?	34.21%	26.5
13. Derive inductively the relations among chords, arcs, central angles, and inscribed angles.	Two figures are similar if they have the same	36.84%	30
14. Prove theorems related to chords, arcs, central angles, and inscribed angles.	Given the circle with points A, B, C, and D. What relation exists between the measures of $\angle ABD$ and $\angle ACD$?	47.37%	40.5
	Given: $\angle AEC \cong \angle DEB$ Complete the proof that $\overline{AB} \cong \overline{CD}$	28.95%	19.5
	What mathematical statement completes the blank on the Table of Statement and Proof above?	44.74%	39
15. Illustrate secants, tangents, segments, and sectors of a circle.	Given the figure above, which is a secant line?	47.37%	40.5
	Which shaded region shows a segment?	42.11%	36
16. Prove theorems on secants, tangents, and segments.	Which is true about a line tangent to the circle?	26.32%	14.5
17. Solve problems on circles.	In the figure above, $\angle y = \frac{1}{2}\widehat{AD}$ and $\angle z = \frac{1}{2}\widehat{BC}$. Since $\angle x = \angle y + \angle z$, what is the relationship of $\angle x$ to the intercepted arcs $\widehat{AD}$ and $\widehat{BC}$?	39.47%	32.5
	Three circles with radii 10, 15, and 18, respectively, are each tangent to the other two. What is the perimeter of the polygon joining their centers?	21.05%	7.5
18. Apply the distance formula to prove some geometric properties.	D, E, and F are midpoints of the sides of $\triangle ABC$ as shown below. If $DE = 6$ cm, $EF = 7$ cm, and $DF = 7$ cm, then the perimeter of	31.58%	23.5
	What is the perimeter of the enclosed figure above?	28.95%	19.5
19. Illustrate the center-radius form of the equation of a circle.	What is the center-radius form of the figure above?	34.21%	26.5
20. Determine the center and radius of a circle given its equation and vice versa.	What is the center and the radius of a circle given by the equation $x^2 + y^2 + 8x - 6y - 11 = 0$?	34.21%	26.5
21. Graph and solve problems involving circles and other geometric figures on the coordinate plane.	Which graph illustrates the equation $9x^2 + 25y^2 = 225$?	42.11%	36

22. Solve problems involving permutations.	In a group of 10 students, the positions of president and vice president are to be filled in. How many possible ways can the two positions be selected?	28.95%	19.5
23. Solve problems involving permutations and combinations.	Above are different sets consisting of three numbers selected from 1, 2, 3, and 4 where the order of the numbers is taken into consideration. If the order of the numbers is not considered, how many sets have exactly the numbers?	36.84%	30
	What is the formula in finding the number of combinations of 3 objects taken 2 at a time based on the given above?	34.21%	26.5
	Six books can be arranged four at a time on a shelf. How many permutations and combinations are there?	26.32%	14.5
24. Find the probability of (A $\cup$ B).	Above is a Venn diagram showing the number of diamonds and/or number of kings in a deck of 52 cards. What is the probability of getting a diamond or a king?	23.68%	11.5
25. Solve problems involving probability.	If you roll a pair of dice, what is the probability of an odd sum or a sum of 9 or more?	18.42%	3

Moreover, among the determined and identified least-learned learning competencies above, “Factor polynomials” got the lowest percent correct (10.53%) followed by “Illustrate geometric sequence” (18.42%), “Determine the geometric means, nth term of a geometric sequence and sum of the terms of a given finite or infinite geometric sequence” (18.42%), and “Solve problems involving probability” (18.42%). On the other hand, “Prove theorems related to chords, arcs, central angles, and inscribed angles” (44.74%), “Prove theorems related to chords, arcs, central angles, and inscribed angles” (47.37%), and “Illustrate secants, tangents, segments, and sectors of a circle” (47.36%) are the top three with the highest percent correct among the least-learned learning competencies. After determining the least learned competencies and their corresponding questions, only seven pre-requisite least learned competencies for General Mathematics and Statistics and Probability were identified and presented in the table below.

Table 4 indicates the pre-requisite least-learned learning competencies from Grade 10 Mathematics to the Senior High School (SHS) mathematics core subjects: General Mathematics and Statistics and Probability. It revealed that among the twenty-five (25) least-learned learning competencies based on the administered mathematics achievement test, seven (7) served as foundational pre-requisites for the two core subjects. Specifically, there were seven (7) pre-requisite least-learned competencies

identified for General Mathematics and two (2) for Statistics and Probability (with overlaps across linked topics).

Table 4. Pre-requisite least-learned learning competencies from Grade 10 Mathematics.

Pre-requisite Least-Learned Learning Competencies in Mathematics 10	General Mathematics Aligned Learning Competencies	Statistics and Probability Aligned Learning Competencies
1. Perform division of polynomials using long division and synthetic division. 2. Prove the Remainder Theorem, Factor Theorem, and the Rational Root Theorem	Solve rational equations and inequalities.	-
	Finds the domain and range of a rational function.	-
3. Understand, describe, and interpret the graphs polynomial functions.	Evaluate functions.	-
	Represents a rational function, inverse function, exponential function, and logarithmic function through table of values and graphs.	-
4. Factor polynomials 5. Solve problems involving polynomial functions.	Finds the domain and range of an inverse function.	-
	Solve problems involving functions, rational functions, equations, and inequalities, inverse functions, and exponential functions.	-
	Compute interest, maturity value, and present value of simple and compound interests.	-
	Solve problems involving simple and compound interests.	-
6. Find the probability of (A U B). 7. Solve problems involving probability.	Performs the different types of operations on propositions.	Find s the possible values of a random variable.
	Illustrate different forms of conditional propositions.	Compute probabilities corresponding to a given random variable.
		Solve problems involving mean and variance of probability distribution.

To elevate these findings beyond a localized, school-level assessment, a deeper examination of the mathematical concepts and pedagogical gaps reveals why these specific competencies, particularly polynomial operations, rational functions, and probability distributions, consistently pose challenges to students. The identification of polynomial operations (long/synthetic division, the Remainder and Factor Theorems), rational functions, and probability concepts as major stumbling blocks

aligns with broader mathematics education literature. Addressing these foundational gaps is crucial, as mastery of these specific Grade 10 topics dictates future competence in mathematics-related subjects in Senior High School and even in college.

Table 5. Analysis of the relationship between academic performance and scores in the Mathematics achievement test.

Variables	Scores of Grade 10 Students in the Mathematics Achievement Test		
	r – value	p – value	Remarks
Academic Performance of Students in Mathematics 10	0.6188	0.0000	Reject Ho

**Significance level is set at 0.05.*

The table above shows the results of the analysis on the academic performance of the grade 10 students and the results of the administered mathematics achievement test. It revealed a strong, significant positive relationship between academic performance and the results of the mathematics achievement test, with an r-value of 0.6188 and a p-value of 0.0000. This means that the higher the scores on the mathematics achievement test, the higher the academic performance.

4. Discussion

The study revealed that Grade 10 students in the School Year 2022–2023 had a mean academic performance of 81.79 (SD = 4.82), with grades ranging from 75 to 94. While this reflects a “Satisfactory” standing in classroom coursework, a notable difference was observed between classroom grades and performance on the administered mathematics achievement test. Students obtained a mean score of 21 out of 48 (SD = 6.00), with scores ranging from 13 to 40. This difference suggests that satisfactory classroom grades do not necessarily correspond to comparable levels of demonstrated mastery when students are assessed through a curriculum-based mathematics achievement test. The finding is particularly important in the context of mathematics, where subsequent learning depends heavily on the mastery of prerequisite concepts and skills. The results therefore indicate a potential readiness gap as students transition to Senior High School (SHS). The concentration of least-learned competencies in prerequisite areas suggests that students may experience difficulty with the more advanced demands of SHS mathematics if these foundational gaps remain unaddressed.

The discrepancy between classroom performance and achievement-test results is further evidenced by the identification of 41 questions representing 25 distinct learning competencies in which fewer than 50% of the students provided correct answers. These competencies were consequently classified as “least-learned.” Critically, seven of these least-learned competencies were identified as essential prerequisites for SHS core subjects, particularly General Mathematics and Statistics and Probability. Statistical analysis further confirmed a significant relationship between classroom academic performance and achievement-test scores. This finding suggests that

classroom academic performance provides useful information regarding students' mathematics achievement, although the relationship should not be interpreted as evidence that grades alone adequately capture mastery of prerequisite competencies. Rather, classroom grades and competency-level achievement-test results may provide complementary information regarding students' mathematics readiness.

The identified least-learned competencies also provide important insights into the nature of students' difficulties. The pattern of results suggests that the readiness gap is not limited to isolated computational errors but extends to competencies that require students to coordinate procedural knowledge, conceptual understanding, symbolic manipulation, and mathematical interpretation. This becomes particularly evident in areas involving polynomial arithmetic and advanced theorems, rational functions and graphical interpretations, and statistics and probability.

For Polynomial Arithmetic and Advanced Theorems, the difficulties students encountered in performing polynomial division and applying or proving core results such as the Factor Theorem and Remainder Theorem may reflect a transition from relatively concrete procedural manipulation toward more abstract algebraic reasoning. These competencies require students to simultaneously coordinate several forms of knowledge: manipulating variables and exponents, maintaining accuracy with negative signs and coefficients, recognizing algebraic structures, and interpreting the meaning of the resulting expressions. Kieran (2018) emphasized the developmental nature of algebraic thinking, particularly the increasing demand for learners to move beyond arithmetic-like manipulation toward reasoning about generalized relationships and algebraic structures.

This interpretation is consistent with the present findings because weaknesses in foundational algebraic skills may interfere with students' ability to perform more advanced polynomial procedures. For example, polynomial division requires learners to coordinate operations on coefficients, variables, exponents, and signs while maintaining the structural relationships among the dividend, divisor, quotient, and remainder. Similarly, the Factor and Remainder Theorems require students to move beyond mechanical manipulation to understand the relationship among an algebraic expression, its remainder upon division, and the roots or factors of a polynomial. Thus, when pre-requisite skills such as combining like terms, applying the laws of exponents, and manipulating algebraic expressions remain insufficiently developed, more advanced procedures such as synthetic division and the identification of rational roots may impose substantial cognitive demands. This interpretation is consistent with cognitive load theory, which emphasizes that learners may experience difficulty when instructional tasks require them to process multiple interacting elements before the underlying schemas have been adequately developed (Sweller et al., 2019).

The results, therefore, suggest that remediation of polynomial competencies should not be limited to repeated procedural exercises. Students may benefit from activities that explicitly connect procedures to their underlying mathematical meaning. For instance, exercises involving polynomial division can be linked to the interpretation of remainders, factors, and zeros, allowing learners to recognize how

different representations of the same polynomial relationship are connected. Such an approach may help students develop more integrated algebraic schemas rather than relying exclusively on memorized procedures. Targeted remediation should therefore revisit foundational algebraic skills while progressively connecting these skills to the more complex polynomial concepts expected in SHS mathematics.

For Rational Functions and Graphical Interpretations, competencies involving the domain and range of rational, exponential, and logarithmic functions, as well as the interpretation of polynomial graphs, require students to coordinate multiple representations of mathematical relationships. These representations may include symbolic expressions, tables of values, graphs, and verbal descriptions. The difficulty observed among the students may therefore be associated not only with computational demands but also with the ability to translate information from one representation to another.

Research on mathematical understanding has consistently emphasized the importance of moving flexibly among multiple representations. Students who rely primarily on memorized rules may be able to perform familiar procedures but may encounter difficulty when required to interpret what an algebraic expression means graphically or when a problem is presented in an unfamiliar representation. Vinner (2020) noted the distinction between procedural knowledge and conceptual understanding, as well as the potential difficulties that arise when learners rely heavily on memorized mathematical images or procedures without developing sufficiently connected conceptual structures.

This issue is particularly relevant to rational functions. Understanding domain restrictions, vertical asymptotes, horizontal behavior, intercepts, and the structural features of rational expressions requires students to recognize relationships between symbolic restrictions and graphical behavior. For example, identifying a value excluded from the domain requires more than performing an algebraic operation; students must understand why a particular value makes the denominator zero and how that restriction is represented on the graph. Similarly, interpreting polynomial graphs requires learners to connect zeros, multiplicity, end behavior, turning points, and algebraic structure. Such demands require analytical processing that may be difficult for students whose foundational understanding of functions and algebraic representations remains incomplete.

The present findings, therefore, suggest that interventions for these competencies should emphasize conceptual visualization and multiple representations. Rather than teaching domain, range, asymptotes, and graph behavior as isolated rules, teachers may provide tasks requiring students to move systematically among equations, tables, graphs, and verbal descriptions. Such activities may strengthen students' ability to interpret mathematical relationships and prepare them for the function-based reasoning required in SHS mathematics. The findings are also consistent with the broader literature emphasizing the role of multiple representations in the development of mathematical concepts and functional thinking (Akkoc & Tall, 2021).

And, for Statistics and Probability, particularly competencies involving compound probability and random variables. Difficulties in this area may stem from the complex interaction between mathematical computation, combinatorial reasoning, language comprehension, and the construction of appropriate mathematical models. Unlike some routine computational tasks, probability problems often require students first to determine what the situation represents mathematically before selecting and applying an appropriate procedure.

Batanero and Borovcnik (2022) emphasized that probability is conceptually demanding because learners must reason about uncertain events, sample spaces, dependence, independence, and probabilistic relationships. Students may consequently experience difficulty distinguishing concepts that appear linguistically similar but have substantially different mathematical meanings. A common example is the distinction between mutually exclusive events and independent events. Mutually exclusive events cannot occur simultaneously, whereas independent events are events in which the occurrence of one does not alter the probability of the other. Confusing these concepts can lead to the inappropriate selection of probability rules, even when students possess the necessary computational skills.

Similarly, compound probability problems require students to identify the relevant events, determine whether those events are dependent or independent, and select an appropriate mathematical model. When the problem is presented in a lengthy verbal context, the additional demand of interpreting language and extracting relevant information can further increase the cognitive burden. Thus, the difficulty observed in Statistics and Probability may reflect not simply insufficient knowledge of formulas but weaknesses in mathematical modeling, logical reasoning, and conceptual interpretation.

These findings highlight the importance of providing students with probability tasks that emphasize reasoning before computation. Teachers may use tree diagrams, Venn diagrams, tables, simulations, and contextualized problems to help learners visualize relationships among events. Such approaches may make abstract probability concepts more accessible and reduce the tendency to treat probability formulas as isolated rules to be memorized. For students transitioning to SHS, remediation in probability should therefore emphasize conceptual distinctions, representation of events, and reasoning about relationships before formal computation.

Taken together, the findings suggest a critical “readiness gap” as students transition from Junior High School to Senior High School. The high concentration of least-learned competencies in prerequisite areas indicates that students may struggle with the more rigorous demands of SHS mathematics if these foundational gaps remain unaddressed. The problem is particularly important because many of the identified competencies function as building blocks for subsequent mathematical learning. Weaknesses in algebraic manipulation, functions, graphical interpretation, and probability reasoning can therefore have consequences that extend beyond the specific Grade 10 competencies in which students demonstrated difficulty.

Furthermore, the significant relationship between academic grades and achievement-test scores suggests that classroom performance remains a useful indicator of students' mathematical achievement. However, the difference between the mean classroom grade and the achievement-test performance demonstrates that grades alone may not provide sufficiently fine-grained information about students' readiness. A student may meet the minimum requirements for passing a course while still having substantial gaps in individual competencies. Consequently, competency-level achievement-test results can supplement classroom grades by identifying specific prerequisite skills that may require intervention.

The findings also have implications for the interpretation of mathematics readiness. Readiness should not be viewed as a single global characteristic that students either possess or lack. Rather, it can be understood as a multidimensional condition that involves mastery of specific prerequisite competencies required for subsequent learning. In this sense, identifying the 25 least-learned competencies provides more actionable information than the overall achievement-test score alone, as it allows teachers and curriculum planners to determine which skills should receive immediate attention.

However, this study is subject to certain limitations. First, although the administered mathematics achievement test underwent expert content validation, item-level analyses, such as determining difficulty and discrimination indices, were not conducted. Consequently, the findings should be interpreted primarily as evidence of students' performance on the administered competency-level achievement test, rather than as comprehensive evidence of the quality of individual test items. Additional item-level analyses in future applications of similar achievement tests could provide stronger evidence regarding item performance and measurement quality.

Second, the study was conducted with a small sample size at a single institution and focused on students from a single academic year, School Year 2022–2023. The findings should therefore be interpreted within the context of the participating institution and cohort. Differences in school resources, teacher qualifications, instructional practices, learner characteristics, and curricular implementation may produce different patterns of prerequisite competency mastery in other schools or regions. Consequently, broader studies involving multiple institutions and cohorts are necessary to establish the generalizability of the identified learning gaps.

Overall, the findings underscore the importance of viewing mathematics readiness as a developmental, evidence-based process rather than simply a consequence of earning a passing classroom grade. The identified disparity between academic performance and achievement-test results, together with the concentration of least-learned competencies in SHS prerequisite areas, demonstrates the importance of systematic assessment and targeted intervention. Schools can provide a stronger foundation for the transition to Senior High School by identifying and addressing prerequisite gaps before students encounter more advanced mathematics. In particular, the findings support the use of targeted remediation and bridging activities focused on the identified least-learned competencies, including foundational algebraic

manipulation, polynomial reasoning, functions and graphical interpretation, and probability concepts. Such interventions can help students strengthen prerequisite knowledge and skills before or during their transition to SHS mathematics.

5. Conclusion

The study concluded that the academic performance of Grade 10 students during School Year 2022–2023 was “Satisfactory” according to the Department of Education’s standard descriptors and grading scale. This indicates that, although the students demonstrated a generally satisfactory level of classroom performance, their achievement test results revealed substantial gaps in their demonstrated mastery of Grade 10 Mathematics competencies. In contrast to their classroom grades, the students obtained considerably lower scores on the researcher-developed mathematics achievement test, indicating a disparity between classroom-based academic performance and performance on a curriculum-aligned comprehensive assessment.

The achievement test results further revealed critical gaps in students’ mathematics learning, with 25 competencies classified as “least-learned” based on the established performance criterion. This finding indicates that a substantial proportion of the students had not sufficiently mastered several Grade 10 Mathematics competencies. Of these 25 least-learned competencies, seven were identified through curriculum mapping as essential prerequisite competencies for selected Senior High School core subjects, particularly General Mathematics and Statistics and Probability. Insufficient mastery of these foundational competencies may pose challenges for students as they transition to the more advanced mathematical concepts and skills required in SHS.

The study also found a significant positive correlation between students’ general academic performance and their mathematics achievement test scores. This indicates that students with higher academic performance tend to obtain higher scores on the achievement test. However, the observed relationship does not imply that academic performance alone is sufficient to determine students’ mastery of specific mathematics competencies. The disparity between classroom performance and achievement test results highlights the value of examining students’ performance at the level of specific learning competencies when assessing mathematics readiness.

Overall, the findings demonstrate that mathematics readiness among incoming SHS students should be assessed in terms of mastery of specific prerequisite competencies rather than solely by general academic performance or overall grades. The identification of 25 least-learned competencies, particularly the seven competencies identified as prerequisites for SHS Mathematics, provides evidence of specific mathematics readiness gaps that require attention. These findings may guide teachers and curriculum planners in designing targeted remediation, bridging

activities, and transition support that address students' identified prerequisite learning needs before or during their transition to Senior High School.

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Conflict of Interest Statement

The authors declare no relevant financial or non-financial conflicts of interest with respect to this manuscript.

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