

Mathematical Readiness of Grade 12 Students for STEM-related College Courses

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Abstract

This study investigates the college mathematical readiness of Grade 12 students, particularly those in STEM and non-STEM strands, and examines the relationship between their senior high school mathematics performance and college mathematical readiness. Utilizing a descriptive-correlational design, the study involved 108 Grade 12 students. The College Mathematics Readiness Test (CMRT) was administered to assess their proficiency in Algebra, Geometry, Statistics and Probability, Trigonometry, Pre-Calculus, and Calculus. Results indicate that 76.92% of STEM students have average mastery, suggesting moderate readiness for college-level mathematics, while 67.07% of non-STEM students exhibit low to very low mastery, indicating a lack of readiness for STEM-related college courses. The study found no statistically significant relationship between senior high school mathematics performance and college mathematical readiness, highlighting a potential disconnect between high school and college mathematics standards. The findings underscore the need for bridging the gap in mathematics instruction between basic education and higher education institutions to better prepare students for STEM fields in college.

Keywords: Mathematical Readiness; Mathematics Performance; STEM Related College Courses; Proficiency; STEM and non-STEM

1. Introduction

In the context of rapid global transformations and complex societal challenges, education plays a pivotal role in shaping national development and long-term progress (Kuranking et al, 2023). Though the quality of education in the Philippines has not been steadily commendable for the past decades due to the deterioration in the performances of Filipino students in international assessments, the Philippine government is unceasingly doing its best to better the quality of education the country offers to Filipino students (Lapinid et al, 2022). The implementation of the K–12 Basic Education Program aligns with the basic education curricula of other Asia-Pacific countries and, more importantly, suits the developmental needs of students (Department of Education, 2019). The Enhanced

Basic Education Act of 2013, also known as Republic Act No. 10533, extends basic education by adding two years of senior high school. During this period, students select from various strands and specialization tracks that align with their intended college programs, preparing them to be ready for higher education or future careers.

In the Philippine Senior High School curriculum, students choose a strand based on their future plans. The STEM strand is for those aiming for science, technology, engineering, and math-related courses, building strong skills in math, research, and scientific thinking. Non-STEM strands include ABM for business and entrepreneurship, HUMSS for social sciences and communication, GAS for students still exploring options, TVL for hands-on technical skills and employment, and the Arts and Design and Sports tracks for those pursuing creative or athletic careers.

Initially, when a student wants to take up science or mathematics related courses like engineering program, mathematics and science education program, he/she must choose the STEM (Science and Technology, Engineering and Mathematics) strand under the Academic Track, wherein fundamental mathematics and specialized courses are taught as preparation for STEM-related courses. However, the CHED (Commission on Higher Education) Memorandum Order 105, Series of 2017, mandated that higher education institutions admit Senior High School graduates regardless of the track or strand taken; moreover, that no Grade 12 graduate shall be denied acceptance in applying for college entrance examinations in the higher education institutions (Commission of Higher Education, 2018).

College readiness is important and can be a starting point for students' success in their studies. It refers to a high school graduate's ability to gain admission to college and successfully complete foundational courses without the need for remediation (Vecaldo et al, 2020). Suppose a student has a high level of readiness for college, then it is more likely that he can easily adjust to college life and manage new and more complex experiences, including more advanced subjects (Alinea et al, 2022). Despite all the preparation in senior high school education, many students graduate high school unprepared for college and need more skills to take up more advanced subjects. In the study of Vecaldo et al (2020), graduates from K-12 lacked essential competencies particularly in science and mathematics.

Research about students' mathematical deficiencies has been widely studied and continues to be a national concern. Many studies have found that many students have been admitted to college without enough readiness or mathematical skills. The study of Perante (2022) assessed the mathematical readiness of first-year engineering students and found that only 43% were mathematically college-ready, while 57% were not. Also, according to Padernal & Tupas (2024), existing first year high school students have weakness in problems presented in word problems. Hence, enhancing mathematical readiness for STEM-related college courses requires addressing gaps in high school education, providing equitable access to advanced courses, and fostering a strong mathematics identity among students. Thus, it is essential to explore mathematical readiness to prepare a diverse and capable cohort of students for success in STEM fields in college. Thus, it is essential to explore mathematical readiness to prepare a diverse and capable cohort of students for success in STEM fields in college.

Numerous studies emphasize the multifaceted nature of mathematical readiness for college, highlighting the combined influence of academic preparation, motivation, and the quality of instruction. Readiness for STEM courses requires strong foundations across several areas. Algebra develops symbolic reasoning and problem-solving skills, while geometry strengthens spatial and analytical thinking needed in design and physics. Statistics and probability support data analysis and decision-making. Trigonometry helps explain relationships involving angles and periodic phenomena, pre-calculus deepens understanding of functions and prepares students for more advanced study, and calculus

introduces limits, differentiation, and integration for analyzing change and complex systems. Together, these areas build the logical, analytical, and quantitative skills necessary for success in STEM fields. Research also shows that high school mathematics exposure, especially completing advanced courses, is linked to better college outcomes, and taking additional math in high school can increase college enrollment rates (Poulsen, 2019). However, readiness is not determined by coursework alone. Alinea et al. (2022) found a gap between senior high school grades and aptitude test performance among engineering freshmen, and Giacobbe (2019) reported that many college students are considered underprepared for college-level mathematics, pointing to a misalignment between high school preparation and college expectations.

Beyond academic metrics, motivational and psychological factors significantly shape students' mathematical performance. Sabanal et al (2024) identified learning engagement as the strongest individual predictor of success in higher mathematics, closely followed by motivation, self-efficacy, and the learning environment. These findings align with Kurlaender, Reed, and Hurtt's (2019) assertion that students' educational beliefs and aspirations influence their attitudes and long-term academic behaviors. Meanwhile, Saha et al. (2024) provided qualitative insights from both students and educators, revealing that struggles often stem from poor study habits, reliance on memorization, and lack of motivation, whereas successful learners benefit from clear conceptual understanding and consistent practice.

Taken together, these studies suggest that improving college readiness in mathematics requires not only strengthening academic curricula but also fostering student engagement, building motivational resilience, and bridging perceptual gaps between high school and college expectations.

2. Methodology

2.1 Research Design

This is quantitative research that utilized a descriptive-correlational design. Descriptive research describes data and characteristics about the population or phenomenon the researchers want to study. The descriptive research design was utilized as this study aims to gather information to assess the mathematical readiness of senior high school grade 12 students who would pursue STEM-related degrees in college. Moreover, the correlation was utilized to establish the extent of the relationship between the students' college mathematical readiness and their SHS academic performance in mathematics.

2.2 Research Objectives

This study aims to determine the demographic profile of the respondents, including their Senior High School strands and average mathematics performance. It also seeks to assess the mathematical readiness of Grade 12 students based on the College Mathematical Readiness Test for both STEM and Non-STEM strands. Furthermore, it examines the significant relationship between the College Mathematical Readiness of Grade 12 students and their senior high school academic performance in mathematics. The term "readiness" in this study refers to the level of preparedness of grade 12 students in Mathematics.

2.3 Participants

The respondents were Grade 12 students in the Academic Track (STEM, ABM, HUMSS) from a national high school in Northern Mindanao, Philippines for the Academic Year 2024-2025. Out of 145 Grade 12 students in the Academic Track, 121 participated in the study, 28 out of 36 being from the STEM Strand and 93 out of 109 being non-STEM Strand. However, due to some missing data, only 108 were considered for data analysis.

2.4 Research Instrument

This study utilized a researcher-made College Mathematics Readiness Test (CMRT). The questionnaire comprises 30 multiple-choice questions covering Algebra, Geometry, Statistics and Probability, Trigonometry, pre-calculus, and Calculus. The assessment is designed to measure students' foundational skills in mathematics necessary for success in STEM programs at the college level. The test evaluates knowledge and problem-solving abilities across multiple domains including algebra, geometry, trigonometry, statistics, probability, pre-calculus, calculus, and applied mathematics. Questions range from basic concepts, such as identifying the domain of a function or the number of sides in a polygon, to more advanced applications, such as simplifying expressions, solving for variables in triangles, evaluating limits, computing rates of change, and interpreting statistical data. Other items involve applied problem-solving, including predicting outcomes using regression equations, calculating areas and volumes, and determining probabilities or hypotheses in real-world contexts. The CMRT aims to identify students' strengths and gaps in mathematical reasoning, conceptual understanding, and computational skills. It provides insight into their preparedness for STEM-related college courses, helping educators target areas that require additional instruction or practice.

The questionnaire's content validity was determined through a review and validation process to ensure that the content and meaning of the questions adequately covered and captured the subject matter and that it was sufficient to measure the knowledge and proficiency of the respondents. The teachers reviewed and validated the questionnaire ($n = 3$), one of which handled mathematics subjects from a senior high school and two college instructors/professors from a state university. Parameters included in the validation process of each question were the clarity and balance, wordiness, appropriateness of the responses, application to praxis, and relationship to the problem. The teacher's role was (1) to recommend the passing score and to provide comments and suggestions to improve the questionnaire and (2) to rate each question based on the parameters on a scale of 1 to 4, with 1 = not acceptable; 2 = Below Expectations; 3 = Expectation Meet; and 4 = Exceed Expectation. Moreover, items were revised as suggested by the validators. A try-out test was administered to 190 college students from a state university. Item analysis was used to evaluate the questionnaire. Discrimination and difficulty indices were the basis for retaining and discarding the items. Based on the result, 30 items were retained with Cronbach's alpha of 0.708, indicating an acceptable reliability level. A similar College Mathematics Readiness Test (CMRT) was developed by Perante (2022) that was mainly composed of standardised mathematical questions intended for freshmen engineering students.

2.5 Data Analysis

Data gathered from the test were tabulated and analyzed. Descriptive statistics such as frequency count, percentage, and mean percentage score (MPS) were used to describe the students' MCR. The student's "readiness" was interpreted based on the guidelines utilized by Herrera Jr. & Dio (2016), which were patterned on the seven—the descriptive equivalent of Achievement Level of the National Education Testing and Research Center (NETRC), as shown in Table 1. The gathered information was examined and deciphered utilizing frequency, simple percentage, mean, and Pearson r .

Table 1. Descriptive equivalent of Achievement Level of the National Education Testing and Research Center

Percentage Score	Descriptors	Remarks
0% - 4%	Absolutely No Mastery	Not Ready
5% - 15%	Very Low Mastery	Not Ready
16% - 34%	Low Mastery	Not Ready
35% - 65%	Average Mastery	Moderately Ready
66% - 85%	Moving Towards Mastery	Moderately Ready
86% - 95%	Closely Approximating Mastery	Ready
96% - 100%	Mastered	Ready

3. Results and Discussion

3.1 Respondents Profile of Grade 12 STEM and Non-STEM Strands

A total of 108 Grade 12 respondents from the academic track were considered in this study. There are 26 students from the STEM strand and 82 students from Non-STEM Strand that comprises 24 ABM Strand students and 58 HUMSS Strand students. Respondents were categorized as STEM and non-STEM based on the mathematics subjects in their curriculum, where the STEM strand has General Mathematics, Statistics and Probability, Pre-calculus, and Calculus subjects. In contrast, non-STEM only has General Mathematics and Statistics and Probability Subjects. Table 2 shows the profile summary of the Grade 12 respondents, of which 24.07% were STEM strands and 75.93% were non-STEM Strands.

Table 2. Profile of Grade 12 student respondents according to Strands

STRAND	Frequency	Percentage
STEM	26	24.07%
NON-STEM	82	75.93%
TOTAL	108	100%

Moreover, Table 3 shows the average mathematics performance of Grade 12 students where STEM strand has a mean grade of 91.44 and standard deviation of 3.39 while non-STEM stand has a mean grade of 85.42 and standard deviation of 4.27.

Table 3. Average Mathematics Performance of Grade 12 Students

SHS Mathematics Performance	N	Mean	Standard Deviation
STEM	26	91.44	3.49
NON-STEM	82	85.42	4.27
TOTAL	108		

3.2 College Mathematical Readiness

3.2.1 Grade 12 STEM Strand

Table 4 presents the College Mathematics Readiness levels of Grade 12 STEM strand students. The results indicate that 76.92% (f=20) of the students demonstrated average mastery in mathematics, while 23.08% (f=6) showed low mastery. This suggests that the majority of STEM students are moderately prepared for college-level mathematics, whereas a smaller portion are not yet ready. Notably, students expressed a desire to pursue STEM-related courses in college and aspire to enter STEM careers after graduation. Their primary motivation for choosing these professions is personal aspiration (Rafanan et al, 2020).

Table 4. College Mathematical Readiness of the Grade 12 STEM students

Percentage Score	Frequency	Percentage	Descriptors	Remarks
16% - 34%	6	23.08%	Low Mastery	Not Ready
35% - 65%	20	76.92%	Average Mastery	Moderately Ready
TOTAL	26	100%		

The findings of Perante (2022) also emphasize that Senior High School students aiming to pursue engineering or other STEM-related courses in college are advised to choose the academic track, specifically the STEM strand. This track significantly increases the chances of students completing foundational courses such as pre-calculus and basic calculus during high school.

3.2.2 Grade 12 Non - STEM Strand

Table 5 shows the College Mathematics Readiness of the Grade 12 non-STEM strand students. The result shows 4.88% (f=4) of Grade 12 non-STEM students have a very low mastery in mathematics, majority of 62.20% have low mastery, and 32.32% (f=27) have an average mastery in mathematics. This means that the majority (f=55, p=67.07%) of non-STEM students need more time to take STEM-related college courses. This result shows the disparity between STEM and non-STEM students, highlighting the significant mathematical preparedness gaps that could impact their success in STEM-related college courses. However, there is a silver lining (f=27, p=32.32%) for the non-STEM students who show moderate readiness, indicating a potential that can be nurtured with appropriate support. This means that these 32.32% of non-STEM students could successfully transition to STEM-related courses with additional support to bridge the gap in their mathematical knowledge.

Table 5. College Mathematical Readiness of the Grade 12 Non-STEM students

Percentage Score	Frequency	Percentage	Descriptors	Remarks
5% - 15%	4	4.88%	Very Low Mastery	Not Ready
16% - 34%	51	62.20%	Low Mastery	Not Ready
35% - 65%	27	32.32%	Average Mastery	Moderately Ready
TOTAL	82	100%		

The findings of this study are consistent with those of Amanonce (2020), which indicated that most students are not adequately prepared for college-level mathematics. The study further emphasized that students with greater exposure to mathematics during high school demonstrated significantly higher levels of readiness compared to those who only completed the minimum required mathematics courses.

3.3 Mathematics Performance and College Mathematical Readiness

3.3.1 Grade 12 STEM Strand

Figure 1 shows the scatter plot between SHS Mathematics performance and the CMRT scores of STEM strand students. A Pearson’s product-moment correlation was run to determine the relationship between the respondents' academic achievement in mathematics and the MCRT for STEM Strand, which was statistically not significant ($r = 0.382, n = 26, p = 0.054$). This result implies that there is no association between SHS Mathematics performance of grade 12 students and their college mathematical readiness. However, the p-value of 0.054 is close to the conventional threshold of 0.05 for statistical significance, which implies that there may be a meaningful relationship that warrants further investigation.

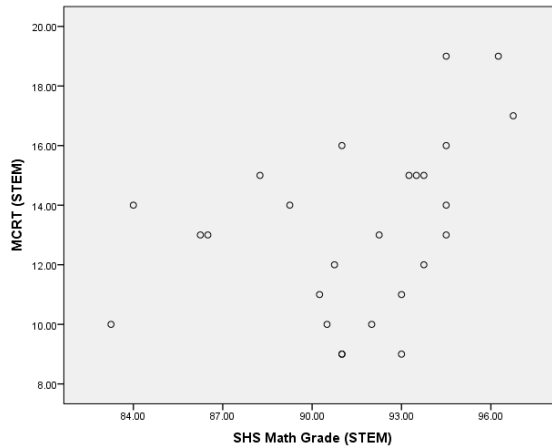


Figure 1. The scatter plot between SHS Mathematics Performance and CMRT scores for Grade 12 STEM Strands

3.3.2 Grade 12 Non - STEM Strand

A Pearson’s product-moment correlation was run to determine the relationship between the SHS Mathematics performance of grade 12 non-STEM students and their CMRT scores, which was statistically not significant ($r=0.137$, $n=82$, $p=0.219$). This result implies that SHS Mathematics Performance is not associated with their college mathematical readiness.

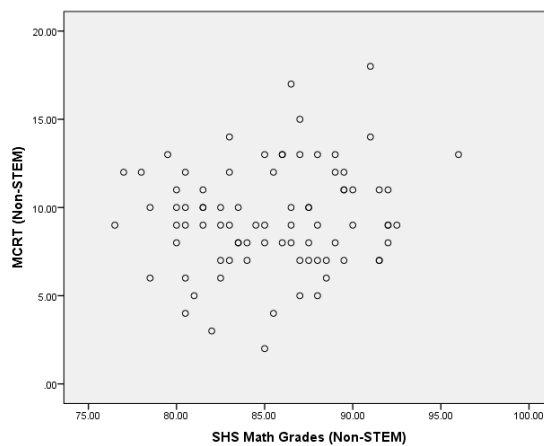


Figure 2. The scatter plot between SHS Mathematics Performance and CMRT scores for Grade 12 Non-STEM Strands

College readiness in STEM disciplines encompasses various dimensions rather than a single factor (Martinez and Ellis, 2023). The shift from high school to pursuing STEM degrees presents challenges for many students due to common academic difficulties and has important consequences for their future prospects (Di Martino et al, 2023). In the paper of Paschal and Taggart (2019), the authors mentioned in their study that early success in college-level mathematics courses is crucial for persistence in STEM majors, especially for underrepresented groups, giving importance to early mathematics support in college. An assessment of college students' mathematics knowledge revealed variability in performance across different mathematical strands, such as algebraic thinking, variables and patterns, linear equations, and linear functions in which students pursuing STEM degrees generally outperformed those in non-STEM fields, indicating a higher level of preparedness in these areas (Mielicki et al, 2019). These are consistent with the result of

this study that majority STEM students are moderately mathematically college ready while majority of non-STEM are not. Also, high school GPA and the completion of advanced math courses are strong predictors of college success, often more so than standardized test scores (Allensworth and Clark, 2020).

However, as the Basic education Curriculum changes, there is often a misalignment between high school and college math standards, leading to students being placed in remedial courses despite being deemed "college-ready" by high school standards (Melguizo and Ngo, 2020). Similarly, in the study Barr et al (2022), high school grades particularly in Pre-Calculus, have been shown to have a disconnect with university Calculus grades, indicating that high school performance may not always predict college success. This disconnection highlights the difference in teaching methods. High school and university courses often employ different teaching methods and assessment strategies. There often needs to be more alignment between high school curricula and college expectations, leading to a disconnect in student preparedness. This misalignment is exacerbated by grade inflation and differing teaching methods.

Furthermore, one study mentioned that not taking mathematics in grade 12 is a strong predictor of placement in below-college-level mathematics courses (Jaffe, 2012). This implies the importance of continuous mathematical education, particularly in the final year of senior high school. Mathematics is a cumulative subject, where each new concept builds on previous knowledge. Skipping mathematics in grade 12 can lead to a decline in these essential skills, making it harder for students to transition smoothly into college-level courses.

The result of this study adds insights to the disconnection of the senior high school mathematics performance and the college mathematical readiness of the STEM and non-STEM students.

4. Conclusion

This study aimed to assess the college mathematical readiness of Grade 12 students, particularly those in the STEM and non-STEM strands, and examine the relationship between their senior high school mathematics performance and college mathematical readiness. The findings reveal that the majority of STEM students (76.92%) have an average mastery or moderate readiness for college-level mathematics, while the majority of non-STEM students (67.07%) have low to very low mastery and are not ready for STEM-related college courses. In the study of Padernal and Tupas (2024), students from the STEM strand also got the highest mean score compared to students in other strands in terms of foundational mathematics skills. Additionally, the study by Bautista et al (2021) found a significant difference in the academic performance of STEM and non-STEM students in College and Advanced Algebra. This suggests that students who graduated from the STEM strand tend to achieve higher academic performance compared to their non-STEM counterparts. The result of this study together with existing studies highlights a significant disparity in mathematical preparedness between the two groups, with non-STEM students facing greater challenges in transitioning to advanced mathematics in college.

The study also found that there is no statistically significant relationship between the students' senior high school mathematics performance and their college mathematical readiness suggesting the disconnection of the two measurements.

This study has some limitations. Score in a single test may not be adequate to determine the overall readiness of students for college mathematics and its association to senior high school mathematics performance. Thus, it is recommended for future researchers to conduct comprehensive analysis and alignment of mathematics competencies. The perspective of the HEI teachers with regard to the students' readiness for college mathematics should also be explored since they have direct involvement on

this matter. Other factors affecting college readiness through a qualitative study may be conducted to have a better generalizability of findings. On a practical, significant note, findings of the study yield necessary implication on the need of bridging the gap of mathematics instruction between Basic Education and Higher Education Institutions. As noted by Arshavsky et al (2025), several practices contribute to enhancing students' readiness for college-level mathematics. These include implementing course-taking policies that mandate enrollment in college preparatory or honors mathematics courses for all students, adopting rigorous, student-centered instructional approaches across classrooms, and offering comprehensive support systems that address both academic and affective student needs. Furthermore, expanding the scope of the study may be conducted to gather more insights into the trend on the relationship between SHS mathematics performance and college mathematics readiness of K-12 graduates.

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