

**College Mathematics Readiness of Students
in the Philippine Senior High School**

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ABSTRACT

Mathematics readiness is essential for success in higher education. This study evaluated the preparedness of Grade 12 senior high school (SHS) students in the Philippines. It focuses on their mastery of core subjects and the new general education curriculum. This study utilized a mixed- methods approach and applies statistical tools such as one-way ANOVA, Tukey post-hoc tests, and normalized gain calculations. Two standardized assessments (CMRT1 and CMRT2) measured students' understanding of key mathematical concepts.

The study involved 758 SHS students from public and private schools across Luzon, Visayas, and Mindanao during the 2022-2023 school year and 10 mathematics teachers from private schools in the National Capital Region. Findings revealed that most student's proficiency level is at the "Beginning" stage and were "Not Ready" for college level mathematics.

Further analysis showed poor understanding across nearly all tested competencies. Teachers cited several factors contributing to these gaps and emphasized the need for targeted interventions. The study recommends implementing standards-aligned assessments and tailoring the curriculum to reflect varying computational skill needs. STEM and ABM students may require deeper mathematical training while non-STEM/ ABM students would benefit from a focus on analytical and reasoning skills to better prepare for college-level demands.

Keywords: College Mathematics Readiness Test (CMRT 1) & (CMRT 2), level of mastery, level of proficiency, learning gap analysis

The study of mathematics plays a critical role in preparing students for the rigorous demands of higher education. Critical thinking and effective problem-solving skills are essential components of mathematical proficiency which serves as a foundation for evaluating the readiness of incoming college students for academic challenges. Recognizing the importance of this preparation, researchers have explored various models and methods grounded in diverse theories to assess college mathematics readiness over the years.

This research is primarily focused on assessing the college mathematics readiness of students within the Philippine senior high school system. The results can hopefully be used as basis to enhance students' mathematics mastery and better prepare them for the new general education curriculum. The study aims to investigate and analyze students' level of mastery in the core curriculum and their proficiency in their new general education curriculum in mathematics.

A critical aspect of this research is the examination of learning gaps between students' mastery of core subjects and their proficiency in the general education curriculum. The presence of such gaps is crucial for understanding students' overall readiness for college-level mathematics. Specifically, the study seeks to answer the following questions.

1. What is the college mathematics readiness of students in the Philippine senior high school based on:
 - a. level of mastery of the prescribed learning competencies in core subjects
 - b. level of proficiency in competencies as prescribed in the new general education curriculum
2. What is the extent of the significance of difference in college mathematics readiness when students are categorized according to track?

3. What learning gaps are identified when analyzing level of mastery in core subjects and proficiency in the new general education curriculum?
4. What factors can be attributed to the identified learning gaps, as perceived by teachers?
5. What curricular innovations can be proposed to enhance the college readiness of senior high school students toward quality and relevant mathematics education?

The study involved a sample of 758 grade 12 senior high school students from selected public and private schools across Luzon, Visayas, and Mindanao during the 2022-2023 school year. Participants completed an online survey assessing their proficiency across various subjects.

The analysis utilized average normalized gain and the mean percentage of correct answers (MPCA) to identify the least mastered topics in both the core curriculum and the new general education curriculum. This focused approach allows for a clearer understanding of the areas in which students are struggling.

Additionally, the research included insights from teachers on the root causes of these learning gaps, providing invaluable information for curriculum reviewers. This feedback can inform future curriculum development and revisions which will ultimately support the successful transition of senior high school students into college-level mathematics programs.

It is important to acknowledge the limitations of this study, which primarily focuses on assessing the readiness of SHS students and gathering feedback from teachers regarding factors contributing to learning gaps. Notably, this study does not account for physical and emotional readiness which are the important parameters crucial for a comprehensive understanding of student preparedness.

Moreover, the sampling was uneven due to limited responses from the Visayas and Mindanao regions brought about by COVID-19 pandemic restrictions at alert levels 1 and 2 which hindered access to a broader participant pool. Future research could enhance understanding of SHS students' readiness by using stratified

sampling methods to ensure proportional representation across all regions. Involving educational stakeholders, including parents and policymakers, would also provide diverse perspectives on student readiness and the factors affecting learning.

In summary, this study represents a critical effort to determine the college mathematics readiness of students by identifying learning gaps, exploring teacher perspectives, and proposing curricular and instructional innovations. This could hopefully lead to more initiatives to improve quality and relevant mathematics education in the 21st century to adequately prepare students for the academic demands of higher education.

REVIEW OF RELATED LITERATURE

College Readiness

College Readiness is defined as a student's preparedness to enroll in and succeed at a collegiate institution that offers a baccalaureate degree (Conley, 2007). This concept aims to identify K to 12 graduates who are adequately equipped for the academic demands of higher education (Jawad, 2017). Notably, having a high school diploma does not necessarily imply that a student is ready for the intellectual challenges of adult life (Porter & Polikoff, 2012).

Framework for College Readiness

Conley's extensive works (2008, 2010, 2013, 2014) emphasize the importance of rigorous coursework and meeting specific metrics on standardized assessments to achieve college readiness. Conley identifies essential cognitive and metacognitive skills, such as analysis, interpretation, precision, accuracy, problem solving, and reasoning, as critical for success in college-level studies. Also, students must possess knowledge of key concepts across subject areas and exhibit academic self-management behaviors, which include time management, effective study skills, and persistence (Conley, 2014).

Caldwell (2021) further emphasized the importance of contextual skills, which encompass navigating college choice, admissions, financial aid, and institutional systems during the initial year of college. A student is considered college-ready when he/she possesses the requisite knowledge, skills, and academic

preparation to succeed without the need for remediation (Hunt Institute, North Carolina Department of Public Instruction).

Traditionally, college readiness has been measured through successful course completion, high school grade point average or GPA, and standardized test scores (Noble & Sawyer, 2004). Despite the extensive attention given to defining and measuring college readiness, a consensus on its precise meaning is lacking (Conley, 2008).

Carroll's (1993) theory outlines three components that contribute to readiness:

1. Cognitive Readiness which refers to an individual's prior knowledge and cognitive abilities relevant to a specific learning domain.
2. Affective Readiness encompassing the motivational and attitudinal aspects that contribute to readiness.
3. Conative Readiness involving behavioral and volitional dimensions of readiness

College Readiness in the Philippine Context

In the Philippines, college readiness is assessed according to the Policy Guidelines on the National Assessment of Student Learning for the K to 12 Basic Education Program (DepED, 2016). The Basic Education Exit Assessment (BEEA) plays a crucial role in this assessment, primarily serving as a feedback mechanism rather than a college entrance examination (Mamba et al., 2020). This raises concerns about whether the assessment effectively measures the college readiness of K to 12 graduates (Wenceslao, 2022).

Mathematics Readiness Assessment

CMRT 1 (College Mathematics Readiness Test) and CMRT 2 were developed to assess the readiness of SHS students in mathematics, covering essential learning competencies in core curriculum subjects and the new general education curriculum, respectively. According to the Readiness Theory, enhanced readiness positively correlates with improved learning outcomes. A strong foundation in prior knowledge and skills allows students to effectively assimilate new information and apply what they have learned in new contexts. Higher readiness levels lead to faster, more

effective learning, deeper understanding, and improved problem-solving abilities.

Wenceslao (2022) highlighted significant gaps in mathematical preparation among Philippine high school graduates transitioning to college. He suggested that many K to 12 students are not adequately prepared for college-level math courses (Amanonce, 2020). The K to 12 education system in the Philippines has been criticized for its inability to prepare students effectively for STEM degree programs, such as engineering (Almerino et al., 2020). These findings indicate the need for higher education institutions in the Philippines to reassess their admissions policies and selection criteria to enhance the mathematical readiness of incoming college freshmen, particularly in STEM fields (Wenceslao, 2022).

Research Gap and Study Focus

While studies on college-level readiness have explored various contributing factors, there remains a significant gap in research that focuses specifically on aligning the core curriculum with the new general education curriculum in mathematics. This study aims to examine the learning gaps between these two curricula, with the goal of facilitating a smoother transition and better preparing SHS students for college-level mathematics. By addressing these gaps, the research seeks to improve overall academic readiness and support students in their pursuit of higher education.

Conceptual Framework

The conceptual framework underlying this study is founded on David Conley's (2008) four essential aspects of college readiness, which serve as a guide to evaluating and enhancing the college mathematics readiness of SHS students in the Philippines.

1. **Key Cognitive Strategies.** Conley (2008) identifies key cognitive strategies as critical for fostering problem-solving, analytical, and critical thinking skills. The CMRT 1 and CMRT 2 are designed to assess these cognitive skills among SHS students. Specifically, CMRT 1 evaluates students' mastery in essential topics within the core curriculum, including General Mathematics and Statistics. In contrast, CMRT 2 measures proficiency in the new General Education curriculum, particularly Mathematics in the Modern World.

By analyzing the cognitive complexity of the questions on CMRT 1 and aligning them with those in CMRT 2, this study effectively gauges how well these assessments prepare students for the analytical demands of college-level mathematics.

2. **Key Content Knowledge.** This aspect focuses on the subject-specific knowledge and skills that CMRT 1 and CMRT 2 aim to assess and improve. CMRT 1 addresses foundational topics, while CMRT 2 introduces students to modern mathematical concepts required in the new general education curriculum. The alignment of these two tests not only highlights the progression in content knowledge expected of students but also serves as a means of identifying gaps in understanding that need to be addressed for successful transition into higher education.
3. **Academic Behavior.** Academic behaviors encompass self-management skills, study habits, and goal-setting abilities crucial for success in college. This study investigates these non-cognitive skills through qualitative observations and assessments provided by teachers regarding perceived learning gaps. Understanding these behaviors enables stakeholders to identify specific areas where students may struggle and offers insight into how these non-cognitive skills interact with academic performance (Conley, 2007).
4. **Contextual Skills and Awareness.** Navigating the transition from high school to college involves more than academic preparation. It also requires understanding college admission processes, campus life, and the differences in academic expectations. This broad perspective includes developing essential life skills and cultural awareness which are vital for succeeding in a college environment (Visser & Zyl, 2013). By exploring these contextual skills, the study aims to ensure that students are not only prepared academically but also equipped with the tools necessary to thrive in a new educational setting.

As illustrated in Figure 1, the study's paradigm represents a systematic approach to evaluating college mathematics readiness among SHS students in the Philippines. By investigating the four aspects of college readiness as they relate to CMRT 1 and CMRT 2, this study sought a comprehensive understanding of how various factors contribute to students' preparedness. The analysis aims to

highlight strengths and weaknesses, providing actionable insights for curriculum and instructional strategies.

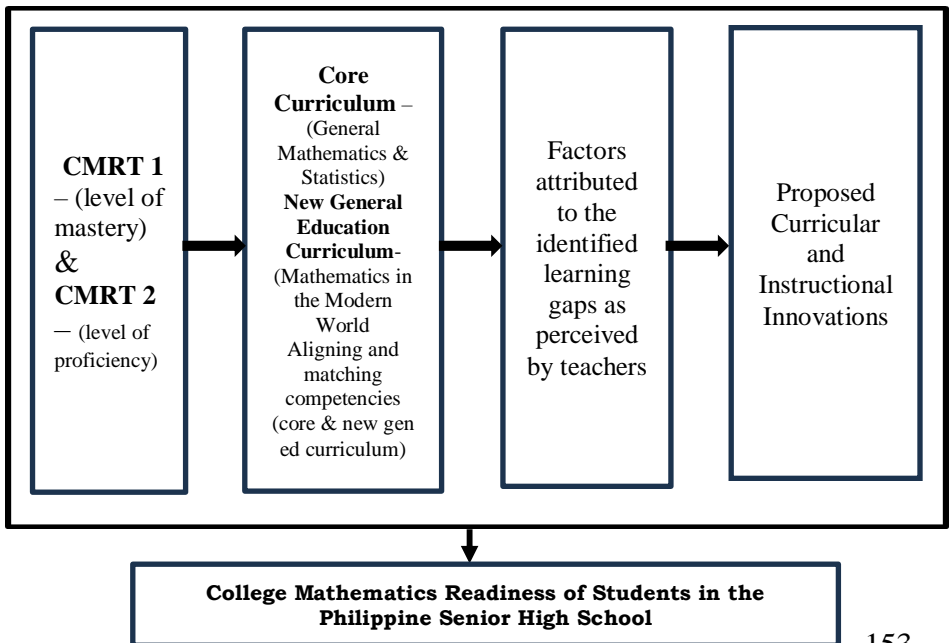
Following Conley’s framework, learning gaps were identified using the average normalized gain formula while engaging teachers for qualitative feedback regarding students’ study habits and perceptions of mathematics. The learning gaps and the contributing factors that have been identified and analyzed were used as a basis for proposing targeted curricular and instructional innovations. The interventions are designed to better equip students for the challenges of the new general education curriculum, thereby enhancing their overall readiness for college.

The paradigmatic framework established in this study not only adheres to Conley’s four aspects of college readiness but also offers a detailed roadmap for evaluating and improving SHS students’ preparedness for higher education. Through a thorough examination of cognitive strategies, content knowledge, academic behaviors, and contextual skills, the study aimed to facilitate a more robust, holistic approach to enhancing college readiness.

METHODOLOGY

Figure 1

College Mathematics Readiness of Students in the Philippine Senior High School



METHODOLOGY

This study employed a mixed-method design that combines both quantitative and qualitative research to comprehensively evaluate the mathematical and analytical readiness of Grade 12 students, who are transitioning to first-year college, across the Philippines during the academic year 2022-2023. The use of mixed-method design provided directions for gathering and analyzing data from multiple sources in a single study (Creswell, 2018).

Quantitative Method

The first phase of the study utilized the quantitative method focusing on the respondents' readiness for the core curriculum and new general education curriculum in mathematics. To compare students' readiness based on academic strands, quantitative data was collected, which included basic frequency tabulations and mean differences.

Locale of the Study

The study covered selected schools of SHS programs in the Philippines. The three major island groupings namely Luzon, Visayas, and Mindanao were chosen as the locale of the study. Geographically and statistically, these major regions represent the ethnically diverse people of the country. The study covered 39 schools across 9 regions. The regional distribution of the schools was as follows. These are the regions where the researcher has received approval to conduct the study.

Regions	Number of Schools
1	5
2	3
3	3
4	3
6	1
7	2
9	1
10	1
NCR	20

Respondents of the Study

The respondents included 758 students coming from 39 SHS from Luzon, Visayas, and Mindanao from 20 private schools and 19 public schools recognized by the Department of Education offering at least four strands. The table below shows the distribution of SHS respondents based on their type of school and academic strand.

Table 1

Distribution of SHS Respondents According to Type of School and Academic Strand

Type of School		Strand				Total
		ABM	GAS	HUMSS	STEM	
Private	Luzon	146	24	56	217	443
	%	32.30	5.30	12.40	48.00	98.00
	Visayas	1	1	1	5	8
	%	0.20	0.20	0.20	1.10	1.80
	Mindanao	0	0	0	1	1
	%	0.00	0.00	0.00	0.20	0.20
Total		147	25	57	223	452
		32.50	5.50	12.60	49.30	100.00
Public	Luzon	15	93	101	53	262
	%	4.90	30.40	33.00	17.30	85.60
	Visayas	0	8	2	3	13
	%	0.00	2.60	0.70	1.00	4.20
	Mindanao	0	0	1	30	31
	%	0.00	0.00	0.30	9.80	10.10
Total		15	101	104	86	306
		4.90	33.00	34.00	28.10	100.00
GRAND TOTAL		162	126	161	309	758
	f					
	%	21.37	16.62	21.24	40.77	100.00

The G-Power analysis was used to determine at least 748-sample size with a medium effect size of 0.30 based on 95% confidence level (alpha = 0.05, one tailed).

Instrumentation

The CMRT is the primary instrument developed for this study to assess the mathematical readiness of SHS students. It was designed by the researcher and validated using the Winstep Rasch Analysis Model 5.2.3. The CMRT comprises three main sections: (a) respondent profile, (b) CMRT 1, and (c) CMRT 2. The profile section gathers demographic and academic information such as region, province, academic strand (ABM, GAS, HUMSS, STEM), school type (private or public), and school name.

CMRT 1 evaluates competencies from the core curriculum, specifically General Mathematics and Statistics, through questions 1 to 25. CMRT 2 assesses competencies from the new general education curriculum, particularly the Mathematics in the Modern World course, using questions 26 to 50. Together, these two parts measure students' masteries of essential mathematical concepts across both curricula.

The test developed process involved aligning the Most Essential Learning Competencies (MELC's) from both curricula. Only matched topics were included. Four key competencies were identified: (1) Functions/Language, which explores mathematical relationships and function analysis; (2) Logic and Symbols, which focuses on mathematical language and symbolic reasoning; (3) Problem Solving, which cultivates critical thinking and strategic approaches to real-world problems; and (4) Statistics, covering data analysis, variability, distributions, and hypothesis testing.

A specification table was used as guide in the test construction. It incorporated Bloom's Revised Taxonomy (2001) to align items with cognitive and knowledge levels. Initially, the test had 60 multiple-choice items, but 10 were removed based on feedback from four mathematics experts (two college professors and two SHS teachers). These experts rated item relevance on a scale of 1 to 4. This resulted in a strong content validity index (S-CVI) of 0.90.

The finalized 50-item CMRT was pilot-tested with 244 Grade 12 students from the National Capital Region (NCR) during the 2021-2022 school year. Winstep Rasch Analysis Model 5.2.3 confirmed the test's reliability and validity. The result showed a unidimensionality coefficient of 1.00 and acceptable Infit and Outfit

Mean Square (MNSQ) values (0.5-1.50). Also, CMRT1 and CMRT 2 showed a high correlation ($r = 0.701$, $p < 0.01$) which demonstrates inconvergent validity. Each item effectively discriminates between students with high and low mathematical proficiency, with matched question groups (e.g., Q1-Q55 with Q26-Q30). This validates the test's structural integrity.

Data Collection and Approval Process

The researcher obtained approval from the Graduate School Committee of the University of Luzon prior to data collection. A formal letter requesting permission to conduct the study was addressed to the School Division Superintendent (SDS), university and school presidents, principals, and SHS coordinators of the participating institutions. The researcher emailed this request to 23 School Division Offices of the Department of Education in the Philippines. Out of these, 13 offices responded, but only 6 granted permissions to proceed with the study in their regions.

After receiving the approval, the researcher coordinated with the principals, SHS coordinators, and grade 12 advisors to provide the Google Form Link and schedule the online administration of the CMRT for the grade 12 academic track students. The researcher monitored and collected the respondents' responses through google drive.

Data Analysis

For specific problem no. 1, the study assessed college math readiness by analyzing SHS students' CMRT scores using descriptive statistics. Following DepEd's K to 12 grading system (order No. 31, s. 2012), mean scores were converted to percentage grades via excel to evaluate mastery and proficiency based on core and general education competencies.

For specific problem no. 2, one way ANOVA was used to examine the differentials in measuring the college mathematics readiness among academic strands. The Tukey Post Hoc Test was employed to determine which among the academic strands significantly differed in the respondents' college mathematics readiness.

For specific problem no. 3, average normalized gain was used to identify the learning gaps that exists between CMRT 1 and CMRT 2. Moreover, the mean percentage of the correct answers (MPCA) was considered to identify the least and most mastered topics in the identified learning competencies.

Qualitative Method

In addition to the quantitative methods, a qualitative approach was adopted using thematic analysis. This analysis was introduced by Clarke and Barun (2006) who developed this technique as a method for analyzing qualitative data and exploring patterning and meaning within the data.

Respondents of the Study

The study included ten (10) mathematics teachers from private schools in the NCR. Among them, seven (7) have master's degree and three (3) have bachelor's degrees in mathematics. These educators provided qualitative insights into the factors contributing to the identified learning gaps among SHS students in mathematics.

Data Collection

Statement of the problem no. 4 was the sole item designed for qualitative analysis. It explored teachers' perceptions of the challenges faced by students. This adds added context and depth to the quantitative findings. The researcher communicated with the participants through messaging platforms and video calls to gather their insights.

Ethical Considerations

The research proposal was reviewed and granted ethical clearance by the UE Ethical Research Committee on August 9, 2022. This study adhered to stringent data privacy protocols. Personal information collected through the questionnaire was exclusively used for survey administration and not for any other purposes. All data gathered was treated with the utmost confidentiality to ensure that neither the names of schools nor individual learners were identifiable in the final report.

Data was securely stored on Google drive which is accessible solely to the researcher. This information will be deleted two years

after the study's completion. Additionally, participants and the respective schools were informed about the study's objectives to maintain transparency.

Participation in the study was entirely voluntary. The respondents were informed that they can withdraw at any time without facing any prejudice. All participants were empowered to make fully informed decisions, and their dignity was respected throughout the process.

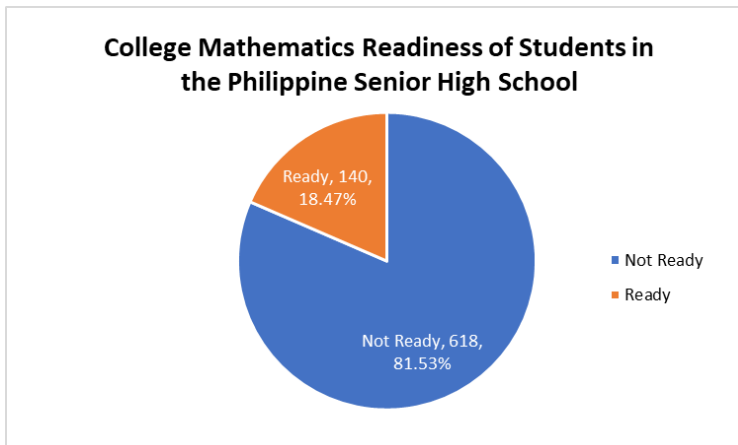
Informed consent forms were integrated into the initial section of the CMRT questionnaires. Upon agreeing to participate, respondents proceeded to the second section, which collected demographic information, followed by the third section, which comprised the CMRT questionnaire.

RESULTS AND DISCUSSION

Figure 2 illustrates the alarming results of the CMRT among SHS students in the Philippines.

Figure 2

Graph Showing the percentage of the College Mathematics Readiness of SHS students in the Philippines



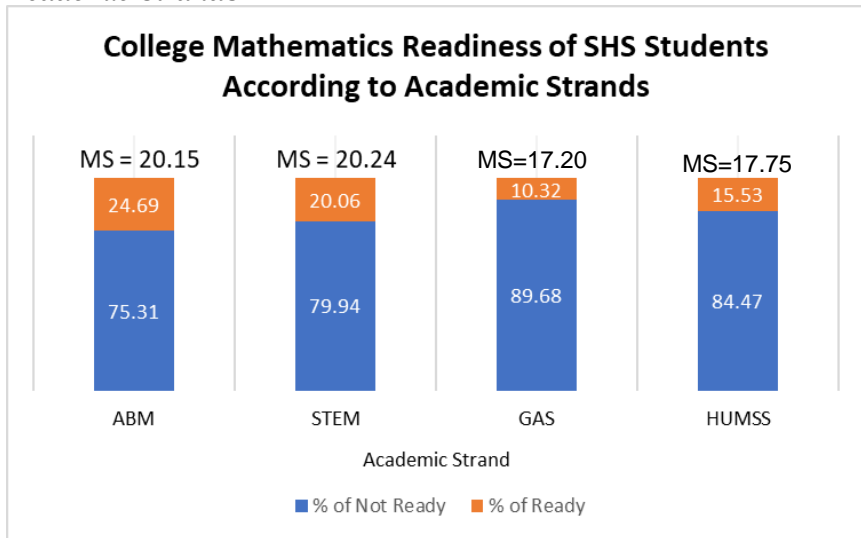
Out of 758 students assessed, only 140 (18.47%) demonstrated readiness for college-level mathematics, while a significant majority, 618 (81.53%), were found to be not ready. The overall mean score (MS) of 19.18 is notably below the passing mark of 25. This result demonstrates serious concerns regarding the mathematical preparedness of these students as they transition to higher education.

This finding is consistent with previous reports from the Department of Education (DepEd). The 2018 and 2022 PISA assessments highlighted the Philippines' position near the bottom of the global rankings in mathematics, placing 78th out of 79 countries in 2018 and 77th out of 81 in 2022 (DepEd, 2019). Such statistics shows a broader issue related to the quality of basic education in the country. Wenceslao (2020) asserted the concerning issue on mathematical performance among Filipino learners. Additionally, Amanonce (2020) noted that a lack of readiness for college-level mathematics is a persistent issue affecting many graduates in the United States. This often resulted in a high percentage of students requiring remedial or developmental courses.

Further analysis, as shown in Figure 3, reveals that college mathematics readiness varied significantly across academic strands. Within the Accountancy, Business, and Management (ABM) strand, only 40 students (24.69%) were considered ready; in the Science, Technology, Engineering, and Mathematics (STEM) strand, the figure was 62 (20.06%); the General Academic Strand (GAS) showed only 13 students (10.32%) ready; and the Humanities and Social Sciences (HUMSS) strand accounted for 25 students (15.53%) ready. Corresponding mean scores for each academic strand also fell below the passing threshold of 25 out of 50 items as shown by the following: ABM: 20.15, STEM: 20.24, GAS: 17.20, HUMSS:17.75.

Figure 3

Graph showing the percentage of the College Mathematics Readiness of SHS respondents in the Philippines according to Academic Strands



These results further illustrate a widespread struggle among SHS students, irrespective of their academic tracks, to exhibit the necessary readiness for college-level mathematics. The data clearly indicates that targeted interventions are urgently needed to address these deficiencies. This will ensure that students are adequately prepared for the academic challenges they will encounter in higher education. These findings shed light on the critical state of mathematical readiness among SHS students in the Philippines. A multidisciplinary approach involving curriculum reforms, teacher training, and student support initiatives will be essential to bridge the identified gaps and improve overall educational outcomes.

Table 2*Level of Readiness with Respect to Academic Strands and MELC's*

MELC'S/STRAND	ABM	STEM	GAS	HUMSS	OVERALL
Functions/Languages	Beginning Level 72.22	Beginning Level 74.27	Beginning Level 67.06	Beginning Level 67.45	Beginning Level 71.16
Logic/Symbols	Beginning Level 67.10	Beginning Level 66.60	Beginning Level 65.56	Beginning Level 66.45	Beginning Level 66.48
Problem Solving	Developing Level 75.31	Developing Level 75.61	Beginning Level 68.59	Beginning Level 70.85	Beginning Level 73.34
Statistics	Beginning Level 71.06	Beginning Level 69.96	Beginning Level 66.91	Beginning Level 68.16	Beginning Level 69.29

Table 2 presents the college mathematics readiness of SHS students, categorized by academic strands and aligned with the MELC's from both the core and new general education curriculum. The findings reveal notable insights into the readiness levels across various competencies. The data provides a comprehensive overview of students' preparedness for higher education in mathematics.

Across all academic strands (ABM, STEM, GAS, and HUMSS), students exhibited a Beginning Level of readiness for competencies related to Functions/Languages, Logic/Symbols, and Statistics. The uniformity indicates that students from all strands are starting at similar foundational levels in these critical areas, with overall readiness scores reflecting the following average percentages: Functions/Languages: 71.16, Logic/Symbols: 66.46, Statistics: 69.29.

The Beginning Level signifies that while students possess some awareness of these mathematical concepts, they require substantial further development to achieve proficiency. In contrast, the competency area of Problem Solving revealed a distinct divergence in readiness levels among the strands. Both the ABM and STEM strands demonstrated a Developing Level of competence, with average scores of 75.31 and 75.61, respectively. This indicates a greater degree of preparedness and ability to engage with problem-solving tasks compared to their counterparts. Conversely, the GAS

and HUMSS strands remained at the Beginning Level with scores of 68.59 and 70.85 respectively. This demonstrates a significant gap in problem-solving readiness for these academic paths.

The variation in readiness for the Problem-Solving competency suggests that students enrolled in the ABM and STEM tracks may have had more exposure to practical and analytical applications of mathematics. This will enhance their problem-solving skills. In contrast, the GAS and HUMSS students may benefit from targeted interventions focused on developing these critical competencies.

Table 2 revealed the pressing need for tailored instructional strategies that address the varying levels of readiness across academic strands. By understanding these differences, educators and policymakers can better support SHS students in bridging the identified gaps, particularly in foundational competencies. This would ensure a smoother transition into college-level mathematics.

Level of Mastery on the Prescribed Learning Competencies in the Core Curriculum

Table 3 illustrates that the majority of SHS students currently possess only a foundational level of mastery in the core curriculum as assessed by CMRT 1. The data calls for a strategic approach to curriculum design and instructional methods that can better equip these students.

The results indicate that a significant majority of students, comprising 545 out of 758 (71.90%), are categorized at the Beginning Level of mastery. This finding suggests that these students lack the foundational understanding and skills necessary to meet the entry-level requirements for college mathematics. In contrast, only a small proportion have attained higher mastery levels: 38 students (5.01%) achieved the Advanced Level, and 23 students (3.43%) reached the Proficiency Level. Moreover, 71 students (approximately 9.37%) are at the Approaching Proficiency Level, while 78 students (10.29%) are classified at the Developing Level.

Table 3

Level of Mastery of the SHS Students Based on the Prescribed Learning Competencies of the Core Curriculum

MPG	Frequency	Percentage %	Level of Mastery
74.99% -Below	545	71.90%	Beginning Level
75.00%-79.99%	78	10.29%	Developing Level
80.00%-84.99%	71	9.37%	Approaching Proficiency Level
85.00%-89.99%	26	3.43%	Proficient Level
90.00%-100.00%	38	5.01%	Advanced Level

Note: N = 758, Mean Score = 10.13 & Mean Percentage Grade = 70.26%

The data shows an uneven distribution across these levels. Most students occupy the Beginning Level, with an overall mean percentage grade (MPG) of 70.26%. This score reflects a foundational understanding of the competencies being evaluated but indicates that many students have yet to develop the higher order knowledge and skills necessary for advanced mathematics.

According to Suri (2023), strong mathematical skills and higher levels of mastery are closely correlated with improved problem-solving abilities, critical thinking, and logical reasoning which are essential competencies for success across various academic disciplines. Therefore, the findings from Table 2 exhibited an urgent need for targeted educational interventions to elevate students from the Beginning Level to higher mastery levels.

By focusing on the specific areas where students struggle, educators can implement tailored instructional strategies that foster deeper understanding and skill development in mathematics. Some of the key strategies include differentiated instruction to accommodate the diverse learning needs of students and to recognize that students have varied backgrounds, learning paces and preferences, scaffolding to break down complex information into smaller manageable parts and flip classroom. This flip classroom reverses the traditional learning environment.

Level of Proficiency on the Prescribed Learning Competencies in the New General Education Curriculum in Mathematics

The proficiency levels assessed by CMRT 2 reveals a critical need for targeted interventions and curriculum enhancements

within the new general education curriculum. By addressing the learning gaps highlighted in Table 4, educators can develop more effective instructional methods that support SHS students in achieving higher levels of proficiency.

Table 4

Level of Proficiency of the SHS Students Based on the Prescribed Learning Competencies of the New General Education Curriculum

MPG	Frequency	Percentage %	Level of Proficiency
74.99% -Below	643	84.83%	Beginning Level
75.00%- 79.99%	40	5.28%	Developing Level
80.00%- 84.99%	29	3.83%	Approaching Proficiency Level
85.00%- 89.99%	15	1.98%	Proficient Level
90.00%- 100.00%	31	4.09%	Advanced Level

Note: N = 758, Mean Score = 9.05 & Mean Percentage Grade = 68.11%

The data indicates that a substantial majority of the SHS students which is 84.83% (643 students) are classified at the Beginning Level of proficiency, corresponding to scores below 75%. This alarming trend suggests that most students lack the foundational knowledge and skills required for the entry-level demands of higher mathematics education. In contrast, only 5.28% (40 students) achieved a Developing Level of proficiency, while 3.83% (29 students) reached the Approaching Proficiency Level. Moreover, the number of students attaining advanced mastery is negligible, with only 4.09% (31 students) at the Advanced Level and 1.98% (15 students) at the Proficient Level.

The findings revealed a significant concern which is that the dominance of the Beginning Level reflects considerable gaps in students' mathematical abilities and suggests that many are not prepared for the rigors of college-level coursework. The high number of students at this introductory level calls for immediate and focused instructional strategies to address these identified gaps in understanding and skills.

With a Mean Score (MS) of 9.05 and an overall MPG of 68.11%, in reference to DepEd Order No. 31, s. 2012, these results indicate that while some foundational concepts have been grasped, the general level of mathematical readiness among SHS students remains insufficient. In essence, the MPG < 75% signifies that students are the entry level of comprehension regarding the competencies outlined in the new curriculum. This shows that they lack the required depth of knowledge and application skills necessary for more advanced studies.

Differentials in the College Mathematics Readiness of the SHS Students Across Academic Strand

Table 5 presents the result of a One-Way ANOVA analysis, which reveals a significant difference in college mathematics readiness among SHS students across different academic strands as shown by an F-ratio of 6.301 ($p < 0.01$). This statistical significance suggests that the academic strand a student is enrolled in influences their level of readiness for college mathematics. It supports the importance of curricular focus and instructional resources tailored to specific strands.

Table 5
One-Way ANOVA Result of College Mathematics Readiness Across Academic Strands

Parameters	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1324.821	3	441.607	6.301	.000
Within Groups	52841.321	754	70.081		
Total	54166.142	757			

The post hoc analysis further elucidates these differences. The result clearly demonstrates that SHS students in the ABM and STEM strands show markedly higher levels of mathematics readiness compared to their peers in the GAS and HUMSS strands. The MS (.091) of ABM students and STEM students show no significant difference ($p > 0.05$). This shows that both groups are equally prepared for college mathematics.

Table 6

Post Hoc Test Result of College Mathematics Readiness Across Academic Strands

Academic Strand		Mean Difference	Sig.
ABM	STEM	-.091	.999
	GAS	2.950*	.016
	HUMSS	2.403*	.049
STEM	ABM	.091	.999
	GAS	3.041*	.003
	HUMSS	2.494*	.012
GAS	HUMSS	-.547	.947

However, the ABM students' mean score significantly differs from that of HUMSS students ($MS = 2.403$, $p < 0.05$) and GAS students ($MS = 2.950$, $p < 0.05$). This disparity suggests that students in the ABM strand have developed a stronger foundation in mathematics. This may be likely attributed to the curriculum's emphasis on quantitative skills necessary for business-related applications.

Similarly, STEM students also exhibit significant differences in math readiness when compared to HUMSS ($MS = 2.494$, $p < 0.05$) and GAS students ($MS = 3.041$, $p < 0.05$). This finding aligns with the expectation that STEM education inherently involves a greater focus on mathematics. This suggests that students are equipped with the analytical skills required for success in college-level math courses.

Conversely, there is no significant difference between the mean scores of HUMSS students and GAS students ($MS = 0.547$, $p > 0.05$). This result suggests that both strands have comparable levels of college mathematics readiness. This could imply that the curricular approaches in these two areas may not provide a robust foundation in mathematics. This further implies that students are less prepared for the quantitative demands of higher education. The lack of a significant difference between the HUMSS and GAS strands suggests that both are performing at an entry-level. Moreover, this result further indicates that neither is adequately prepared for college mathematics. This is a problem that needs to be addressed because if left unaddressed, it could lead to a domino effect of unpreparedness in further academic pursuits.

Table 7 provides the results of the Tukey Homogenous Subset Test. It further validates the findings of the One-Way ANOVA regarding the college mathematics readiness of SHS students across academic strands. The analysis indicates that the ABM and STEM strands form a homogenous group which suggests comparable levels of readiness. In contrast, the GAS and HUMSS strands are also classified as homogenous. This shows that they share lower readiness levels in college mathematics.

Table 7

Homogenous Subset Test Result of College Mathematics Readiness Across Academic Strands

Tukey HSD ^{a, b}			
Subset for alpha = 0.05			
Strand	N	1	2
GAS	126	67.20	
HUMSS	161	67.75	
ABM	162		70.15
STEM	309		70.24
Sig.		.931	1.000

The curricular structures of these academic strands contribute to these findings. Both STEM and ABM incorporate specialized mathematics subjects tailored to enhance mathematical understanding and skills. For instance, STEM students engage with subjects like Pre-Calculus and Calculus, while ABM students focus on Business Mathematics and Finance. In contrast, HUMSS and GAS do not include equivalent mathematics-focused subjects which may contribute to their lower proficiency levels.

The principles outlined in the Thorndike Law of Exercise (1932) emphasizes the value of regular practice in mastering subject material. As students in STEM and ABM consistently engage with mathematics, they reinforce their skills that would improve their readiness for college level mathematics. Research by Zelkowski (2011) supports this notion which claims that students with continuous exposure to mathematics courses are more likely to be college ready.

Carroll’s Readiness Theory (1993) further illuminates these findings. It suggests that an individual’s prior knowledge and skills significantly influence their capability to acquire new academic competencies. The data illustrates that HUMSS and GAS students may benefit from supplemental bridging courses in mathematics to enhance their readiness for higher-level mathematics curriculum.

While the STEM and ABM strands exhibit a heightened state of readiness, it is noteworthy that all academic strands perform below the expected proficiency levels of 50% as outlined in the DepEd Order No. 31, s. 2012. This emphasizes a critical need for differentiated learning competencies for those in the HUMSS and GAS strands. It aimed at improving overall mathematics readiness among SHS students.

Learning Gap Analysis that are Identified Relative to the Level of Mastery of SHS Students in the Core Curriculum and the Level of Proficiency in the New General Education Curriculum in Mathematics

The data presented in Table 8 delineates a clear need for reevaluation of the instructional methods and curriculum strategies employed between CMRT 1 and CMRT 2. By addressing these identified gaps, educators can develop more effective teaching approaches aimed at improving students’ mathematical readiness. This will promote greater success in the new general education curriculum.

Table 8
Learning Gap Analysis as Identified using the Average Normalized Gain

Learning Competency	CMRT 1 MS	CMRT 2 MS	Max Possible Score	Max Possible Gain	Actual Gain	Average Normalized Gain (G)	Interpretation
Functions/Languages	2.12	1.70	5	2.88	-0.42	-0.14	Loss
Logic/Symbols	1.65	1.84	5	3.35	0.19	0.06	low gain
Problem Solving	3.27	2.53	7	3.73	-0.75	-0.20	Loss
Statistics	2.99	3.09	8	5.01	0.10	0.02	low gain
As a whole	10.13	9.05	25	14.87	-1.08	-0.07	Loss

Source: Average Normalized Gain by Hake, R (1998) American Journal of Physics

Table 8 provides a comprehensive analysis of the learning gaps among SHS students, as measured by their performance on the CMRT 1 and CMRT 2. The descriptive statistics indicate a marked decline in students' mastery from CMRT 1 to CMRT 2, with a mean score (MS) of 10.13 on CMRT 1 significantly higher than the MS of 9.05 on CMRT 2. This difference of 1.08 is statistically significant (t -value = 8.27, $p < .05$). These findings demonstrate a concerning trend in student performance and highlighting the necessity for further investigation into specific content areas where students face challenges.

To quantify this decline, the researcher employed the average normalized gain (G), a metric developed by Hake (1998) that measures the effectiveness of instructional approaches by assessing the actual gain relative to the maximum possible gain. The findings reflect a negative average normalized gain of -0.07 across all competencies. This signifies a notable decline in student performance from CMRT 1 to CMRT 2. This consistent negative gain illuminates a learning gap which suggests that students are struggling to retain and build upon the mathematical concepts learned in the initial assessment.

Delving deeper into specific competencies, the analysis reveals significant challenges in the areas of Functions/Languages and Problem Solving, both of which registered negative G-values of -0.14 and -0.20 respectively. These figures exhibit critical content areas where students are experiencing significant learning gaps. It emphasizes the urgent need for targeted interventions in these domains. Conversely, the G-values for Logic/Symbols (0.05) and Statistics (0.02) indicate minimal gains which also suggests that while some learning is occurring, it is insufficient to denote substantial progress toward mastery.

The implications of these findings are profound. The limitations in student performance in Functions/Languages and Problem-Solving highlight specific areas for instructional focus. As these competencies are foundational to mathematical understanding and application, addressing the associated learning gaps is essential for preparing students for the rigors of the new general education curriculum. The minimal gain in Logic/Symbols and Statistics also suggest that students are not making adequate progress in these critical areas. This calls for a necessary

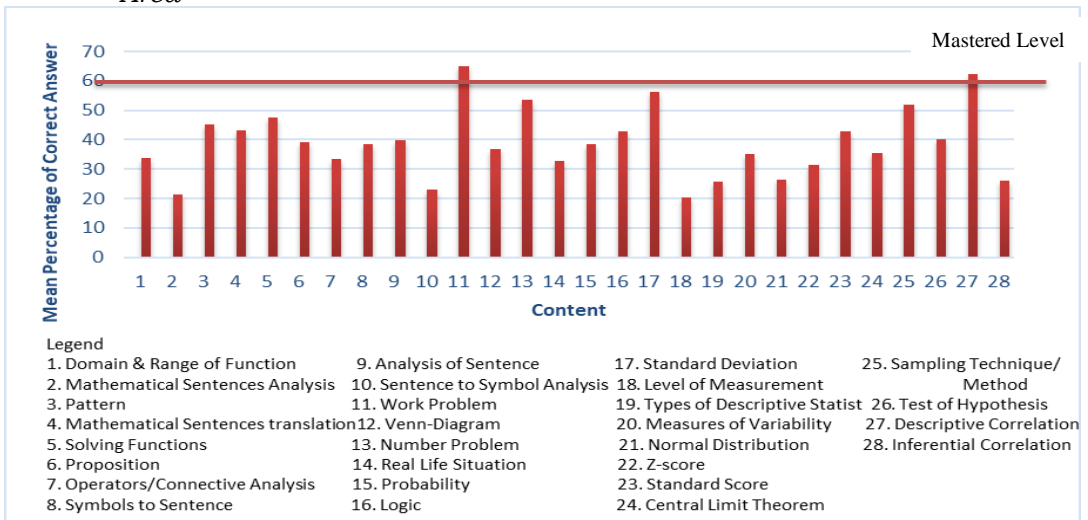
instructional strategy that promotes deeper understanding and retention.

Moreover, as noted by Suri (2023), strong mathematical skills are directly correlated with enhanced problem-solving abilities, critical thinking, and logical reasoning. These are essential for success across various academic disciplines. Therefore, timely and effective interventions aimed at closing these learning gaps will not only fortify students' mathematical competencies but also enhance their overall academic readiness.

Figure 4 presents a detailed analysis of the mean percentage of correct answers (MPCA) across various content areas aligned with the four learning competencies outlined in the core curriculum and the new general education curriculum. The content areas encompass Functions/Languages (items 1-5), Logic/Symbols (items 6-10), Problem Solving (items 11-16), and Statistics (items 17-28). This analysis provides critical insights into SHS students' performance on the CMRT 1 and CMRT 2 and highlights areas of strength and weaknesses.

To classify mastery levels, the study employed the parameters recommended by Gabuyo (2012), indicating that a topic was considered least mastered if fewer than 60% of students answered correctly and most mastered if 60% or more were correct. The results clearly show that most students struggle significantly in various content areas.

Figure 4
Mean Percentage of Correct Answers (MPCA) for Each Tested Content Area



In the Functions/Languages domain, several topics were least mastered, particularly Mathematical Sentences Analysis (21.24%) and Domain/Range of Functions (33.84%). Notably, the overall performance across this domain reflects a concerning lack of foundational knowledge. Similarly, in the Logic/Symbols area, critical topics such as Symbols to Sentence Analysis (38.59%) and Sentence to Symbols Analysis (23.22%) reveal considerable gaps in understanding key concepts. This would potentially impede students' ability to engage with more complex mathematical reasoning.

The Problem-Solving content area demonstrated that only the Work Problem topic achieved mastery (64.91%), while other topics, like Real Life Situations (32.72%) and Venn-Diagram (36.74%), were notably less understood. This inconsistency indicates that while students may grasp specific problem-solving applications, a significant portion of the skill set remains underdeveloped.

The Statistics content area highlighted even more alarming deficits. Among the most challenging topics, Inferential Correlation (25.99%) and Level of Measurement (20.32%) revealed the students' difficulties in grasping fundamental statistical concepts essential for higher-level analysis. The high percentage of students failing to master these topics illustrates a critical gap in statistical literacy. These are considered increasingly important in various academic and professional fields.

The findings reflect the principles outlined by Biggs (1996), proposing that unmet expectations signal potential misalignment within the curriculum. The misalignment can hinder effective learning and retention that prompts a need for educators to reassess instructional methods and curricular design.

Addressing these gaps should be a priority. Students must acquire foundational skills in math competencies to succeed in college-level mathematics. Waite (2023) stresses that these competencies encompass foundational skills, problem-solving abilities, and mathematical reasoning. Without targeted interventions focused on these identified weak areas, students risk moving forward in their education without the necessary skills, and this will contribute to widening the achievement gap that will be increasingly difficult to close.

Factors Attributed to the Identified Learning Gaps as Perceived by Mathematics Teachers

The identified learning gaps in mathematics among SHS students can be attributed to a variety of interrelated factors, as expressed by mathematics teachers. These factors encompass curriculum design, teacher qualifications, student attitudes, and institutional support.

1. Curriculum Design and Content

A well-structured curriculum is essential for equipping students with fundamental knowledge and developing critical thinking skills. However, several challenges arise within the existing framework. Teacher 1 highlighted a significant one-year learning gap, explaining that mathematics is only offered in Grade 11, with a lack of specialized subjects in Grade 12, particularly for students in the HUMSS and GAS. Teacher 2 further noted that students tend to forget concepts if not practiced regularly. This highlighted the need for consistent reinforcement of mathematical skills.

Further complicating matters, Teacher 3 raised concerns regarding the overwhelming number of lessons and competencies. She suggested that not all mandated topics can be thoroughly covered due to various disruptions such as class routines and holidays. The results in a superficial understanding of critical sections of the curriculum, including Logic and Correlation. Additionally, Teachers 4, 5, and 6 expressed concern over irrelevant topics like relation and logarithmic functions. They claimed that these topics may not align with the needs of HUMSS and GAS learners and further noted of a curriculum misalignment.

2. Teacher-Related Factors

The effectiveness of mathematics instruction is significantly influenced by teacher-related factors. Teachers 7 and 8 noted the pressure teachers face to prioritize quantity over quality in covering competencies required for exams which resulted in rushed instruction.

Teacher 9 highlighted the importance of teacher qualifications and stated that well-trained educators promote better comprehension of mathematical concepts and conversely, neglect critical details. Furthermore, Teacher 2 emphasized that teachers who lack confidence, particularly those not specialized in mathematics, can negatively affect student retention information. This emphasizes the need for comprehensive teacher training and support systems.

3. Student-Related Factors

Students' attitude and beliefs significantly impact learning. Teacher 6 identified negative attitudes, such as math phobia and intimidation, which can stifle interest and mastery. Similarly, Teacher 3 and 6 observed a fixed mindset among some students. This leads to disengagement and a lack of effort in improving their mathematical abilities.

Moreover, Teachers 7 and 10 noted that students increasingly focus on distractions like video games. This kept them away from the study time needed to practice fundamental skills such as solving fractions and word problems.

4. School-Related Factors

School-based factors also play a crucial role in learning outcomes. Teacher 1 argued that large class sizes hinder individualized attention. This ultimately affected student learning. Additionally, Teacher 4 advocated for implementing specialized tutoring and enrichment programs to support struggling students.

Lastly, Teacher 5 emphasized that limited access to technology has been exacerbated by the COVID-19 pandemic as these presented challenges in participating in virtual lessons and accessing digital resources.

Addressing the factors contributing to learning gaps in mathematics among SHS students necessitates a collaborative approach involving schools, teachers, parents, and students. By tackling curriculum relevance, enhancing teacher training,

facilitating positive student attitudes, and improving institutional support, educators can better prepare SHS students in the Philippines for the demands of college-level mathematics within the new general education curriculum.

Proposed Curricular and Instructional Innovations to Enhance College Readiness of the SHS Students

Below are proposed curricular innovations and Instructional strategies designed to improve SHS readiness for the academic demands of college coursework.

Area 1: Curricular Innovations

- 1. Alignment of Mathematics Core Curriculum with the New General Education Curriculum.** According to Biggs (1996), misalignment between instruction and assessment can hinder student success. Strengthening the focus on foundational mathematical concepts, alongside real-world applications and problem-solving exercises, will enhance students' ability to apply mathematical reasoning effectively.
- 2. Review and Streamlining of Core Curriculum Content.** It is essential to review the core curriculum for redundancies, particularly in topics repeated from the Junior High School Curriculum such as Functions and basic statistical concepts. By omitting or briefly addressing these topics, educators can allocate more time to less covered areas like logic and inferential statistics. This adjustment will better prepare SHS students for new topics in the general education curriculum.
- 3. Integration of Enrichment Mathematics.** Since mathematics is only offered in Grade 11, incorporating enrichment-level mathematics subjects in Grade 12 could be beneficial. This aligns with Thorndike's Law of Exercise (1932), which advocates for continuous practice to prevent forgetting. Increased engagement with mathematics can solidify students' understanding and retention of key concepts.
- 4. Standardized Learning Competencies for all Academic Strands.** To ensure that all students are adequately prepared for the challenges posed by college-

level mathematics, it is essential to establish standardized learning competencies across all academic strands, including STEM, ABM, HUMSS, and GAS. Given that the new general education curriculum in mathematics is a requirement for all tertiary students, aligning the competencies across different strands will create a more cohesive learning experience.

- 5. Additional Math Subjects for HUMSS and GAS.** To further support students in HUMSS and GAS, it is crucial to introduce additional mathematics subjects tailored to their specific needs. These subjects should focus on practical applications of mathematical concepts, which are directly relevant to real-world scenarios. By doing so, we can equip these students with essential skills that not only prepare them for college but also enable them to navigate everyday challenges that require mathematical reasoning.
- 6. Continuous Improvement of the Curriculum.** Recognizing that no curriculum is perfect, it is vital to continuously refine and improve it as flaws are identified. This ongoing process will help advance student success in college and beyond.

Area 2: Instructional Strategies

Innovative Teaching Strategies. To boost student engagement and enhance understanding of mathematical concepts, innovative teaching strategies are essential. Techniques such as problem-based learning, collaborative learning, flipped classrooms, and the integration of technology (e.g., educational apps and online resources) promotes active learning, critical thinking, and problem-solving skills (Amanonce, 2020).

The flipped classroom model represents a shift from traditional lecture-based teaching to a more student-centered approach. As noted by Mohamad (2016), this method enables students to engage with instructional materials-often via videos or recordings- outside of class. Furthermore, it allows class time to focus on interactive application-based learning activities.

Effectiveness of the Flipped Classroom

Research indicates that the flipped classroom can significantly improve student achievement. For example, Nwosis et al., (2016) found that implementing the flipped approach for even 30% of a course's content greatly benefited students and instructors. This strategy has shown to lead to better learning outcomes. Flipped classrooms are also encourage students to take control of their learning. It helps students engage with material at their own pace and allowing for more effective class interactions (Nouri, 2016).

Proposed Steps for Implementing the Flipped Classroom Approach

1. **Awareness and Support.** It is crucial to foster an understanding of the flipped classroom model among all stakeholders involving students, parents, teachers, and school administration to ensure a successful transition.
2. **Resource Preparation.** Effective implementation requires careful planning of teaching materials and resources:
 - Lecture Materials-** Instructors can create engaging videos, utilize PowerPoint presentations with voiceovers, or source ready-made content from educational platforms like You Tube and blogs.
 - Devices** – Encourage the use of accessible technology (laptops, tablets, smartphones) that students are comfortable with.
3. **Classroom Management.** In a flipped classroom, class time is dedicated to active learning. Students should prepare for class by engaging with materials beforehand. At the beginning of class, they can complete assignments or quizzes to ensure understanding and readiness. Class time will then be focused on applying, practicing, and analyzing concepts collaboratively, with instructor support.

Implementing the flipped classroom model can significantly enhance the college readiness of SHS students, equipping them for success in college-level mathematics.

CONCLUSIONS

1. The findings indicate that the majority of SHS students participating in the study are not ready for college-level mathematics. Their mastery and proficiency are at the Beginning Level. This suggests that they possess only minimal knowledge and skills as outlined in the core and new general education curriculum.

2. Students across various academic strands (ABM, STEM, GAS, and HUMSS) are performing below the expected proficiency threshold of 50%. While ABM and STEM students show similar levels of readiness, GAS and HUMSS students also align at a comparable level. This shows a significant disparity, as ABM and STEM students are better prepared for college mathematics compared to their HUMSS and GAS counterparts. This further indicates a pressing need for differentiated learning competencies to enhance mathematics readiness, particularly for HUMSS and GAS students.

3. There exists a significant learning gap between the core curriculum (as measured by MS in CMRT 1) and the new general education curriculum (assessed through MS in CMRT 2), demonstrated by the Average Normalized Gain results. Thus, SHS students in the study are not ready for the new general education curriculum in mathematics.

4. Addressing the challenges identified by teachers is crucial for improving readiness and effectively preparing SHS students in the Philippines for the demands of college-level mathematics within the new general education curriculum. A holistic approach involving collaboration among schools, teachers, parents, and students is essential to bridge these learning gaps.

5. The proposed curriculum and instructional innovations will serve as inputs to enhance senior high school students' college mathematics readiness and prepare them for success in college-level courses.

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