Mathematical Skills and General Mathematics Performance of Grade 11 Students in a Public National High School in Southern Negros Occidental, Philippines

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ABSTRACT. Mathematical skills are essential tools that form the foundation for understanding complex concepts in mathematics relevant to our daily lives. General Mathematics is considered a core subject in the senior high school curriculum. This study investigated the mathematical skills and General Mathematics performance of Grade 11 students at a public National High School in southern Negros Occidental, Philippines. Researchers analyzed the relationship between these skills and academic performance, considering potential differences between sexes and academic strands. Using statistical methods like the Kruskal-Wallis test and Spearman's correlation, the study found students demonstrated approaching proficient mathematical skills but only developing-level General Mathematics performance. Significant differences in verbal skills were observed between academic strands, while nonverbal skills varied by both sex and strand. Crucially, a strong correlation emerged between mathematical skills and overall performance in General Mathematics.

1.0. Introduction

Mathematics is a fundamental language that allows us to comprehend the world around us. Mathematical skills are essential tools that enable us to learn mathematics. These skills form the foundation for understanding complex concepts in mathematics relevant to our daily lives. Mathematical skills can be viewed in separate areas, including verbal components, such as number knowledge, counting, and mathematical reasoning, and nonverbal components, such as math notation, reasoning in time and space, and computation (Bachar, 2023). Mathematical verbal components usually focus on the capacity of the learners to differentiate various numbers, count, and understand mathematical concepts to express ideas and solve mathematical problems. On the other hand, mathematical nonverbal components usually deal with math notations, where math problems are made to be concise and specific; math reasoning, where learners apply logical thinking to derive the correct mathematical approach for a certain problem; and computation, where learners perform different mathematical operations.

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Mathematics performance in the Philippines has consistently performed poorly in international and national mathematics assessments. Yet, as years go by, the significance of mathematics remains constant. There has been a decrease in scores in the 2018 National Achievement Test performance from 50.7% to 46.3%. Similarly, in an international assessment like the 2003 Trends in International Mathematics and Science Study, among the 38 participating countries, the Philippines placed 34th in high school (Department of Education [DepEd], 2003). Nevertheless, in the recent results of the 2022 PISA study, the Philippines achieved two points better in mathematics, from 353 in 2018 to 355 in 2022 (Chi, 2023). These results indicate that more Filipino students who belong below international standards in mathematics proficiency show insufficient mathematics skills compared to their age group counterparts from other nationalities (Lapinid et al., 2022).

In the K-12 program of the Department of Education, General Mathematics is one of the core subjects of the senior high school curriculum, which has three areas: Functions and Graphs, Business Mathematics, and Logic. Mathematics from the K to 12 curriculum is a skill subject. It is said that mathematics is one of the subjects studied the most, taken up from the Pre-K level throughout college.

The level of General Mathematics performance of the students was based on the policy guidelines on classroom assessment for the K to 12 Basic Education Program under the DepEd Order No. 8, s. 2015, where DepEd used an assessment scale of advanced, proficient, approaching proficient, developing, and beginning with a corresponding mean score for each level (DepEd, 2015).

The Department of Education, through the Regional Memorandum No. 827, S. 2022, also known as the 2022 Enhanced Regional Unified Numeracy Test (ERUNT), has its main objective, which is to determine the numeracy level of the learners across various grade levels and provide appropriate intervention for non–numerate learners. Numeracy, as utilized in this memorandum, is the competency of the learners to solve problems involving integers in senior high school. In the public national high school in southern Negros Occidental, where the study was conducted, the recent ERUNT results of the Grade 11 students found that 40.09% are considered non–numerates. Non–numerate learners are those learners who did not score at least 80% on the test, with 32 correct answers out of 40 items (DepEd, 2022).

Various studies were conducted to assess the students' mathematical skills in secondary high schools. Studies analyzed senior high school students' competency in General Mathematics (Mamolo, 2019; Cerbito, 2020) and the algebraic skills and academic achievement in mathematics of Grade 7 students (Garinganao & Bearneza, 2021). Some research even focused on the level of General Mathematics performance of senior high school students (Mamolo & Sugano, 2020; Antonio & Baduria, 2022). However, these studies did not provide any information on the relationship between mathematical skills and the General Mathematics performance of senior high school students. Therefore, the result of the study will contribute to the gap in the literature as it adds to the understanding of the relationship between mathematical skills and the General Mathematics performance of Grade 11 students.

Thus, the researcher examined the relationship between mathematical skills and students' General Mathematics performance. The findings of this study served as a basis for developing supplementary instructional materials that will further progress the mathematical skills of the students and improve the school's mathematics curriculum.

2.0. Framework of the Study

The study theorizes that the level of mathematical skills is associated with the General Mathematics performance of the students according to the theory of constructivism. Thus, this study is mainly anchored on Bruner's (2021) Theory of Constructivism.

Constructivism's major theme is that learning is an active process in which learners construct new ideas based on their current or past knowledge. This explains that as learners encounter new information, they assess and compare it to their existing knowledge and interpret it in a meaningful way. Moreover, the theory is based on three principles: readiness, where instruction must be adequate with the experiences that make the students motivated to learn; spiral organization, where students can build upon what they already learned; and going beyond the information given, where instruction should facilitate extrapolation of ideas and understanding and allow learners to transcend the boundaries of the information provided (Mugambi, 2018).

Relating this theory to the present study, constructivism suggests that students' knowledge of mathematical skills must be established first since learners create new information based on their existing or past knowledge. The theory also implies that the principle of readiness, spiral organization, and going beyond the information given will help students improve their mathematical skills and general mathematics performance. With the K-12 framework, a spiral curriculum, it is essential for students to develop a deep understanding of the basic skills in mathematics. In this curriculum, it is the teacher's responsibility to reinforce and strengthen students' mathematical skills each time they encounter the mathematics subject. Thus, students are expected to have adequate mathematical skills in their current grade level, given that they are supposed to acquire mathematical skills gradually and repeatedly in a more complicated context from their elementary years up to their present grade level. Furthermore, this theory can serve as a basis for developing a framework for generating useful strategies in the classroom and instructional materials that may enhance students' mathematical skills and general mathematics performance.

3.0. Methodology

Research design and respondents. The study utilized a quantitative research design, specifically descriptive, comparative, and correlational research designs, to determine the level of mathematical skills and General Mathematics performance among the 278 Grade 11 students enrolled during the first semester of the school year 2022 – 2023 in a public national high school in southern Negros Occidental, Philippines. The researcher utilized the stratified random sampling technique where the different strata were the various strands in Grade 11. Random numbers were used to select the respondents.

Research instruments. For the research instruments in mathematical skills, a thirty–item

questionnaire was employed to assess the students in mathematics in verbal and nonverbal components. For the General Mathematics performance, a sixty–item questionnaire was used to assess the students in General Mathematics. The two researcher-made questionnaires were subjected to validity, item analysis, and reliability testing.

Data collection. The researchers secured an Ethics Clearance from the Dean of Recoletos de Bacolod Graduate School, University of Negros Occidental - Recoletos, to conduct the study. A letter seeking permission was also given to the Division Schools Superintendent, School Principal, and Grade 11 Adviser for the pilot testing and conducting the Mathematics Skills and General Mathematics Performance questionnaires. Parents' consent was also secured to the respondents prior to the day of the test administration. The two test questionnaires were administered on different days to avoid mental exhaustion to the respondents. The Mathematical Skills Test questionnaire was conducted within one hour. After two days, the General Mathematics Performance Test questionnaire was also administered, and the time allotted for the test was one and a half hours.

Data analysis. Descriptive and inferential data analysis were used to analyze and interpret the data. A normality test was conducted to determine the appropriate inferential statistical tool. Shapiro Wilk test of normality was used, and data were found to be not normally distributed; thus, the researcher utilized non-parametric statistical tools. Kruskal-Wallis Test, Mann-Whitney U test, and Spearman's Correlations were the inferential statistical tools utilized to analyze and interpret the data.

Ethical considerations. The researcher followed the rules of the Philippine Health Research Ethics Board (PHREB) to ensure that the study was conducted ethically, respects people's rights, aims to do good, and treats everyone fairly. The researcher obtained parental consent from the respondents of the study before the conduct of the study to address the participants' minority. The researcher also ensured their voluntary involvement and advised them of their right to withdraw at any moment throughout the study if they felt uncomfortable or inconvenient. The researcher guaranteed the respondents that their data would be kept completely confidential and that their identity as respondents would remain anonymous.

4.0. Results and Discussion

Demographic Profile of the Respondents

Table 1 shows the demographic profile of the respondents. When grouped according to sex, 47.8% are females (n = 133), while 52.2% are males (n = 145). When grouped according to strand, 7.2% are ABM students (n = 20), 36.0% are HUMSS students (n = 100), 4.0% are STEM students (n = 11), and 52.8% are TVL students (n = 147). In general, the study utilized a total of 278 respondents.

Table 1
Demographic Profile of the Respondents

Variable	f	%
Sex		
Female	133	47.8
Male	145	52.2
Strand		
ABM	20	7.2
HUMSS	100	36.0
STEM	11	4.0
TVL	147	52.8
Total	278	100.0

Level of Mathematical Skills in Verbal and Nonverbal Components

Table 2 shows the level of mathematical skills of the students. Grade 11 students are at the "Approaching Proficient" level of mathematical skills when taken as a whole (M = 16.85, SD = 4.53). In terms of verbal mathematical skills, students are at the "Proficient" level (M = 9.47, SD = 2.49), while students are at the "Approaching Proficient" level of nonverbal mathematics skills (M = 7.39, SD = 2.65).

Overall, the Grade 11 students likely have the foundational mathematical knowledge. However, they may want additional assistance and practice to apply these understandings and to achieve a higher level of mathematical skills. This may be caused by students having inconsistent comprehension and application of the basic mathematical concepts. In terms of verbal mathematical skills, the students have achieved the fundamental verbal mathematical skills. This indicates that students already have a solid understanding of verbal mathematical skills and can solve problems with minimal errors. In nonverbal mathematical skills, students have learned and can demonstrate nonverbal mathematical skills but also need guidance from teachers and peers to apply these understandings. Specifically, more students have errors in the components of reasoning in time and space and mathematical computations, which means that students still need improvement in these components to develop higher levels of nonverbal mathematical skills.

This result is relevant to the findings of the study of Igarashi and Suryadarma (2023), which

Table 2
Level of Mathematical Skills in Verbal and Nonverbal Components

Mathematical Skills	M	SD	Interpretation
Verbal	9.47	2.49	Proficient
Nonverbal	7.39	2.65	Approaching Proficient
Whole	*16.85*	*4.53*	*Approaching Proficient*

Mean Scale: (Verbal & Nonverbal 15-items) 0.00-3.00 Beginning, 3.01-6.00 Developing, 6.01-9.00 Approaching Proficient, 9.01-12.00 Proficient, and 12.01-15.00 Advanced; (Whole 30-items) 0.00-6.00 Beginning, 6.01-12.00 Developing, 12.01-18.00 Approaching Proficient, 18.01-24.00Proficient, and 24.01-30.00 Advanced

concluded that high school students do not master the foundational mathematical skills taught during their elementary years. Contrastingly, the result differs from the study of Panagdato et al. (2024), which concluded that respondents have a good performance on computational skills, which suggests that they can execute the four basic operations in real numbers, apply the properties of equalities of real numbers, and derive formulas from a given equation. Moreover, the result of the study by Baraquia (2019) also established that the computation skills of students have a stronger correlation with students' performance in mathematics.

Level of Mathematical of Grade 11 Students when grouped according to sex and strand

Table 3 presents the level of mathematical skills in terms of verbal and nonverbal components among Grade 11 students when grouped according to sex and strand.

Both females (M = 9.80, SD = 2.08) and males (M = 9.17, SD = 2.79) are at the "Proficient" level of verbal mathematical skills. Meanwhile, among the strands, students taking up STEM (M = 10.31, SD = 2.10) are at the "Advanced" level of verbal mathematical skills, while students taking up TVL (M = 8.42, SD = 2.34) are at the "Approaching Proficient" level of verbal mathematical skills. In terms of nonverbal mathematical skills, both females (M = 7.78, SD = 2.50) and males (M = 7.02, SD = 2.74) exhibit an "Approaching Proficient" level of nonverbal mathematical skills, while only students taking up STEM (M = 6.42, SD = 2.45) have "Proficient" level of nonverbal mathematical skills.

This means that both males and females are at the same level of mathematical skills, both in verbal and nonverbal mathematical skills. This suggests that all students, male or female, perform similarly. Among all the strands, only STEM students excel in verbal and nonverbal mathematical skills. This means that STEM students developed primary verbal and nonverbal skills while the remaining three strands still need guidance from their teachers and peers to achieve proficiency. It only shows that the STEM students are more knowledgeable of mathematical skills because their strand focuses more on science and mathematics. STEM students may also be advantageous since most students already have more mathematics exposure than other strands. On the other hand, students enrolled in the TVL strand still need more attention to developing their mathematical skills because TVL strand curricular training is more focused on developing and applying specialized practical skills.

The study varies from the results of Halpern et al. (2007), which stated that mathematics achievement requires the ability to explain and understand abstract ideas effectively. Thus, female students' more notable verbal ability than male students is advantageous and helpful in all academic domains. Meanwhile, the result of the study is related to the study of Almerino et al. (2020), which concluded that STEM students obtained above-average scores in nonverbal reasoning and mathematical capacity, while the ABM group achieved above-average scores in mathematical capacity and mathematical application.

Table 3
Level of Mathematical Skills in terms of Verbal and Nonverbal Components among Grade 11 Students when grouped according to Sex and Strand

Mathematical Skills	N	M	SD	Interpretation
Verbal				
Sex				
Female	133	9.80	2.08	Proficient
Male	145	9.17	2.79	Proficient
Strand				
ABM	20	11.10	1.37	Proficient
HUMSS	100	10.31	2.10	Proficient
STEM	11	13.00	1.41	Advanced
TVL	147	8.41	2.34	Approaching Proficient
Nonverbal				
Sex				
Female	133	7.78	2.50	Approaching Proficient
Male	145	7.02	2.74	Approaching Proficient
Strand				
ABM	20	8.70	2.18	Approaching Proficient
HUMSS	100	8.24	2.50	Approaching Proficient
STEM	11	10.09	1.58	Proficient
TVL	147	6.42	2.46	Approaching Proficient

Mean Scale: (15 items) 0.00-3.00 Beginning, 3.01-6.00 Developing, 6.01-9.00 Approaching Proficient, 9.01-12.00 Proficient, and 12.01-15.00 Advanced

General Mathematics Performance of Grade 11 Students

Table 4 shows the General Mathematics performance of the students in the areas of Functions, Introduction to Business Mathematics, and Logic. The data illustrate that the students have "Developing" performance in general mathematics when taken as a whole (M = 18.12, SD = 6.10). The table also shows that the students have a "Developing" performance in the areas of functions (M = 10.94, SD = 4.61), Introduction to Business Math (M = 4.02, SD = 1.80), and Logic (M = 3.17, SD = 1.51).

This means that Grade 11 students possess only a minimum knowledge, skills, and core understanding of General Mathematics and need help transferring and applying the concepts in real life. The developing level of students in General Mathematics may result from low performance in mathematics and the lack of mastery of basic mathematical skills. It may also result from the numerous competencies the students must acquire in a short period.

Overall, the results above affirm the results of the study of Mamolo and Sugano (2020), which stated that the acquired competency of the students in the three areas of General Mathematics: Functions, Introduction to Business Mathematics, and Logic was only fair.

Additionally, the result is congruent with the results of the studies of Abanador (2018), Mamolo and Sugano (2020), Olaco and Rebucas (2021), and Antonio and Baduria (2022) which revealed that the performance level in General Mathematics of the students is low. The developing level of Grade 11 students in General Mathematics could be caused by the low performance of students in content and procedural knowledge, computational skills, visualization, problem-solving, and other skills and processes in mathematics that are connected to the lack of mastery of the fundamental skills of the students and the language used to teach the subject (Jaudinez, 2019).

However, it differs from the results of the studies of Alova (2019) and Alova and Calanza-Alova (2022), which indicated that the academic performance in General Mathematics of Grade 11 students was very satisfactory. Moreover, it varies with the results of the studies of Cerbito (2020), Malgapo and Villaflor (2022), and Picat (2023), which stated that the General Mathematics performance of Grade 11 students was at the average level.

General Mathematics Performance of Grade 11 Students when grouped according to sex and strand

Table 5 presents the performance in General Mathematics in the areas of Functions, Introduction to Business Math, and Logic of Grade 11 students when grouped according to sex and strand.

Males (M = 10.37, SD = 4.05) and females (M = 11.56, SD = 5.09) both demonstrate a "Developing" performance in the areas of functions. In terms of strands, only students taking up STEM (M = 24.36, SD = 1.63) have "Proficient" performance in the area of functions, while students in the TVL strand (M = 9.23, SD = 3.20) only have a "Developing" performance. In addition, the result also indicates that in all variables, students have a "Developing" performance in the Introduction to Business Math, except for those enrolled in STEM (M = 7.46, SD = 1.04) who have an "Approaching Proficient" performance. Lastly, in Logic, all variables show that the students have "Developing" performance.

This means that males and females acquired minimum knowledge, skills, and core understanding in General Mathematics: Functions, Introduction to Business Mathematics, and Logic. In terms of strands, only STEM students developed the core understanding in both Functions and Introduction to Business Mathematics. In Logic, all Grade 11 students only earned a minimum core understanding and need assistance transferring the concepts to real-life situations. The results suggest that STEM students are better at learning and comprehending math classes because they have had more exposure to the subject. Thus, making the students grasp the concept easily allows the teachers to discuss more coverage in the syllabus compared to other strands. Moreover, the developing level in Logic by Grade 11

Table 4
General Mathematics Performance in the areas of Functions, Introduction to Business Mathematics, and Logic of Grade 11 Students

General Mathematics Performance	M	SD	Interpretation
Functions	10.94	4.61	Developing
Introduction to Business Math	4.02	1.80	Developing
Logic	3.17	1.51	Developing
Whole	*18.12*	*6.10*	*Developing*

Mean Scales: (Functions 34-items) 0.00-6.80 Beginning, 6.81-13.60 Developing, 13.61-20.40 Approaching Proficient, 20.41-27.20 Proficient, and 27.21-34.00 Advanced; (IBM 14-items) 0.00-2.80 Beginning, 2.81-5.60 Developing, 5.61-8.40 Approaching Proficient, 8.41-11.20 Proficient, and 11.21-14.00 Advanced; (Logic 12-items) 0.00-2.40 Beginning, 2.41-4.80 Developing, 4.81-7.20 Approaching Proficient, 7.21-9.60 Proficient, and 9.61-12.00 Advanced; (Whole 60-items) 0.00-12.00 Beginning, 12.01-24.00 Developing, 24.01-36.00 Approaching Proficient, 36.01-48.00 Proficient, and 48.01-60.00 Advanced

students may indicate that the competencies in logic are not properly presented and thoroughly discussed with the students, which may lead to not mastering the key concepts in logic. The developing performance may also signify a lack of exposure to important concepts or skills needed to comprehend logic. The developing level can also hinder the student's ability to progress in higher–level mathematics and limit their preparedness in complex mathematics, affecting students' overall mathematics performance.

The results are relevant to Alova (2019) and Antonio and Baduria (2022), who stated that both Grade 11 male and female students fall at the satisfactory level in General Mathematics. However, it differs from the results of Alova and Calanza-Alova (2022), who employed both male and female students to have a fairly satisfactory level of academic performance in mathematics. Likewise, the study conducted by Abanador (2018) concluded that both males and females did not master the projected learning competencies in the three areas of General Mathematics: Functions, Introduction to Business Mathematics, and Logic.

Specifically, in the area of Functions, the result is relevant to the findings of Lanuza et al. (2022), which implied that students in senior high school from the different strands were only at the beginning level, suggesting that students have limited knowledge in regard to the topic of Functions. In the area of Introduction to Business Mathematics, the result is congruent with the findings of Galigao (2022), which established that the students had an average academic performance in business mathematics. However, it varies with the results of the study of Mamolo and Sugano (2020), which indicated that the students acquired competency in the area of Introduction to Business Mathematics was only fair. In the area of Logic, the result differs from the study of Santos (2017), which concluded that the average grade implied a satisfactory performance in terms of mathematical logic performance.

In terms of students' strand, the above result conforms to the results of Alova (2019), which noted that STEM students are considered to be at the outstanding level, while TVL and Arts and Design are both at a fairly satisfactory level in their General Mathematics performance. The results are also relevant to the study of Mamolo (2019), which indicated that only the STEM strand got a satisfactory rating on the competency test among all the strands involved.

Difference in the Level of Mathematical Skills of Grade 11 Students according to sex and strand

Table 6 presents the difference in the level of mathematical skills of students in terms of verbal and nonverbal components when the students are grouped according to sex and strand.

On verbal mathematical skills, results show that there was no significant difference in the level of verbal mathematical skills when the students were grouped according to sex [U = 10662.00, p = 0.125] at the 0.05 level of significance. Moreover, results show that there was a significant difference in the level of verbal mathematical skills when the students were grouped according to strand [$X^2(3) = 80.20^{**}$, $p<.001$] at the 0.05 level of significance. Meanwhile, in the areas of non-verbal mathematical skills, results show that there was a significant difference in the level of non-verbal mathematical skills when the students were grouped according to sex [U = 11320.50, p = 0.012] and strands [$X^2(3) = 46.51^{**}$, $p <.001$] at the 0.05 level of significance.

The findings imply that in the students' level of verbal mathematical skills, only the students' strand where the respondents are enrolled is a significant factor, and students' sexes do not determine verbal mathematical skills. This may indicate that regardless of student's sexes,

Table 5
General Mathematics Performance in the areas of Functions, Introduction to Business Mathematics, and Logic of Grade 11 Students when grouped according to Sex and Strand

General Mathematics	M	SD	Interpretation
Functions			
Sex			
Female	11.56	5.09	Developing
Male	10.37	4.05	Developing
Strand			
ABM	14.50	4.27	Approaching Proficient
HUMSS	11.25	3.66	Developing
STEM	24.36	1.63	Proficient
TVL	9.23	3.20	Developing
Introduction to Business Math			
Sex			
Female	4.00	1.90	Developing
Male	4.04	1.72	Developing
Strand			
ABM	4.45	1.50	Developing
HUMSS	4.06	1.64	Developing
STEM	7.46	1.04	Approaching Proficient
TVL	3.68	1.72	Developing
Logic			
Sex			
Female	3.46	1.60	Developing
Male	2.90	1.37	Developing
Strand			
ABM	3.85	1.76	Developing
HUMSS	3.43	1.65	Developing
STEM	4.27	1.01	Developing
TVL	2.81	1.30	Developing

Mean Scales:(Functions 34-items) 0.00-6.80 Beginning, 6.81-13.60 Developing, 13.61-20.40 Approaching Proficient, 20.41-27.20 Proficient, and 27.21-34.00 Advanced; (IBM 14-items) 0.00-2.80 Beginning, 2.81-5.60 Developing, 5.61-8.40 Approaching Proficient, 8.41-11.20 Proficient, and 11.21-14.00 Advanced; (Logic 12-items) 0.00-2.40 Beginning, 2.41-4.80 Developing, 4.81-7.20 Approaching Proficient, 7.21-9.60 Proficient, and 9.61-12.00 Advanced

it does not impact the verbal mathematical skills of the students. The findings also reveal that, in terms of nonverbal mathematical skills, both students' sexes and strands are considered significant factors. This suggests that strands where students choose to enroll significantly affect their verbal and nonverbal mathematical skills.

Table 6
Difference in the Level of Mathematical Skills of Grade 11 Students according to sex and strand

Mathematical Skills	M	U/X^2	df	p
Sex				
Female	9.80	10662.00		0.125
Male	9.17			
Strand				
ABM	11.10	80.20**	3	< .001
HUMSS	10.31			
STEM	13.00			
TVL	8.41			
Nonverbal				
Sex				
Female	7.78	11320.50**		0.012
Male	7.02			
Strand				
ABM	8.70	46.51**	3	< .001
HUMSS	8.24			
STEM	10.09			
TVL	6.42			

*Note: p < 0.05***

The result differs from the findings concluded by Halpern et al. (2007), who stated that females tend to stand out in verbal abilities and that achievement in mathematics involves the ability to communicate and understand abstract ideas effectively. Thus, females' advantage in verbal abilities should be helpful in all academic domains. Additionally, in terms of nonverbal components, the result is congruent to the study of Van de Weijer-Bergsma et al. (2022), which presented that boys outperform girls in mathematical word problem-solving tasks. However, it varies from the results of Lachance and Mazzocco (2006), which employed that significant differences in sex are very minimal or nonexistent. Moreover, the findings of the study adhere to the result of Rosselli et al. (2009), which concluded that there is a difference in the performance of mental mathematical operations and in resolving arithmetical problems among students.

Post Hoc Analysis in the Difference in the Level of Mathematical Skills of Grade 11 Students when grouped according to Strand

Table 7 presents the post hoc analysis of the difference in the level of mathematical skills of students in terms of verbal and nonverbal components when the students are grouped according to strand.

In the areas of verbal mathematical skills, students taking up TVL differ from the students taking up ABM, HUMSS, and STEM, with z-differences of 5.040, 6.643, and 6.002, respectively. Furthermore, students taking up STEM differ from students taking up HUMSS, with a z-difference of 3.195.

In the areas of nonverbal mathematical skills, students taking TVL differ from students taking AMB, HUMSS, and STEM, with z-differences of 3.511, 5.289, and 4.537, respectively.

Difference in the Level of General Mathematics Performance of Students when grouped according to Sex and Strand

Table 8 illustrates the difference in the level of General Mathematics performance of students in the areas of Functions, Introduction to Business Math, and Logic when grouped according to sex and strand.

In the areas of functions, there was a significant difference in the performance when the students were grouped according to sex [U = 11142.00, p = 0.025] and strands [X^2 (3) = 66.57**, p < .001] at the 0.05 level of significance. When students are grouped according to sex, the result reveals no significant difference in the areas of introduction to Business Mathematics [U = 9480.50, p = 0.807] at a 0.05 level of significance. When the students were categorized according to strands, there was a significant difference in the area of Introduction to Business Math [X^2 (3) =32.22**, p < 0.001] at a 0.05 level of significance. Lastly, at the 0.05 level of significance, there was a significant difference in the areas of Logic when the students were grouped according to sex [U = 11481.50, SD = 0.005] and strands [X^2 (3) = 20.09**, p < 0.001].

Table 7
Post Hoc Analysis on the Difference in the Level of Mathematical Skills of Students when grouped according to Strand

Comparison	z	p
Verbal		
ABM – TVL	5.040**	< .001
HUMSS – STEM	-3.195**	< .001
HUMSS – TVL	6.643**	< .001
STEM – TVL	6.002**	< .001
Nonverbal		
ABM – TVL	3.511**	< .001
HUMSS – STEM	-2.306	0.011
HUMSS – TVL	5.289**	< .001
STEM – TVL	4.537**	< .001

*Note: p < 0.05***

The findings imply that students' sexes are significant factors in determining the level of General Mathematics performance in the areas of Functions and Logic only. In contrast, it cannot determine the level of General Mathematics performance in the area of Introduction to Business Mathematics. Additionally, the findings reveal that the students' strand is a significant factor in determining the level of General Mathematics performance of students in all the areas: Functions, Introduction to Business Mathematics, and Logic. This means that the strand where students choose to enroll has an important influence on the general mathematics performance of the students.

The result of the study differs from the findings of Abanador (2018), which concluded that there was no significant difference in the students' mastery of the learning competencies in functions and their graphs when students were grouped according to sex. The results also determined a significant difference between the male and female students' extent of mastery of the learning competencies in Business Mathematics. Thus, female students are more likely to have a greater extent of mastery of the learning competencies in Business Mathematics than male students. The study also stated that male students possess a higher level of proficiency in Math Logic compared to female students.

Moreover, the findings of the study vary from the results of Galigao (2022), who discovered that there is a difference in the mathematics performance of students. It showed that female students are better than male students in terms of academic performance in Business Mathematics. At the same time, the result of the study is also relevant to the findings of Palomares-Ruiz and García-Perales (2020), which concluded that boys exhibited higher scores in the items of the logical numerical series compared to girls.

In terms of students' strand, the result of the study is congruent to the results of Tio (2023), which revealed a significant difference in the students' learning competency test in General Mathematics when they were grouped according to their senior high school track. The findings of the study are similar to the results of Cerbito (2020), who concluded that there are significant differences in the proficiency level of students in mathematics across senior high school strands.

Contrastingly, the result of the study differs from the result of Olaco and Rebucas (2021), which suggested that there is no significant degree of correlation between students' strands and proficiency level in General Mathematics which means that the strands where students are enrolled do not affect their proficiency level in General Mathematics.

Table 8
Difference in the Level of General Mathematics Performance of Students in the areas of Functions, Introduction to Business Mathematics, and Logic when grouped according to Sex and Strand

General Mathematics	M	U/X^2	df	p
Functions				
Sex				
Female	11.56	11142.00		0.025
Male	10.37			
Strand				
ABM	14.50	66.57**	3	< .001
HUMSS	11.25			
STEM	24.36			
TVL	9.23			
Introduction to Business Math				
Sex				
Female	4.00	9480.50		0.807
Male	4.04			
Strand				
ABM	4.45	32.22**	3	< .001
HUMSS	4.06			
STEM	7.46			
TVL	3.68			
Logic				
Sex				
Female	3.46	11481.50		0.005
Male	2.90			
Strand				
ABM	3.85	20.09**	3	< .001
HUMSS	3.43			
STEM	4.27			
TVL	2.81			

Post Hoc Analysis on the Level of General Mathematics Performance of Students in the areas of Functions, Introduction to Business Mathematics, and Logic when grouped according to Strand

Table 9 presents the post hoc analysis of the level of General Mathematics performance of students in the areas of Functions, Introduction to Business Math, and Logic when grouped according to strand.

In the areas of functions, the students taking up TVL differ from those taking up ABM, HUMSS, and STEM, with z-differences of 4.997, 4.160, and 6.478. Moreover, students taking up STEM differ from students taking up ABM and HUMSS, with z-differences of 2.222 and 4.677, respectively. Furthermore, students taking up ABM differ from students taking up HUMSS with a z-difference of 2.661.

Meanwhile, in the areas of Introduction to Business Math, students taking up TVL differ from students taking up ABM and STEM with z-differences of 1.777 and 5.516, respectively. In addition, students taking up STEM create a difference compared to students taking up ABM and HUMSS, with z-differences of 3.465 and 4.784, respectively.

Finally, in Logic, the students taking up TVL differ from those taking up ABM, HUMSS, and STEM, with z-differences of 2.517, 2.921, and 3.358, respectively. Meanwhile, the students taking up STEM differ from HUMSS, with a z-difference of 2.113.

Table 9
Post Hoc Analysis on the Level of General Mathematics Performance of Students when grouped according to Strands

General Mathematics Performance	z	p
Functions		
ABM – HUMSS	2.661**	0.004
ABM – STEM	-2.222	0.013
ABM – TVL	4.997**	< .001
HUMSS – STEM	-4.677**	< .001
HUMSS – TVL	4.160**	< .001
STEM – TVL	6.478**	< .001
Introduction to Business Math		
ABM – STEM	-3.465**	< .001
ABM – TVL	1.777**	0.038
HUMSS – STEM	-4.784**	< .001
STEM – TVL	5.516**	< .001
Logic		
ABM – TVL	2.517**	0.006
HUMSS – STEM	-2.113	0.017
HUMSS – TVL	2.921**	0.002
STEM – TVL	3.358**	< .001

*Note: p < 0.05***

Relationship between the Mathematical Skills and the General Mathematics Performance of Students

Utilizing Spearman's rho, Table 10 shows that there is a significant relationship between the mathematical skills of the students and their General Mathematics performance [r_s (276) = 0.34, p < .001] at a 0.05 level of significance.

The result reveals a significant correlation between mathematical skills and the General Mathematics performance of the Grade 11 students. Students with good mathematical skills will likely perform better in their General Mathematics subject. This suggests that emphasis should be put on the development of foundational mathematical skills to ensure that students have a strong understanding of the basic skills because it is essential for their success in more difficult and advanced mathematical topics.

The results of this study are relevant to the results concluded by Erturan and Jansen (2015), which suggested that there is a significant relationship between perceived math competence and students' mathematics performance. Additionally, the result is congruent with the findings of the study of Peñaflor (2017), which concluded that mathematical ability is moderately correlated to students' academic performance in mathematics. It also noted that mathematical ability predicts students' academic performance in mathematics.

A similar result was also found in the study conducted by Nizoloman (2013), which implied a positive relationship between students' mathematical ability and achievement in mathematics. This indicates that a higher level of mathematical ability means higher academic achievement in mathematics and vice versa.

In general, the Theory of Constructivism explains that learning is an active process in which learners construct new ideas and concepts based on their current or past knowledge. This theory plays a significant role in explaining the importance of first establishing the mathematical skills of the students. The results, therefore, validate that the current study theorizes that the level of mathematical skills is associated with the General Mathematics performance of the students. Students approaching proficient level in mathematical skills resulted in a developing level of general mathematics performance. The general mathematics performance of the students can be improved to a higher level by creating meaningful connections with prior knowledge in mathematics, such as mathematical skills.

Students' low general mathematics performance was a result of their low mathematical skills, indicating that students need to understand foundational mathematical concepts and prior knowledge in order to perform

Table 10
Relationship between the Mathematical Skills and the General Mathematics Performance of Students

Variables	r_s	df	p
Mathematical Skills			
General Mathematics	0.34**	276	< .001

successfully in general mathematics. In this study, improvement in students' mathematical skills, specifically nonverbal components, will increase their level of general mathematics performance.

5.0. Conclusion

An approaching proficient level of mathematical skills and a developing level of general mathematics performance implies that students attained the foundational mathematical knowledge but may want additional assistance and practice to apply this understanding. Moreover, mathematical skills are significantly related to the General Mathematics performance of the students. With the students' lack of mastery in mathematical skills, they are not ready to learn the complexities of the competencies taught in General Mathematics since they need mastery in mathematical skills to understand the concepts in General Mathematics. The relationship between mathematical skills and general mathematics performance also indicates that a low level of mathematical skills may lead to low performance in general mathematics, while sufficient knowledge of mathematical skills may give high performance in general mathematics. Supplementary instructional material with problem exercises may give students the needed aid and support to improve their mathematical skills and General Mathematics performance. With the help of this instructional material, students can build a stronger mathematical foundation and improve their overall performance in mathematics.

6.0. Limitations of the Findings

The present study may be limited to only one public national high school in southern Negros Occidental, Philippines, where the mathematical skills and General Mathematics performance of students in other schools were not assessed. Thus, results cannot be generalized for the whole division of Negros Occidental. Also, an additional identified limitation of the study is that the respondents experienced two years of modular distance learning during their Grade 9 and Grade 10 in junior high school. The modular learning modality may have impacted and contributed to their understanding and application of the mathematical concepts, which influenced their mathematics performance. Moreover, the study only establishes a correlation between mathematical skills and General Mathematics performance but cannot be able to establish causation. Interpretation of the findings was also limited to the method used to gather the data and the statistical analyses utilized in the study.

7.0. Practical Value of the Paper

The findings of the study will be of great value to the Department of Education – Senior High School Curriculum. Specifically, it will serve as a starting point for senior high teachers on where to focus more on teaching the competencies of the General Mathematics subject. With the help of the output of this study, students can increase their level of mathematical skills and their General Mathematics performance. In addition, the findings of this study contributed to the body of knowledge addressing the gap in the literature, especially in the context of General Mathematics subject of the Senior High School Curriculum.

8.0. Directions for Future Research

The researcher recommends that future researchers explore more about the study, including the existing variables but with a larger scope of respondents to establish the generalizability of the findings of the study. The present study also suggests creating an instrument where participants can answer within an hour but without compromising the content of the questionnaire and what it intends to measure.

9.0. Declaration of Conflict of Interest

The authors reported no potential conflict of interest.

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