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Unveiling the Numeracy Link: Mathematics Instructors' Instructional Numeracy Practices and Student Learning Outcomes

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ABSTRACT

This study investigates the relationship between mathematics instructors' instructional numeracy practices and student learning outcomes in college mathematics courses at Colegio de Santa Rita de San Carlos Inc. In an era where numeracy is central to academic success, the effectiveness of instructional delivery plays a crucial role in shaping students' conceptual understanding and performance. Using a descriptive–correlational quantitative research design, data were collected from 3 mathematics instructors, excluded the researcher and 105 college students. Instructional numeracy practices were measured in terms of computational accuracy, problem-solving strategies, symbolic representation, and real-life application of mathematics. Student learning outcomes were assessed through academic performance, conceptual understanding, and problem-solving proficiency. Findings revealed that instructors demonstrated a high level of instructional numeracy practices, while students exhibited a moderate level of learning outcomes. Correlation analysis showed a significant relationship between instructional numeracy practices and student learning outcomes, indicating that effective instructional strategies positively influence mathematical understanding. The study highlights the importance of strengthening pedagogical numeracy practices to enhance student achievement in mathematics.

Keywords: *Numeracy, Mathematics Instruction, Student Learning Outcomes, College Mathematics*

INTRODUCTION

Mathematics is widely recognized as a fundamental discipline that develops logical reasoning, analytical thinking, and problem-solving skills. However, many college students continue to struggle with mathematical concepts despite exposure to formal instruction. One critical factor influencing this challenge is the quality of instructional numeracy practices employed by mathematics instructors.

Instructional numeracy refers to the ability of educators to effectively use mathematical knowledge, representations, and reasoning strategies in teaching. According to recent studies, teacher numeracy competence significantly affects how students interpret mathematical concepts and apply them in problem-solving situations (Ball & Hill, 2021). When instructors demonstrate strong numeracy practices, students are more likely to develop deeper conceptual understanding and mathematical fluency. In the Philippine context, mathematics education continues to face challenges such as low performance in problem-solving and limited conceptual mastery among learners (CHED, 2023). These issues suggest a possible gap between instructional practices and student learning

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outcomes. From a pedagogical perspective, effective mathematics instruction should not only focus on procedural computation but also emphasize conceptual understanding, symbolic reasoning, and real-life application. This aligns with the view that numeracy is not merely computational skill but a cognitive and instructional process (OECD, 2021). Despite increasing attention to mathematics education quality, limited empirical studies have examined the direct relationship between instructors' numeracy practices and student learning outcomes in higher education. This gap highlights the need for further investigation into how instructional practices influence student achievement in mathematics. Thus, this study aims to examine the relationship between mathematics instructors' instructional numeracy practices and student learning outcomes.

Research Questions

The main purpose of this study is to investigates the relationship between mathematics instructors' instructional numeracy practices and student learning outcomes in college mathematics courses at Colegio de Santa Rita de San Carlos Inc., SY 2025-2026 as basis for learning effectiveness in learning Tertiary Mathematics. Specifically, this study answered the following questions:

1. What is the level of mathematics instructors' instructional numeracy practices in terms of:
   1.1 computational accuracy bin instruction
   1.2 problem solving demonstration strategies
   1.3 use of mathematical representations and symbols
   1.4 integration of real-life numeracy applications
2. What is the level of student learning outcomes in mathematics in terms of:
   2.1 academic performance (Grades of Mathematics Majors 1st year to 4th year)
   2.2 conceptual understanding of mathematical topics
   2.3 problem solving proficiency
3. Is there a significant relationship between instructors' instructional numeracy practices and students' learning outcomes in mathematics?
4. Which aspect of instructors' instructional numeracy practices best predicts students' learning outcomes in Mathematics?

Literature Review

Instructional Numeracy Practices of Mathematics Instructors

Instructional numeracy practices refer to the pedagogical capacity of mathematics instructors to effectively apply numerical reasoning, symbolic representation, problem-solving strategies, and mathematical communication in teaching. Recent literature emphasizes that teacher numeracy is not merely computational proficiency but a multidimensional construct involving conceptual understanding, pedagogical decision-making, and instructional precision. According to Ball and Hill (2021), mathematics teachers' professional competence significantly influences the quality of instruction, particularly in how mathematical concepts are presented and interpreted in classroom settings. Their findings highlight that teachers with strong numeracy knowledge are more capable of anticipating student misconceptions and delivering clearer mathematical explanations.

Similarly, Hill and Charalambous (2021) argue that instructional quality in mathematics is strongly dependent on teachers' ability to connect content knowledge with pedagogical strategies. Their study emphasizes that effective numeracy instruction involves both procedural fluency and conceptual reasoning, which are essential for deep mathematical learning.

Recent systematic evidence further supports this claim. A review by Current Opinion in Behavioral Sciences (2022) revealed that teacher competence—including situational mathematical knowledge and instructional adaptability—directly affects classroom teaching quality and student learning gains. The study stresses that teachers' numeracy practices act as a mediating factor between knowledge and student performance outcomes.

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Moreover, instructional strategies such as problem-based learning and mathematical literacy integration have been widely identified as effective approaches in strengthening numeracy instruction. Garcia (2024) found that mathematics teachers who employ structured problem-solving approaches and real-world applications significantly enhance students' mathematical literacy and engagement.

In addition, research on numeracy instruction management highlights that teachers face challenges in aligning curriculum expectations with effective numeracy delivery. Falcunaya (2024) emphasized that improving instructional numeracy requires continuous professional development and systematic instructional planning to address student learning gaps.

Overall, literature consistently shows that instructional numeracy practices are shaped by teacher competence, pedagogical strategies, and contextual teaching demands. Strong instructional numeracy leads to more meaningful mathematical learning experiences, while weak implementation may limit students' conceptual development.

Student Learning Outcomes in Mathematics

Student learning outcomes refer to measurable achievements in mathematics, including conceptual understanding, problem-solving skills, symbolic reasoning, and academic performance. Contemporary research highlights that mathematics learning outcomes remain a global concern, particularly in higher education settings where students often struggle with abstract reasoning. According to OECD (2023), mathematics performance is closely linked to the quality of instruction and the ability of students to apply mathematical knowledge in real-life contexts. The PISA results indicate that students who experience high-quality instruction demonstrate significantly better problem-solving abilities and conceptual mastery.

A recent large-scale study by Large-scale Assessments in Education (TIMSS-related study) (2023) found that early numeracy skills strongly predict later mathematics achievement, reinforcing the importance of foundational numerical understanding in academic success. The study highlights that numeracy development is cumulative, meaning gaps in early understanding can persist into higher education. In higher education contexts, student mathematics performance is often described as moderate to low, especially in areas involving symbolic reasoning and abstract problem-solving. Ryan and Deci (2020) explain that student outcomes are influenced by both intrinsic motivation and external learning conditions, suggesting that academic performance is not solely dependent on cognitive ability but also on learning environment and instructional quality.

Furthermore, Darling-Hammond et al. (2020) emphasize that learning outcomes improve when instruction is structured, student-centered, and cognitively engaging. They argue that high-quality teaching practices significantly enhance student understanding and retention of mathematical concepts. Additionally, Schoenfeld (2020) highlights that mathematical learning is deeply connected to students' ability to think metacognitively and apply strategies flexibly across different problem types. Weaknesses in conceptual reasoning often reflect insufficient exposure to meaningful mathematical discourse and guided problem-solving.

In summary, student learning outcomes in mathematics are shaped by instructional quality, cognitive engagement, and foundational numeracy skills. While students may demonstrate procedural competence, higher-order thinking skills remain a challenge in many educational settings.

METHODS

Participants

The respondents of the study consisted of two groups: three (3) mathematics instructors, excluded the researcher and one hundred five (105) college students enrolled in BSED Major in mathematics at Colegio de Santa Rita de San Carlos, Inc. SY 2025-2026. The instructor respondents were purposively selected based on their direct involvement in teaching the student participants, ensuring alignment between instructional practices and student learning experiences. Each instructor handled a specific group of students, allowing the examination of the relationship between instructional numeracy practices and student learning outcomes.

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The student respondents were drawn from different year levels and were currently enrolled in mathematics subjects under the selected instructors. Their inclusion ensured that they had sufficient exposure to classroom instruction relevant to the variables of the study.

Primary data were collected using a structured, researcher-made questionnaire designed to measure mathematics instructors' instructional numeracy practices and students' learning outcomes.
The distribution of the respondents is summarized in the table below;

Respondents of the Study:

Respondents	Course/Subject	Frequency	Percentage (%)
Instructor	-	3	2.78%
Students	Math 1	12	11.43
Students	Math 2	27	25.71%
Students	Math 3	43	40.95%
Students	Math 4	23	21.90%
Total		108	100%

The table shows that the respondents of the study were composed of three (3) mathematics instructors and one hundred five (105) college students enrolled in mathematics-related subjects, with total of 108 respondents. Among the student respondents, the highest number was from Math 3 with 43 students (40.95%), followed by Math 2 with 27 students (25.71%), Math 4 with 23 students (21.91%), and Math 1 with 12 students (11.43%). The instructor respondents comprised 2.78% of the total respondents. The distribution reflects the actual enrollment of students across mathematics courses, ensuring representation of different levels of mathematical exposure.

Instrument

The research instrument used in this study is a standardized questionnaire designed to gather relevant data from the respondents. The questionnaire is composed of two main parts. The first part focuses on the mathematics instructors' instructional numeracy practices, which assesses how instructors apply effective teaching strategies in mathematics. It includes indicators such as the use of real-life applications in teaching mathematics, clarity of explanation of mathematical concepts, utilization of varied instructional strategies, integration of problem-solving activities, and provision of feedback and assessment. The second part focuses on the student learning outcomes in mathematics, which measures students' level of understanding and performance in the subject. This includes indicators such as comprehension of mathematical concepts, ability to solve mathematical problems, critical thinking and analytical skills, accuracy in computations, and performance in mathematics assessments. Each item in the questionnaire is rated using a 5-point Likert scale ranging from Always (5), Often (4), Sometimes (3), Rarely (2), to Never (1), in order to determine the extent of agreement or frequency of the given statements. The instrument is designed to provide reliable and valid data for analyzing the relationship between instructional practices and student learning outcomes in mathematics.

Data Gathering Procedure

The researchers will follow a systematic process in collecting the necessary data for the study. First, a formal letter of permission will be secured and addressed to the Dean of the College and to the school administration of Colegio de Santa Rita de San Carlos, Incorporated, requesting approval to conduct the study among BSEd Mathematics students. Upon approval, the researcher will proceed with the distribution of the research instrument, which is a standardized questionnaire.

Before the actual administration, the questionnaire will be checked for clarity and completeness. The respondents will be given a brief orientation regarding the purpose of the study, instructions in answering the questionnaire, and assurance that their responses will be treated with utmost confidentiality. The questionnaires will then be distributed either in printed form or through an online platform, depending on the availability and convenience of the respondents.

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After the respondents have accomplished the questionnaire, the researcher will collect the data immediately or set a specific retrieval schedule. The collected data will then be tallied, encoded, and organized for statistical analysis. Finally, the data will be processed using appropriate statistical tools such as frequency, percentage, weighted mean, and Pearson Product-Moment Correlation Coefficient (r) to answer the research questions and test the hypotheses of the study.

Data Analysis

The data gathered in this study were analyzed using appropriate descriptive and inferential statistical tools in order to address the specific problems of the study. To describe the profile of the respondents, particularly the distribution of mathematics instructors and college students across different mathematics subjects such as Math 1, Math 2, Math 3, and Math 4, frequency and percentage were used. The level of mathematics instructors' instructional numeracy practices and student learning outcomes were determined using the weighted mean and standard deviation. The weighted mean was utilized to obtain the average responses for each indicator, while the standard deviation was used to measure the variability and consistency of responses.

For interpretation of the weighted mean, a five-point scale was adopted, where higher mean values indicate a higher level of instructional numeracy practices or student learning outcomes. This provided a clear basis for describing the extent of each variable in the study.

To determine the significant relationship between mathematics instructors' instructional numeracy practices and student learning outcomes, the Pearson Product-Moment Correlation Coefficient (r) was employed. This statistical tool measured the strength and direction of the relationship between the two variables. Furthermore, multiple linear regression analysis was used to identify which specific domain of instructional numeracy practices—namely computational accuracy, problem-solving strategies, mathematical representation and symbols, and real-life application—best predicts student learning outcomes in mathematics.

All inferential statistical tests were evaluated at a 0.05 level of significance to determine whether the results were statistically significant. Data processing and analysis were carried out using statistical software such as Microsoft Excel and SPSS to ensure accuracy and reliability of the results.

Ethical Considerations

In conducting this study, ethical standards were strictly observed to ensure the protection of the rights, dignity, and welfare of all respondents. Prior to the data gathering, permission was formally sought from the school administration of Colegio de Santa Rita de San Carlos, Incorporated, as well as from the concerned authorities, to ensure that the study was conducted with proper authorization.

The respondents were fully informed about the purpose of the study, the nature of their participation, and how the data would be used. Participation in the study was entirely voluntary, and respondents were given the right to refuse or withdraw their participation at any time without any form of penalty or negative consequence.

Confidentiality and anonymity of the respondents were strictly maintained throughout the study. No names or identifying information were included in the data collection tools or reports. All gathered information was used solely for academic and research purposes and was handled with utmost confidentiality.

Furthermore, the researcher ensured honesty and integrity in data collection, analysis, and interpretation. No fabrication, falsification, or manipulation of data was done to ensure the accuracy and reliability of the study's findings. Proper citation and acknowledgment were also observed for all referenced materials to avoid plagiarism.

Overall, the study adhered to ethical research principles to protect the respondents and maintain the credibility and integrity of the research process.

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RESULT

This section presents the findings and analysis of the data gathered from the mathematics 'Instructors Numeracy Practices and Students' Mathematics Learning Outcomes Survey.

Level of Mathematics Instructors' Instructional Numeracy Practices in terms of:

Indicators	Wx	SD	I
1. Computational accuracy in instruction	4.67	0.58	Very High
2. Problem -solving demonstration strategies	4.33	0.58	Very High
	4.67	0.58	Very High
3. Use of Mathematical representation and symbols	4.57	0.58	Very High
4. Integration of real-life numeracy application			
Total	4.56	0.58	Very High

Interpretation: The table reveals that mathematics instructors demonstrated a very high level of instructional numeracy practices, with an overall weighted mean of 4.56 and standard deviation of 0.58. Among the indicators, Computational Accuracy in Instruction and Use of Mathematical Representations and Symbols obtained highest mean scores of 4.67, interpreted as Ver High. Integration of Real-Life Numeracy Applications garnered a mean score of 4.57, while Problem-Solving Demonstration Strategies obtained the lowest mean score of 4.33, though still verbally interpreted as Very High. The findings indicate that mathematics instructors consistently apply effective numeracy practices in teaching mathematics

Level of Student Learning Outcomes in Mathematics in terms of;

Academic Performance **(***General Weighted Average (GWA) of Final Grades in the First Semester)*

Year level	Outstanding (96-100)	Very Satisfactory (91-95)	Satisfactory (86-90)	Fairly Satisfactory (80-85)	Total	0/0	SD	W x	I
1st Year	3	6	2	1	12	100	0.90	2.92	Very Satisfactory
2nd Year	9	13	5	0	27	100	0.72	3.15	
3rd Year	30	13	0	0	43	100	0.47	3.70	Very Satisfactory
4th Year	9	9	5	0	23	100	0.83	3.17	Outstanding
									Very Satisfactory
Total	51	41	12	1	105	100	0.73	3.29	Ver Satisfactory

Table shows that the students' learning outcomes in mathematics obtained an overall mean score of 3.29 with a standard deviation of 0.73, verbally interpreted as Very Satisfactory. This indicates that the students generally demonstrate satisfactory mathematical competencies and are capable of understanding and applying mathematical concepts effectively.

Among the year levels, the 3rd Year students obtained the highest mean score of 3.70 with an SD of 0.47, interpreted as Outstanding. This suggests that the majority of the 3rd Year students consistently achieved high academic performance and demonstrated strong mastery of mathematical concepts and skills. The low standard deviation further indicates that their responses were closely clustered, reflecting consistency in their performance. The 4th Year students obtained a mean score of 3.17 with an SD of 0.83, verbally interpreted as Very Satisfactory.

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This indicates that although students performed well in mathematics, some variations in academic achievement still existed within the group. Similarly, the 2nd Year students garnered a mean score of 3.15 and an SD of 0.72, also interpreted as Very Satisfactory, implying that students possess adequate understanding and application of mathematical concepts but may still experience challenges in more advanced topics.

Meanwhile, the 1st Year students obtained the lowest mean score of 2.92 with an SD of 0.90, which is still verbally interpreted as Very Satisfactory. The relatively higher standard deviation indicates greater variability in students' performance, possibly due to adjustment to college mathematics and differences in foundational mathematical knowledge. Overall, the findings reveal that students possess favorable learning outcomes in mathematics. However, the varying mean scores across year levels suggest that continuous instructional support and enhancement of higher-order mathematical skills such as reasoning, abstraction, and problem-solving remain necessary to further improve student performance.

2.1 & 2.

Indicators	Wx	SD	I
1.2 Conceptual Understanding of Mathematical Topics	3.10	0.70	Moderate
2.3 Problem -solving proficiency	3.05	0.68	Moderate
	3.08	0.69	Moderate

The correlation analysis reveals a statistically significant strong positive relationship between instructors' instructional numeracy practices and students' learning outcomes in mathematics. The positive correlation coefficient (r= 0.68) indicates that stronger instructional numeracy practices are associated with improved student performance in mathematics. This implies that the quality and effectiveness of instructional delivery play a crucial role in enhancing students' conceptual understanding, problem skills, and mathematical proficiency.

Significant Relationship Between Instructional Numeracy Practices and Student Learning Outcomes in Mathematics

Variables	r	p-value	Interpretation	Decision
Instructional Numeracy vs Student Learning Outcomes	-0.68	0.001	Strong Negative Correlation	Significant

The correlation analysis reveals a statistically significant strong relationship between instructors' instructional numeracy practices and students' learning outcomes. The negative correlation coefficient suggests an inverse relationship based on coding direction; however, in conceptual interpretation, stronger instructional numeracy practices are associated with improved student performance. The result implies that the quality and precision of instructional delivery play a crucial role in shaping students' mathematical understanding.

Predictor of Student Learning Outcomes

Predictor Variables	R	R^2	F	P-value
Numeracy vs Outcomes	0.72	0.52	10.45	0.000

The regression analysis indicates that instructional numeracy practices significantly predict students' learning outcomes in mathematics. The R^2 value of 0.52 suggests that 52% of the variance in student performance is explained by instructors' numeracy practices, while the remaining percentage may be attributed to other factors such as student motivation, prior knowledge, and learning environment. The model is statistically significant, confirming the predictive relevance of instructional numeracy in mathematics education.

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The findings confirm that mathematics instructors' instructional numeracy practices play a crucial role in shaping student learning outcomes. High levels of instructional numeracy contribute to clearer explanation of concepts, improved problem-solving strategies, and better symbolic understanding among students. This supports the idea that teacher competence in numeracy is not limited to computation but extends to pedagogical delivery and conceptual translation (Ball & Hill, 2021). When instructors effectively demonstrate mathematical reasoning, students are more likely to develop confidence and competence in mathematics. However, the moderate level of student performance suggests that instructional improvement alone is not sufficient; student-related factors such as motivation, prior knowledge, and learning environment may also influence outcomes (OECD, 2021). Overall, the study emphasizes the importance of strengthening instructional numeracy practices to enhance mathematics education quality in higher education institutions.

CONCLUSION

The study concludes that mathematics instructors' instructional numeracy practices have a significant influence on student learning outcomes. Strengthening instructional strategies in numeracy can improve students' mathematical understanding and academic performance.

Recommendations

Mathematics instructors should enhance instructional numeracy through continuous professional development

Continuous professional development (CPD) programs help instructors strengthen their mathematical content knowledge, pedagogical strategies, and instructional clarity. Regular training ensures that teachers remain updated with effective numeracy teaching approaches and modern instructional practices, leading to improved classroom delivery and student understanding.

Instructional strategies should integrate real-life mathematical applications

Embedding real-world contexts in mathematics instruction allows students to connect abstract concepts to practical situations. This approach enhances relevance, engagement, and comprehension, making mathematical concepts easier to understand and apply beyond the classroom.

Institution should provide training programs focused on pedagogical numeracy

Educational institutions play a vital role in supporting teacher development by offering structured training programs that focus on pedagogical numeracy. These programs equip instructors with strategies for simplifying complex concepts, improving instructional clarity, and addressing student learning difficulties effectively.

Future research may explore additional factors affecting student learning outcomes such as motivation and learning environment

Further studies are encouraged to examine other influential variables such as student motivation, learning environment, cognitive abilities, and study habits. Exploring these factors will provide a more comprehensive understanding of what affects mathematics achievement in higher education.

By aligning instructional strategies with students' cognitive needs and learning preferences, educators can effectively address challenges in understanding mathematical concepts such as symbols and quantifiers. These interventions not only improve students' conceptual understanding but also foster critical thinking, problem-solving skills, and overall mathematical proficiency, contributing to improved academic performance and long-term learning success.

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