STUDENT JOURNAL OF
TECHNOLOGY AND EDUCATIONAL RESEARCH
ISSN (Print): 2945-381X; (Online): 3082-5563 | VOLUME 3, SPECIAL ISSUE 1 (2026)

INFLUENCE OF MATHEMATICAL FLUENCY ON MATHEMATICS PERFORMANCE AMONG FIRST-YEAR PRE-SERVICE TEACHERS IN ISABELA STATE UNIVERSITY

Angel Grace Bernardo, Leonard Delos Reyes, Veejay Mamauag,
Lowrence Senoja, Angel Lyca Ualat
Isabela State University-Echague Campus

Keywords:
Mathematical Fluency, Conceptual Fluency, Procedural Fluency, Mathematics Performance, Pre-Service Teachers

DOI:
10.65141/sjter.sp2026.07

Abstract

This study investigated the mathematical fluency and performance of first-year pre-service teachers in Isabela State University, focusing on conceptual and procedural fluencies and their relationship to performance in Mathematics in the Modern World. A total of 117 respondents, representing various fields of specialization, participated in the study. Findings revealed that respondents generally demonstrated partial proficiency in both conceptual (45.30%) and procedural (55.90%) fluencies, with procedural skills slightly higher than conceptual understanding. Mathematics majors exhibited significantly higher conceptual fluency compared to other specializations, while procedural fluency showed no significant differences across groups. Overall mathematics performance was found to be at a satisfactory level, with the largest proportion of students falling under the "Fairly Satisfactory" category. Correlation and regression analyses indicated that mathematical fluency does not significantly influence mathematics performance, suggesting that other factors may contribute more substantially to students' achievement in mathematics. It is recommended that instructional strategies not only target procedural skills but also enhance conceptual understanding and application of mathematical knowledge to improve overall performance.

INTRODUCTION

Mathematical fluency, which includes both conceptual understanding and procedural proficiency, is a core dimension of mathematical proficiency and has been widely identified as essential for successful mathematical reasoning and learning. Conceptual understanding enables learners to make sense of mathematical ideas and their connections, while procedural fluency involves the accurate, flexible, and efficient execution of mathematical procedures (National Council of Teachers of Mathematics, 2014) . These two strands are interrelated; neither alone ensures deep competence, making both vital for students who will teach mathematics at the secondary level.

In the context of higher education, especially in teacher preparation programs, the level of mathematical fluency among pre-service teachers influences not only their own academic

performance in mathematics courses but also their professional readiness. Research on student teachers shows that many pre-service teachers demonstrate low levels of procedural fluency even when they express confidence in teaching, indicating a misalignment between beliefs and actual mathematics skills (Valencia et al., 2026) . Similarly, studies have emphasized the importance of developing both conceptual understanding and procedural skills in teacher education because these competencies underpin effective teaching and students' later achievements in mathematics (Schulz, 2023) .

Although international studies consistently report systemic weaknesses in mathematical proficiency among Filipino learners, the implications extend into higher education. In the 2022 Programme for International Student Assessment (PISA), Filipino students scored 355 points in mathematics, significantly below the OECD average of 472 points, and only 16 % attained at least the minimum proficiency level, compared to an average of 69 % across OECD countries, indicating persistent gaps in mathematical understanding and reasoning before university entry (OECD, 2023) . The 2019 Trends in International Mathematics and Science Study (TIMSS) further shows that Filipino students scored among the lowest internationally, with a mean score of 297 in fourth-grade mathematics, which reflects challenges in foundational skills that many university entrants also carry forward (TIMSS & PIRLS International Study Center, 2023) . These results suggest that many pre-service teachers may enter higher education with unfinished learning in key mathematical concepts and procedures.

Despite the recognized importance of mathematical fluency and evidence of low performance among learners, there is limited empirical research in the Philippine setting that explicitly investigates how conceptual and procedural fluency influence mathematics performance among first-year pre-service teachers. Most studies focus on basic education outcomes or broad teaching efficacy beliefs without isolating the distinct contributions of these two strands of fluency to academic success in higher education. Addressing this gap is crucial because future mathematics teachers who lack fluency are less prepared to teach complex mathematics concepts effectively, potentially perpetuating the cycle of low mathematical achievement in basic education. Therefore, this study aims to examine the influence of mathematical fluency on mathematics performance among first-year Bachelor of Secondary Education students at Isabela State University, providing evidence to guide teacher preparation programs and curricula.

METHODS

Research Design

This study used a descriptive-correlational research design to determine the relationship between the students' mathematical fluency and literacy. This design enables the researchers to measure the degree of relationship between these two variables.

Respondents and Locale of the Study

The respondents of the study were the first-year students enrolled in the Bachelor of Secondary Education program, currently taking Mathematics in the Modern World at Isabela State University-Echague Campus. To determine the sample size, the researchers used Cochran's formula for a finite population, with a margin of error of 0.05, a Z-value of 1.96, and

an estimated population proportion of 0.5. A stratified sampling technique was employed to select the respondents for the study.

Research Instrument

The research instrument consists of two components. Part I collects the respondents' profile details, such as their name and course. This section aims to outline the demographic characteristics of the participants, which can be used for classification and analytical purposes. Part II comprises the actual assessment designed to evaluate the students' mathematical skills. It includes items that measure both procedural fluency (the ability to correctly execute mathematical procedures and perform calculations) and conceptual understanding (the capacity to comprehend mathematical concepts, principles, and relationships). The assessment tool for mathematical fluency was content validated by mathematics teachers prior to its administration.

Data Gathering Procedure and Analysis

The researchers first requested permission from the teachers to conduct the study. After receiving approval, the researchers identified the student respondents to participate in the research. The researchers provided a consent form to the students, explaining the study and assuring them that their responses would remain confidential and used solely for academic purposes.

The data collected were then organized and encoded for analysis. Appropriate statistical tools were employed to examine the relationship between the variables. Specifically, frequency count, percentage, and mean were used to describe the profile, academic performance, and mathematical fluency of the respondents. Pearson's r correlation coefficient was used to determine the strength and direction of the relationship between mathematical fluency and mathematics performance. One-way ANOVA was employed to determine the differences in the mathematical fluency of the respondents based on fields of specialization. Finally, multiple linear regression was used to determine if mathematical fluency predicts mathematics performance of the respondents.

Ethical Considerations

Prior to the data gathering, the researchers asked permission from the instructor to administer the instruments during class hours. The respondents were informed about the purpose of the study and assured that their participation was voluntary. Only respondents who agreed and signed the consent form were part of the study. The researchers also ensured that all gathered data were kept confidential and were only used for academic purposes related to this research.

RESULTS AND DISCUSSION

Profile of the Respondents

Table 1 presents the profile of the respondents in terms of their fields of specialization. As shown in the table, the majority of the respondents are specializing in Mathematics, followed by those in Social Science specialization. Meanwhile, students specializing in Filipino and English comprise 17% and 24% of the respondents, respectively.

Table 1. Frequency Count and Percentage of Respondents by Fields of Specialization

Profile	Frequency (n=118)	Percent
BSE Mathematics	37	31.36%
BSE Filipino	21	17.80%
BSE Social Science	31	26.27%
BSE English	29	24.57%

Mathematical Fluency of the Respondents

Table 2. Mathematical Fluency of the Respondents

Mathematical Fluency	Mean Score (10 items)	Percentage Score	Fluency Level
Conceptual Fluency	4.53	45.30	Approaching Proficiency
Procedural Fluency	5.59	55.90	Approaching Proficiency

80-100: Advanced; 60-79: Proficient; 40-59: Approaching Proficiency; 20-39: Developing; 0-19: Beginning

Table 2 provides the mathematical fluency of the respondents in terms of conceptual and procedural fluencies. The results reveal that respondents obtained a mean score of 4.53 (45.30%) in conceptual fluency and 5.59 (55.90%) in procedural fluency. Based on the given scale, both dimensions fall under the "Approaching Proficiency" level, indicating that while students demonstrate partial understanding and skills, they have not yet fully achieved mastery in either domain.

A closer examination shows that procedural fluency is relatively higher than conceptual fluency. This suggests that respondents are more capable of performing mathematical procedures, such as applying formulas than they are at understanding underlying mathematical concepts and relationships. Such a pattern implies that students may rely more on memorization and routine processes rather than deep comprehension, which is essential for flexible problem-solving and transfer of learning.

Difference in the Mathematical Fluency of the Respondents

Table 3. Difference in the Mathematical Fluency of the Respondents when Grouped According to Fields of Specialization

Mathematical Fluency	Group Means				F-value	p-value
	(a) Filipino	(b) Social Science	(c) Mathematics	(d) English		
Conceptual Fluency	3.48[c]	3.90[c]	5.62[abd]	4.55[a]	14.03	<.001
Procedural Fluency	5.24	5.23	6.24	5.41	56.51	0.11

Table 3 presents the difference in the mathematical fluency of the respondents when grouped according to their fields of specialization. The results reveal that for conceptual fluency, there is a statistically significant difference among the groups, as indicated by an F-

value of 14.03 and a p-value of less than .001. This suggests that students' level of conceptual understanding in mathematics varies significantly depending on their field of specialization.

In particular, students specializing in Mathematics obtained the highest mean score (5.62), followed by those in English (4.55), Social Science (3.90), and Filipino (3.48). The post-hoc test further indicates that Mathematics majors significantly differ from the other groups, implying that their stronger exposure to mathematical concepts likely contributes to their higher conceptual fluency.

On the other hand, for procedural fluency, the results show no statistically significant difference among the groups, as reflected by an F-value of 56.51 and a p-value of 0.11. Although Mathematics majors still obtained the highest mean (6.24), followed by English (5.41), Filipino (5.24), and Social Science (5.23), these differences are not large enough to be considered statistically significant. This indicates that students across different specializations tend to have relatively similar abilities in performing mathematical procedures and computations.

Mathematics Performance of the Respondents

Table 4. Mathematics Performance of the Respondents

Grade Description	Frequency (n=118)	Percent
Very Satisfactory(1.25)	24	20.00
Satisfactory(1.50)	14	12.00
Fairy satisfactory(1.75)	54	46.00
Good(2.0)	26	22.00
Average	**1.67 (Satisfactory)**	

Table 4 presents the mathematics performance of the respondents based on their grades in Mathematics in the Modern World, a General Education course in mathematics in Philippine Higher Education. The table reveals that the largest proportion of students (46.00%) falls under the "Fairly Satisfactory" category (1.75), followed by those classified as "Good" (22.00%) and "Very Satisfactory" (20.00%). A smaller proportion (12.00%) attained a "Satisfactory" rating. The computed overall mean of 1.67 corresponds to a "Satisfactory" level of performance, indicating that, on average, students demonstrate acceptable but not outstanding proficiency in mathematics.

Relationship Between Mathematics Performance and Mathematical Fluency

Table 5. Relationship between Mathematics Performance and Mathematical Fluency

Mathematical Fluency	r-value	p-value
Conceptual Fluency	0.06	0.53
Procedural Fluency	0.01	0.91

Table 5 shows the relationship between mathematics performance and mathematical literacy among the respondents. As evidenced by their p-values, it can be concluded that mathematical fluency does not significantly correlate to mathematics performance. This indicates that higher levels of fluency in mathematical concepts and procedures do not necessarily translate to better overall performance in mathematics. This result negates the

findings of Schulz (2023) who corroborated that mathematical fluency influences mathematics performance of the students.

A regression analysis further revealed that mathematical fluency does not influence mathematics performance. This is evidenced by the p-values of the omnibus ANOVA test of the regression analysis which is greater than the alpha level. This implies that conceptual and procedural fluencies do not necessarily influence the mathematics performance of the students.

Table 6. Model Coefficients

Model	R	R^2	Conceptual Fluency		Procedural Fluency	
			F	p-value	F	p-value
1	0.06	0.00	0.38	0.54	0.01	0.93

CONCLUSION AND FUTURE WORKS

Based on the results, it can be concluded that while respondents demonstrate partial proficiency in both conceptual and procedural fluencies, their overall mathematical performance remains at a satisfactory level, with procedural skills slightly stronger than conceptual understanding. Mathematics majors exhibit higher conceptual fluency compared to other specializations, yet procedural fluency is relatively consistent across all fields of specialization. Despite differences in fluency, the analysis indicates that mathematical fluency, whether conceptual or procedural, does not significantly correlate with or influence mathematics performance. This suggests that other factors may play a more critical role in determining students' success in mathematics. It is recommended that interventions focus not only on improving fluency but also on enhancing conceptual understanding and practical application of mathematical knowledge.

ACKNOWLEDGMENT

The authors express their deepest gratitude to God for providing them with the knowledge, wisdom, and ability to carry out this study. It is only by His grace that they have been sustained throughout this endeavor.

The researchers sincerely thank their research adviser, Sir Randy P. Acoba, for his continuous guidance, wise counsel, and invaluable support throughout the study. The help and knowledge you shared greatly contributed to the successful completion of this paper.

Special thanks are also extended to the teachers and administrators of Isabela State University Main Campus, particularly those in the College of Education, for allowing the researchers to conduct the study and for their cooperation during data collection. Your assistance was greatly appreciated.

The authors also wish to thank the group of students who voluntarily participated in the study. Without their responses to the questionnaires, meaningful results could not have been generated.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding this paper.

DECLARATION OF AI USE

ChatGPT and Grammarly were used to assist the researchers in paraphrasing the selected portions of the text to improve clarity and coherence. This tool did not influence the methods, analysis, and interpretation of results. Final responsibility rests with the authors.

REFERENCE

National Council of Teachers of Mathematics (NCTM). (2014). Procedural Fluency in Mathematics (Procedural fluency definition and relation to conceptual understanding).

Organisation for Economic Co-operation and Development (OECD). (2023). PISA 2022 Results: Philippine mathematics performance below OECD averages.

Schulz, A. (2023). Assessing student teachers' procedural fluency and strategic competence. Journal of Mathematics Teacher Education: conceptual & procedural fluency in teacher preparation.

TIMSS & PIRLS International Study Center. (2023). TIMSS 2019 International Results in Mathematics and Science

Valencia, R. J. A., Pal, A. M. B., & Manog, G. D. (2026). Pre-Service Teachers' Mathematics Teaching Efficacy Beliefs and Procedural Fluency. Journal of Tertiary Education and Learning: evidence on low procedural fluency among pre-service teachers.