ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue XI November 2025

Post-Pandemic Study Between the Students' Attitude Towards Mathematics and their Level of Mastery on the Fundamental Operations of Integers

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DOI: https://dx.doi.org/10.51244/IJRSI.2025.12110101

Received: 24 November 2025; Accepted: 01 December 2025; Published: 10 December 2025

ABSTRACT

This study examined the relationship between students' attitudes toward mathematics and their mastery of the fundamental operations of integers in the post-pandemic context. Using a descriptive-correlational research design, data were gathered from 146 Grade 7 students across three public secondary schools in Mandaue City, Philippines during the 2022–2023 school year. Students' attitudes were measured using the Attitude Toward Mathematics Inventory (ATMI), while their mastery of integer operations was assessed using the Integer Test of Primary Operations (ITPO). Descriptive results showed that students generally exhibited a neutral attitude toward mathematics in terms of self-confidence, enjoyment, and motivation, while demonstrating a positive attitude toward the value of mathematics. In contrast, the majority of students (73.97%) performed at the Beginning level in integer operations, indicating substantial learning gaps following the pandemic. Spearman's rho revealed a statistically significant but weak positive correlation between students' attitudes toward mathematics and their mastery of integer operations ($r_s = 0.181$, $p = .029$). This suggests that although students with more positive attitudes tend to show higher mastery, attitude alone explains only a small portion of performance variance. The findings highlight the need to strengthen both cognitive and affective dimensions of mathematics learning through targeted instructional interventions. Improving foundational skills while simultaneously fostering confidence, enjoyment, and motivation may better support student recovery from pandemic-related learning losses.

Keywords— Teaching Mathematics, Attitude, Mastery Level, Descriptive-Correlational, Mandaue City, Cebu, Philippines

INTRODUCTION

The COVID-19 pandemic disrupted traditional schooling and forced an abrupt shift to remote learning, resulting in substantial learning loss and diminished student engagement, particularly in mathematics. Limited interaction, unequal access to technology, and reduced instructional supervision contributed to gaps in students' understanding of foundational mathematical concepts. As schooling resumed onsite, these deficits became more visible, especially in competencies requiring fundamental numerical skills such as the operations of integers. Mastery of integer operations is essential because it underpins more advanced mathematical ideas, including algebraic reasoning, functional relationships, and problem solving (Van de Walle, Karp, & Bay-Williams, 2013). Deficiencies at this foundational level hinder students' progression to higher mathematics and related STEM fields, where negative number reasoning is indispensable (Nurnberger-Haag, Kratky, & Karpinski, 2022).

Student attitudes toward mathematics are a critical but often underexamined factor influencing achievement. Attitude encompasses learners' beliefs, emotions, and dispositions toward the subject, shaping motivation, engagement, and performance (Mazana, Montero, & Casmir, 2019). The Expectancy–Value Theory posits that learners' success expectations and perceived value of tasks significantly affect their behavior and academic outcomes (Eccles & Wigfield, 2020). Likewise, Stimulus–Response theory underscores how feedback, reinforcement, and learning experiences contribute to the development of either positive or negative dispositions toward mathematics (Thorndike, 1898). Constructivist perspectives further highlight that learners actively

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construct understanding based on prior knowledge and meaningful interactions, making positive learning environments crucial for conceptual development (Piaget, 1952; Bruner, 1960).

The Philippine K–12 curriculum adopts a spiral progression approach in which fundamental operations of integers taught in the elementary level are revisited and expanded in Grade 7. However, post-pandemic monitoring reports indicate that many learners have not retained these competencies, raising concerns about curriculum continuity and student readiness. Understanding how attitudinal factors relate to students' current mastery levels is vital for designing interventions that support both affective and cognitive recovery in mathematics education.

Therefore, this study investigates the relationship between Grade 7 students' attitudes toward mathematics and their mastery of fundamental integer operations in the post-pandemic context. Specifically, it aims to determine students' attitudinal profiles across four domains—self-confidence, value, enjoyment, and motivation—assess their mastery level of integer operations, and examine whether a significant correlation exists between these variables. The findings serve as a basis for strengthening pedagogical approaches to rebuild foundational numeracy and foster more positive mathematical dispositions among learners.

METHODS

Research Design

This study employed a descriptive–correlational research design to examine the relationship between students' attitudes toward mathematics and their mastery of the fundamental operations of integers. This design was appropriate because it allowed the researchers to measure existing conditions and determine the degree of association between attitudinal factors and performance outcomes without manipulating variables.

Research Environment

The study was conducted in three public junior high schools in the Mandaue City Schools Division, Philippines: Don Gerardo Ll. Ouano Memorial National High School, Mandaue City Comprehensive National High School, and Mandaue City Science High School. These schools share similar instructional contexts and reported comparable post-pandemic learning concerns based on School Monitoring, Evaluation, and Adjustment (SMEA) results.

Respondents

The respondents were Grade 7 students enrolled during the 2022–2023 academic year. A total of 146 valid responses were obtained. Sample size determination followed Slovin's formula with a 5% margin of error. Proportional stratified random sampling ensured representation from all three schools, reflecting the distribution of their Grade 7 populations.

Instruments

Two standardized instruments were used:

Attitude Toward Mathematics Inventory (ATMI). The ATMI (Tapia & Marsh, 2004) consists of 40 Likert-scale items measuring four attitudinal domains: self-confidence, value, enjoyment, and motivation. Responses ranged from 1 (strongly disagree) to 5 (strongly agree), with negatively worded items reverse-scored. The instrument is widely validated and suitable for secondary-level learners.

Integer Test of Primary Operations (ITPO). The ITPO (Nurnberger-Haag, Kratky, & Karpinski, 2022) is an open-ended assessment composed of 30 items measuring students' mastery of addition, subtraction, multiplication, and division of integers. Items were dichotomously scored (correct/incorrect). The test was cross-checked with the Most Essential Learning Competencies (MELCs) of the K–12 Mathematics Curriculum and validated by the Mathematics Supervisor prior to administration.

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Data Gathering Procedures

Formal permission was secured from school authorities through transmittal letters. Informed consent and assent were obtained from all participants. The researchers administered the ATMI and ITPO during scheduled sessions, coordinated with mathematics teachers to avoid disruption of regular classes. Completed questionnaires were collected, screened for completeness, encoded, and prepared for analysis. Confidentiality and ethical guidelines were strictly observed.

Statistical Treatment

Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to summarize attitude levels and mastery scores. Mastery levels were interpreted using the proficiency descriptors of DepEd Order No. 73, s. 2012. Since ATMI data were ordinal and ITPO scores were not normally distributed (as confirmed by the Shapiro–Wilk test), Spearman's rank-order correlation was used to determine the relationship between attitude and mastery. A 95% confidence level ($\alpha = .05$) guided significance testing.

RESULTS AND DISCUSSION

Students' Attitudes Toward Mathematics

Analysis of the Attitude Toward Mathematics Inventory (ATMI) revealed that students generally exhibited a neutral attitude toward mathematics across most domains. As shown in *Table 1*, the domains of self-confidence, motivation, and enjoyment recorded mean scores within the neutral range. These results suggest that students neither strongly dislike nor strongly favor mathematics, but instead demonstrate moderate or undecided dispositions toward the subject.

In contrast, the value domain yielded a positive attitude, indicating that most students recognize the usefulness and importance of mathematics in daily life and future endeavors. This aligns with previous findings that students tend to appreciate the relevance of mathematics even when they experience difficulty engaging with the subject (Mazana et al., 2019). Among the three participating schools, Mandaue City Science High School showed the most positive overall attitude, likely reflecting its academically oriented student population.

Domain	Mean Score	**Interpretation**
Self-confidence	2.97	Neutral Attitude
Value	4.04	Positive Attitude
Enjoyment	3.55	Neutral Attitude
Motivation	3.42	Neutral Attitude
Overall Attitude	3.50	**Neutral Attitude**

Table 1: Students' Attitudes Toward Mathematics Across Four Domains

Students' Mastery of Fundamental Integer Operations

Performance results from the Integer Test of Primary Operations (ITPO) showed that a substantial majority of students demonstrated low mastery of the fundamental operations of integers. As presented in Table 2, 73.97% of the respondents fell under the Beginning proficiency level, with only a small proportion reaching Proficient or Advanced levels. The mean mastery score (M = 56.28%) further supports the conclusion that students face significant challenges in performing basic integer operations.

These findings align with national concern over post-pandemic learning loss, particularly in mathematics, where foundational competencies such as integer operations were insufficiently reinforced during remote learning.

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Prior studies emphasize that mastery of these operations is essential for success in algebra and other higher mathematics (Van de Walle et al., 2013; Nurnberger-Haag et al., 2022).

Mastery Level	Frequency	Percentage
Beginning (≤74%)	108	73.97%
Developing (75–79%)	8	5.48%
Approaching Proficiency (80–84%)	7	4.79%
Proficient (85–89%)	7	4.79%
Advanced (≥90%)	16	10.96%
Total	**146**	**100%**

Table 2. Students' Mastery Level in Fundamental Integer Operations

Correlation Between Attitude and Mastery

Spearman's rank-order correlation revealed a statistically significant but weak positive relationship between students' attitudes toward mathematics and their mastery of integer operations ($r_s = .181$, $p = .029$). As shown in *Table 3*, this suggests that students with more positive attitudes tended to have slightly higher mastery scores, although the effect size was small. The coefficient of determination (3.28%) indicates that attitude explains only a limited proportion of the variance in mastery.

This outcome supports the Expectancy–Value Theory, which posits that students' beliefs and values influence achievement-related behaviors (Eccles & Wigfield, 2020), but also underscores that attitude alone does not fully determine performance. Other factors—such as prior knowledge, instructional quality, learning environments, and pandemic-related disruptions—likely played a substantial role in the observed mastery gaps.

Overall, the results highlight the importance of addressing both cognitive and affective domains in mathematics instruction. Improving students' foundational skills while cultivating confidence, motivation, and enjoyment may enhance learning outcomes more effectively than focusing on either dimension in isolation.

Variables Correlated	n	Spearman's rho	p-value
ATMI Score × ITPO Mastery Level	146	0.181	0.029*

Table 3. Spearman's Correlation Between Students' Attitudes and Integer Mastery

CONCLUSION

This study investigated the relationship between students' attitudes toward mathematics and their mastery of the fundamental operations of integers in the post-pandemic learning environment. Overall, students demonstrated a neutral attitude toward mathematics in terms of self-confidence, motivation, and enjoyment, while expressing a positive view of the subject's value. Despite this, most students exhibited low proficiency in integer operations, with the majority performing at the Beginning level. These results highlight a substantial gap between students' recognition of mathematics as important and their ability to demonstrate foundational numerical skills.

The correlation analysis revealed a statistically significant but weak positive relationship between attitude and mastery, indicating that students with more favorable attitudes tend to perform slightly better in integer

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operations. However, attitude accounted for only a small portion of performance variability, suggesting that other factors—such as prior instructional quality, learning disruptions during the pandemic, and foundational skill deficits—play a more influential role in shaping mathematical outcomes.

The findings underscore the need for instructional interventions that integrate both affective and cognitive support. Strengthening students' mastery of basic mathematical skills while cultivating confidence, motivation, and enjoyment may accelerate learning recovery and lay a more stable foundation for future mathematics achievement. Future research may explore additional variables influencing mastery, including students' learning experiences, home support, and teacher practices.

ACKNOWLEDGEMENT

The authors truly appreciate the Mandaue City Schools Division and Cebu Technological University—Main Campus for their cooperation and permission to undertake this study. We would want to express our gratitude to Grade 7 teachers, Math Coordinators and school administrations from Don Gerardo Ll. Ouano Memorial National High School, Mandaue City Science High School, and Mandaue City Comprehensive National High School for their collaboration and support during the data collection process. The Grade 7 students who took part in this study are also thanked by the authors for their time and commitment. Their assistance was essential to the study's completion. The authors also thank the panel members and their thesis supervisor for their advice, which greatly improved the manuscript's quality. Lastly, the authors extend their appreciation to all individuals who provided support throughout the research process.

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