European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available online at: www.oapub.org/edu

DOI: 10.46827/ejes.v12i12.6451 Volume 12 | Issue 12 | 2025

# NAVIGATING THE CHALLENGES: STUDENTS' SKILLS AND CONFUSION IN INTEGER OPERATIONS

**Keshia R. Pariño[1i],**
**Mellonnah V. Canoy[2],**
**Marjorie I. Augusto[3]**
[1]Junior High School Mathematics Teacher,
Sangat National High School,
Sangat, San Fernando,
Cebu, Philippines
[2]Senior High School Mathematics Teacher,
Sangat National High School,
Sangat, San Fernando,
Cebu, Philippines
[3]Elementary School Teacher,
Mactan Elementary School,
Mactan, Lapu-Lapu City,
Cebu, Philippines

**Abstract:**
This research investigated the relationship between students' skills and confusion in performing operations on integers among the Grade 8 students at a public high school in Lapu-Lapu City, Cebu, Philippines, for the school year 2024-2025 using a descriptive correlational research design. There were 187 Grade 8 learners who participated in the study, who were identified using simple random sampling. The data gathered were treated using frequency count, percentage, weighted mean, standard deviation and Pearson's r. The results showed that most of the respondents have a satisfactory level of performance in performing operations on integers. On the other hand, the respondents have moderate confusion about the operations on integers. Interestingly, there was a significant relationship between respondents' skills and confusion in integer operations. It is concluded that confusion towards fundamental rules and operations has a bearing on their skill level in integer operations. Hence, it is recommended that teachers utilize strategies that enhance students' understanding of the basic rules of the operations on integers to minimize confusion in their application.

**Keywords:** skills, confusion, operations on integers, grade seven students

[i] Correspondence: email baxiang1234parino@gmail.com

 

## 1. Introduction

Mathematics as part of the education curriculum aims to equip individuals with the skills and knowledge to succeed in many aspects of life, from daily tasks to advanced scientific reasoning (Agbata *et al.*, 2024). It encourages logical reasoning and problem-solving skills. It teaches students how to approach problems methodically, break them down into smaller parts and find solutions. Math as part of everyday life is used for budgeting, cooking, shopping, arts and home repairs. It helps people make informed decisions and manage their personal and professional lives effectively. It is crucial in technological advancement, as it develops understanding for innovations in technologies, from computer algorithms to data analysis. Learning math helps develop cognitive abilities such as memory, attention and spatial reasoning (Hawes & Ansari, 2020). It also enhances creativity by encouraging people to think abstractly and explore different solutions. A strong understanding of math will lead to different career opportunities; it can open doors to a wide range of job opportunities (Alam & Mohanty, 2023). Despite the many benefits of mathematics, many individuals still find it hard to understand basic math concepts (Peconcillo *et al.*, 2020).

The learning challenges and problems have been great in education, especially since the Department of Education in the Philippines is still in the process of adopting the National Learning Recovery Program (NLRP) through DepEd Order No. 013, s. 2023, due to the Distance Learning Modalities during the COVID-19 pandemic. The modalities of learning during the pandemic have greatly increased the problems in education by causing severe learning gaps in the area of Mathematics (Saga *et al.*, 2023). The learning gaps among learners all throughout the elementary and secondary levels of education are undeniable. While the department is doing its part to solve these learning gaps, educators on their end are doing their part to participate through conducting action research and even designing a thesis that would help solve the pending challenges and problems in education. Even before the COVID-19 pandemic, there were already existing problems and challenges. In 2019, the Philippines participated in the Trends in International Mathematics and Science Study (TIMSS) alongside 58 countries worldwide. The Philippines scored 297 in mathematics, the lowest of all participating countries (Santos *et al.*, 2025). This result leads to various studies in the country to identify the factors of poor performance in mathematics. One reason for the students' poor performance is a lack of basic mathematical skills, specifically in grasping the concepts of integers and mastering integer arithmetic.

Many educators in mathematics agree that the gateway to higher mathematics is the first-year algebra course (Bolyard & Moyer-Packenham, 2012). One of the basic and important skills high school students must master to understand algebra is integer arithmetic. In the Philippines, this skill in mathematics is introduced at the onset of junior high school. This skill is crucial because it is foundational in mathematics, also called pre-algebra. It will affect students' readiness and attitude toward grasping mathematical concepts in algebra, the fundamental language of mathematics, as they advance to the next level. Mathematics teachers of a public high school in a highly urbanized city in

Cebu, Philippines, have observed that the students have a hard time inculcating lessons in higher math at different levels, leading them to more confusion in the subject area. The presence of signed numbers marks a different perception for junior high school students, especially since they are used in dealing with whole numbers and positive rational numbers all throughout their elementary years. Signed negative numbers are still one of the known issues that students have difficulty learning mathematics (Beswick 2021; Bryant *et al.*, 2020). There has been a challenge in making students deal with signed numbers, which leads to difficulty in performing operations on signed numbers, i.e., integers. When learners are asked to add integers, they sometimes subtract, and when they are asked to subtract integers, they often perform addition. This concept of adding and subtracting integers in itself is a paradox. To young minds unprepared for abstract thinking, it is confusing. Fluency in integer arithmetic has been a challenge (Rinne *et al.*, 2020). Assessing students' confusion in math is essential for fostering a supportive learning environment, improving educational outcomes and ensuring that students develop a solid understanding of mathematical concepts. This will also help the teacher tailor their instruction to the students.

This study seeks to identify and address students' confusion level in performing operations on integers. This aims to foster the student's confusion in basic operations of integers to link to better academic performance, to aid teachers' various strategies in handling students' struggles in integers, and to create interventions or an action plan that can be part of the school program. With this, students will receive targeted support to help them overcome specific struggles. Teachers can refine their approach and ensure that concepts are explained in ways that resonate with students. The school will have a basis for providing an action plan to improve the school's Mean Percentage Score in mathematics.

## 2. Literature Review

This study is anchored on Constructivist Learning Theory by Jean Piaget (1964) and Social Development Theory by Vygotsky (1978), Deped Order no. 25 s. 2002 and R.A. no. 10533 (Enhanced Basic Education Act) and DepEd Memorandum 054, s. 2023 (Pilot Implementation of Matatag Curriculum).

Constructivism is an approach to learning where students actively construct their knowledge, and that reality is determined by the experiences of the students (Romdhon, *et al.*, 2024). It is a learning theory that is grounded in a contextual approach where knowledge is built through a controlled process rather than a spontaneous activity (Fitri, 2020). In this context, learning would be based on the learners' hands-on experience with the lesson at hand. According to a study by Naufal (2021), the implementation of the constructivist approach using real learning media significantly improved learning outcomes. The nature of constructivism is student-centered, that is, students construct their understanding (Rahayu, 2022). Constructivism, as an approach, plays a crucial role in assessment practices, allowing for feedback that encourages student reflection and enhances critical learning (Permata *et al.*, 2024). As such, it is of great interest to the

teachers to assess the learners' capability in utilizing basic operations of integers, since mathematics revolves around handling these operations.

According to Vygotsky (1978), much important learning by the child occurs through social interaction with a skillful tutor. The tutor may model behaviors and/or provide verbal instructions for the child. Like Piaget, Vygotsky believes that young children are curious and actively involved in their learning, discovering and developing new understandings/schemas. However, Vygotsky emphasized social contributions to the development process, whereas Piaget emphasized self-initiated discovery. Teaching styles grounded in constructivism represent a deliberate shift from teachers transmitting knowledge to teachers creating an environment where students can explore, collaborate, and actively construct their understanding (Rahayu, 2022; Ilham *et al.,* 2023). Rather than having teachers impose their understanding onto students for future recitation, the teachers are expected to be more innovative and flexible in their approach in facilitating the teaching - learning process. Comprehending ideas is a big factor in learning; thus, learners not only need to learn by doing and reflection, but they should also have a teacher or peer who guides them in their reflection (Peteros, 2022). A large classroom population hinders meaningful learning. Most teachers prefer traditional teaching due to the lack of space and to avoid noisy and disordered environments. Thus, learners are deprived of an actual hands-on experience.

In Mathematics, integers are a special set of numbers comprising zero, positive numbers and negative numbers, excluding fractions. All arithmetic operations, like addition, subtraction, multiplication, and division, can be performed on integers. The difficulty in teaching mathematics is a global trend. The researcher observed that most of the students in her class cannot perform the four basic operations in mathematics on integers. One of the causes mentioned by Khalid and Embong (2020, p. 2) is due to "*students being taught to follow rules and procedures in a very abstract manner without going through the models for better conceptual understanding*." For learners to understand basic operations in integers, help them create connections with their previous learnings and utilize appropriate strategies in learning. Some of these difficulties are as follows: learners get confused by the signs and operations on integers, the current number line model that is popular among teachers is confusing to learners, and learners often fail to apply the correct heuristic or learning strategies they have acquired when attempting the problem-solving task.

It is known that the lack of knowledge about arithmetic operations leads students to errors in algebraic expressions (Arnawa & Nita, 2019). In this context, learners tend to have difficulty understanding complex mathematical problems due to a lack of foundational knowledge of basic operations with integers. Khalid and Embong (2020) investigated students' sources and causes of errors and misconceptions in solving routine problems involving addition, subtraction, multiplication, and division of integers. This qualitative study involved observation of eight Year 7 classes and interviews with the respective classroom teachers. Sixteen Year 7 students who exhibited errors when solving the problems given in the Error Identification Integer Test (EIIT) were also interviewed to probe their thinking. The researchers found out that the main cause of errors and

misconceptions is superficial understanding, which was most probably due to teachers rushing to complete the extensive syllabus, and consequently, students resorted to memorizing rules because of surface understanding. Teaching episodes were found to lack multiple representations, creativity, as well as cooperative learning and active learning.

Khalid and Embong (2020) formulated an intervention study that emphasizes concrete representation to improve students' conceptual understanding in learning mathematics. The study specifically examined the effectiveness of focusing on concrete representations – the algebra tiles- in minimizing students' errors in the operation of integers. A quasi-experimental design with a sample of 60 students from two intermediate Year 7 classes was employed in this study. This study suggests that teaching with an emphasis on concrete representation improves students' conceptual understanding. Hence, students' understanding of integers was enhanced due to the promotion of concepts through manipulatives, pictures, and verbal and symbolic representation, which were also employed during the intervention.

Fuadiah and Suryadi (2019) studied a series of Didactical Design Research in the prospective analysis stage to comprehensively identify some obstacles in learning negative integers, to capture how the learning process is used by teachers and how the impact on students in understanding the concept of negative numbers. This research is a case study administered to seventh-grade students in one of the classes in a junior secondary school in Indonesia to investigate how the teacher managed the learning process of integers and identified students' thinking construction. Involving a mathematics teacher and 37 students, this qualitative study collected data from field observations, interviews, and document reviews. Findings show how the teacher describes the negative integers and the arithmetic concepts to the students and its contribution to causing misunderstanding among the students.

Ismail *et al.* (2023) investigated the impact on students' performance in addition and subtraction of integers using a virtual manipulative called Gizmos. It examined the students' views on the intervention using Gizmos. Forty-four grade nine students were selected by the use of a multistage sampling in one of the secondary schools in Brunei, who were subjected to a Gizmos-based lesson intervention in addition to the subtraction of integers. Data were collected, and the paired sample t-test showed that there was an improvement in students' performance. Gizmo–based intervention, based on the result, offered opportunity to students to enhance their confidence, understand, play, learn and visualize integers.

Khalid *et al.* (2018) aimed to validate and present the preliminary findings of a paper-and-pencil test used to diagnose the errors exhibited by Form 1 students in West Malaysia. A stratified sample of 622 students from eight different schools (urban and rural), representing four different regions of West Malaysia (North, South East, and Middle), were involved in this study. Students were given a diagnostic test consisting of 40 routine problems in the operations of integers to uncover the errors and misconceptions held by some of them. SPSS was used to analyze the data. The result

shows that the diagnostic test is a reliable and valid instrument for the detection of students' errors and misconceptions in operations involving integers.

Makonye and Fakude (2016) studied the errors and misconceptions that learners manifest in the addition and subtraction of directed numbers. Data were collected from 35 Grade 8 learners' exercise book responses to directed number tasks as well as through interviews. Content analysis was based on Kilpatrick *et al.*'s strands of mathematical proficiency. The findings were as follows: 83.3% of learners have misconceptions, 16.7% have procedural errors, 67% have strategic errors, and 28.6% have logical errors on addition and subtraction of directed numbers. The sources of the errors seemed to be a lack of reference to mediating artifacts such as number lines or other real contextual situations when learning to deal with directed numbers. The study recommends that building a conceptual understanding of directed numbers and their operations must be encouraged through the use of multi-representations and other contexts meaningful to learners.

Kwakye and Aggrey (2022) conducted a study on the impact of the Number Rule as an instructional aid in teaching addition and subtraction of integers. This study concluded that the Number Rule should be used as a manipulative in teacher-led and learning addition and subtraction of integers at group settings in junior high school level. Through the use of manipulatives, students were encouraged to cooperate and share resources, which allowed students to solve issues collectively, discuss mathematical ideas and concepts, communicate mathematical thinking, create presentations and solve problems without only following the teachers' instructions. In this case, students are the makers of meanings and active contributors to the creation of knowledge.

Rubin *et al.* (2014) investigated that students often have difficulty with the concept of integers, which makes them struggle when they algebraically solve equations. This action research study focuses on data gathered in a seventh-grade mathematics class. The researchers analyzed the effect of various activities using models of integers, like the Target integer, Integer chips, the use of Damath, and an online game, Number Cruncher, on students. The combination of these data sets suggests that students' conceptual understanding and procedural skills are enhanced when activity-based teaching is used.

Owusu *et al.* (2023) investigated common errors and misconceptions made by some pre-service mathematics teachers of the St. Louis College of Education in Ghana about operations on integers. This study employed a mixed-method and sequential explanatory design. Diagnostic test instruments were designed and administered to sixty pre-service mathematics teachers. The study identified errors made by pre-service mathematics teachers in the interpretation of inequality symbols, problem solving, and how the concept of integers was introduced. It concludes that a deficiency in the language affects misconceptions and errors in performing arithmetic.

Sercenia *et al.* (2023) investigated the students' metacognitive awareness and conceptual understanding of integers. A descriptive-correlational method approach was utilized, and it was carried out on 303 seventh-grade students. The data were obtained using a metacognitive awareness inventory and an achievement test on integers. The study provides relevant information for educational managers on the potential factors to

be considered in improving mathematics education practices, particularly in promoting metacognition among high school students.

Bowers (2021) investigated how Intermediate Phase (Grades 4, 5, and 6) teachers identify and respond to learners' mathematical errors and misconceptions in the content area of Numbers, Operations, and Relationships (NOR). A qualitative approach was adopted by using three cycles of participatory action research (PAR). The empirical data collected during this study included a variety of data collection instruments. The instruments include interviews, class observations, focus groups, and field notes. Data from these instruments were analyzed, and the findings suggest that when teachers attend to learner errors and the reasoning behind their errors, they are able to identify and address misconceptions.

Numerous studies revealed students' difficulties in basic operations on integers. These studies also showed possible ways for learners to learn and understand this concept effectively. The researcher could come up with an effective action plan based on these studies and theories. It is important to assess learners and provide appropriate strategies based on this assessment.

## 3. Purpose of the Study

This research assessed the skills and confusion of the Grade 8 students on the operations of integers at a public high school in Lapu-Lapu City, Cebu, Philippines, for the school year 2024-2025. Specifically, this study sought to answer the following objectives:

1) To assess the level of skills of the respondents in performing the operations on integers.
2) To determine the level of confusion of the respondents in performing the operations on integers
3) To test the relationship between the skills and the confusion of the respondents in performing the operations of integers

## 4. Materials and Methods

This section presents the results on the data gathered for the respondents' skills in performing operations on integers and their confusion about the rules. Moreover, this section also presents the test of the relationship between these variables.

### 4.1 Research Design

This study utilized a descriptive correlational research design, which aimed to test the relationship between the level of skills and the level of confusion of Grade 8 learners in performing operations on integers. According to Aprecia *et al.* (2022), a descriptive correlational research design describes the variables and measures the extent of the relationships among them.

### 4.2 Respondents

The respondents in this study were Grade 8 students at a public high school in Lapu-Lapu City, Cebu, Philippines. Simple random sampling was used to select respondents for the study. Table 1 shows the distribution of the Grade 8 learners of Mactan National High School, the school that will participate in this study. 187 Grade 8 students participated and were distributed across eight sections. To ensure a sufficiently large sample size for this study, the researchers use Cochran's Formula in determining the sample size.

**Table 1:** Distribution of the Respondents

| Name of Section | N | n | % |
|---|---|---|---|
| Augusto | 35 | 23 | 12.30 |
| Berador | 34 | 17 | 9.09 |
| Daomani | 35 | 20 | 10.70 |
| Gevana | 36 | 13 | 6.95 |
| Inot | 36 | 32 | 17.11 |
| Orque | 35 | 26 | 13.90 |
| Pino | 33 | 25 | 13.37 |
| Sanchez | 36 | 31 | 16.58 |
| **Total** | **280** | **187** | **100.00** |

### 4.3 Data Collection Tools

This research utilized a two-part researcher-made survey questionnaire to assess the variables investigated in this study. Part I utilized a questionnaire to assess the level of skills the respondents have in performing integer arithmetic. The respondents answered a 40-item multiple-choice type of test by choosing the letter that corresponds to the correct answer. The test results were summarized and interpreted. Part II utilized a 5-point Likert Scale that identified the level of confusion the respondents experienced in performing integer arithmetic. The respondents will answer each item by choosing their level of agreement on 5 points. The 5-point Likert Scale consists of these points: (1) Not Confused; (2) Less Confused; (3) Moderately Confused; (4) Confused; (5) Highly Confused. The total responses per item/sentiment/indicator will be identified, and the weighted mean will be computed. Then the average level of confusion will be determined.

### 4.4 Data Collection Process

To ensure appropriate observance of the ethical standards in the data collection process, the researchers strictly observed the protocol. The researchers, with the documents needed, sent a letter of approval to the Schools Division Superintendent of the Division of Lapu-Lapu City and School Principals in conducting the study. After the approval, the researchers oriented the school principal about this study and arranged a preferred date for the conduct of the study. During the data gathering, the researchers conducted an orientation before distributing the questionnaires to the respondents. Informed consent was secured from the respondents before they were allowed to participate in the undertaking. An adequate time allotment was provided to the respondents to complete

the questionnaires for skill and level-of-confusion assessment in integer arithmetic. After completing the questionnaires, the researchers collected them and ensured a high retrieval rate. The data gathered were sorted, summarized, tabulated, treated, interpreted and summarized to determine the results based on the study's objectives.

### 4.5 Data Analysis

The data gathered were treated using descriptive and inferential statistics. A frequency count was used to determine the number of respondents who fell into the same category for their performance in operations on integers. The percentage was used to determine the proportion of the respondents who belong to the same category with respect to the total number of respondents. The weighted mean was used to determine the respondents' level of confusion when performing operations on integers. In contrast, the standard deviation was used to measure the spread of the respondents' answers to the questionnaire about their confusion. Pearson's r was utilized to test the significance of the relationship between the skills and confusion of the respondents in performing operations on integers.

## 5. Results and Discussion

This section presents the results on the data gathered involving the respondents' skills in performing the operations on integers and their confusion about the rules of the operations. This section also presents the test of the relationship between these variables.

### 5.1 Level of Skills in Performing Operations on Integers

This part presents the results of the assessment of the skills of the respondents in performing operations on integers. Skill is defined as the ability to use one's knowledge effectively and readily in execution or performance. Students' skills are also subject to many influences, such as environment, motivation, and teaching and coaching.

**Table 2:** Level of skills of the respondents in performing the operations of integers

| **Level** | **Numerical Range** | **f** | **%** |
|---|---|---|---|
| Outstanding | 32-40 | 7 | 3.74 |
| Very Satisfactory | 24-31 | 38 | 20.32 |
| Satisfactory | 16-23 | 87 | 46.52 |
| Fairly Satisfactory | 8-15 | 55 | 29.41 |
| Poor | 0-7 | 0 | 0.00 |
| **Total** | | **187** | **100.00** |
| Mean | | 19.58 | |
| St. Dev. | | 6.08 | |

Table 2 shows the respondents' skill levels in performing integer operations based on their assessment scores. The average score of the respondents on their level of skills is 19.58, which belongs to the satisfactory level. The survey showed that almost half of the respondents have a satisfactory level of skill in performing the operations of integers,

meaning the respondents at least have a form of understanding in dealing with integers, though in terms of assessment, they still lack the necessary skill to at least pass the diagnostic. Thirty-eight or 30.32 percent have the necessary skills to pass the assessment, though barely. Seven or 3.74 percent have the skill to pass the assessment in performing operations on integers. Khalid and Embong (2019) accentuated that students facing difficulties in solving integers have been known throughout the world. Students often encounter errors and misconceptions in understanding the concepts and operations on integers because students learn basic operations involving integers procedurally without understanding and analyzing the concepts (Dube & Robinson, 2018).

In general, this shows that the majority of students have difficulty in dealing with integers, which leads to difficulty in dealing with more complex topics in mathematics. Addressing these issues early is crucial, as problems left unaddressed in foundational education can persist into higher Grades (Felício & Policarpo, 2015). Seng (2013) emphasized the critical role that integer operations play in higher mathematics, such as algebra and trigonometry, which concerns teachers about the potential problems arising from students not mastering this topic.

### 5.2 Level of Confusion in Performing Operations on Integers

Confusion is defined as the quality or state of being bewildered or unclear. Students' confusion stems from a number of reasons, one of which is the lack of basic skills needed to understand the topic at hand. Thus, the confusion level of the respondents was examined and is presented in Table 3.

**Table 3:** Level of confusion of the respondents in performing the operations of integers

| S/N | Indicators | WM | SD | Verbal Description |
|---|---|---|---|---|
| 1 | Understanding the concept of positive and negative numbers. | 2.30 | 1.29 | Less Confused |
| 2 | Rules for adding integers | 2.33 | 1.27 | Less Confused |
| 3 | Rules for subtracting integers. | 2.43 | 1.20 | Less Confused |
| 4 | Rules for multiplying integers | 2.56 | 1.33 | Less Confused |
| 5 | Rules for dividing integers. | 2.88 | 1.37 | Moderately Confused |
| 6 | Rules for dividing integers. | 2.92 | 1.37 | Moderately Confused |
| 7 | Adding a positive to another positive integer | 2.45 | 1.30 | Less Confused |
| 8 | Adding a positive to a negative integer | 2.45 | 1.29 | Less Confused |
| 9 | Adding more than one integer with like signs | 2.66 | 1.29 | Moderately Confused |
| 10 | Adding more than one integer with different signs | 2.75 | 1.32 | Moderately Confused |
| 11 | Subtracting a positive integer from another positive integer | 2.64 | 1.33 | Moderately Confused |
| 12 | Subtracting a negative integer from another negative integer | 2.68 | 1.28 | Moderately Confused |
| 13 | Subtracting a positive integer from a negative integer | 2.59 | 1.31 | Less Confused |
| 14 | Subtracting more than one integer with like signs | 2.82 | 1.26 | Moderately Confused |
| 15 | Subtracting more than one integer with different signs | 2.98 | 1.29 | Moderately Confused |
| 16 | Multiplying a positive integer by another positive integer | 2.56 | 1.41 | Less Confused |

| | | | | |
|---|---|---|---|---|
| 17 | Multiplying a negative integer by another negative integer | 2.65 | 1.37 | Moderately Confused |
| 18 | Multiplying a positive integer by a negative integer | 2.74 | 1.41 | Moderately Confused |
| 19 | Multiplying odd numbers of negative integers. | 2.95 | 1.25 | Moderately Confused |
| 20 | Multiplying an even number of negative integers | 2.89 | 1.32 | Moderately Confused |
| 21 | Dividing a positive integer by another positive integer | 2.87 | 1.33 | Moderately Confused |
| 22 | Dividing a negative by another negative integer | 2.94 | 1.37 | Moderately Confused |
| 23 | Dividing a positive integer by a negative integer | 3.00 | 1.28 | Moderately Confused |
| 24 | Using words in a math equation instead of numbers. | 3.01 | 1.40 | Moderately Confused |
| 25 | Applying integers to real-life scenarios. | 3.30 | 1.45 | Moderately Confused |
| | **Aggregate Mean** | **2.73** | | **Moderately Confused** |
| | **Aggregate Standard Deviation** | | **1.32** | |
| **Legend:** 4.21-5.00-Highly Confused; 3.41-4.20- Confused; 2.61-3.40-Moderately Confused; 1.81-2.60-Less Confused;1.00-1.80-Not Confused | | | | |

Table 3 shows the level of confusion of the respondents in performing operations on integers based on their assessment of their confusion. The average rate the respondents gave themselves was moderately confused. This suggests that the respondents had a vague understanding of their knowledge and skill in performing operations on integers.

"*Misconception is a type of error in understanding each mathematical concept and solving mathematical problems*" (Purwaningrum & Bintoro, 2019, p. 174). The less the respondent knows about their level of skill on a certain topic, the less their understanding of that topic. In the context of the integer operations, students will have difficulties performing the operations when they have limited conceptual understanding of the rules. It can be noted that these rules are more abstract, which needs to be emphasized to the students using real-world applications so that they can relate better to their concepts (Peteros, 2024).

### 5.3 Relationship between Skills and Confusion of the Respondents

This part presents the relationship between the respondent's self-assessment of their confusion level and their skill level, as shown in Table 4.

**Table 4:** Correlation Analysis

| Variables | r-value | Strength of Correlation | p-value | Decision | Result |
|---|---|---|---|---|---|
| Skills and Confusion | -0.411* | Weak Negative | 0.000 | Reject Ho | Significant |
| *significant at p<0.05 (two-tailed) | | | | | |

Table 4 presents the results of the test of the significant relationship between confusion and respondents' skill. Using the Pearson product-moment correlation test, the result shows a p-value of 0.000, which is less than 0.05, indicating a significant relationship between the two variables and rejecting the null hypothesis. The result suggests that students' skill in performing operations on integers is greatly affected by their confusion and misconceptions during their learning. Students often encounter errors and misconceptions in understanding the concepts and operations on integers because students learn basic operations involving integers procedurally without understanding

and analyzing the concepts (Dube & Robinson, 2018). As a result, students struggled to solve problems involving operations on integers.

## 5. Conclusion

The findings of the study clearly demonstrate that the Grade 8 students in the selected public school generally have a satisfactory level of skills in performing integer operations, suggesting that the foundational knowledge needs to be translated into confident and accurate performance in integer operations. On the other hand, the students have moderate confusion in applying the rules on the operations on integers, which needs to be addressed so that the students can effectively apply the rules and strengthen their conceptual understanding beyond procedural memorization. Furthermore, the established correlation suggests that students' skills in integers are reinforced by better conceptual understanding of the rules of integer operations. Hence, the results point to the necessity of designing instructional interventions that address both skill development and conceptual understanding of integer operations. Teachers may consider integrating real-life contexts, scaffolding strategies, and varied practice opportunities to help students internalize the rules of integers and reduce confusion. Strengthening these areas is crucial, as competence in integer operations serves as a foundation for more advanced mathematics topics in the higher grade levels.



**Conflict of Interest Statement**
The authors declare no conflicts of interest.

**About the Author(s)**
**Keshia R. Pariño** is a Junior High School Mathematics Teacher in the Department of Education, Philippines.
**Mellonnah V. Canoy** is a Senior High School Mathematics Teacher in the Department of Education, Philippines.
**Marjorie I. Augusto** is an Elementary Mathematics Teacher in the Department of Education, Philippines.

**References**

Agbata, B. C., Obeng-Denteh, W., Kwabi, P. A., Abraham, S., Okpako, S. O., Arivi, S. S., ... & Adu, G. W. (2024). Everyday uses of mathematics and the roles of a mathematics teacher. *Science World Journal*, *19*(3), 819-827. https://doi.org/10.4314/swj.v19i3.29

Alam, A., & Mohanty, A. (2023). Cultural beliefs and equity in educational institutions: exploring the social and philosophical notions of ability groupings in teaching and learning of mathematics. *International Journal of Adolescence and Youth*, *28*(1). https://doi.org/10.1080/02673843.2023.2270662

Arnawa, I. M., & Nita, S. (2019, October). Errors and misconceptions in learning elementary linear algebra. *Journal of Physics: Conference Series*, *1321*(2). https://doi.org/10.1088/17426596/1321/2/022095

Aprecia, N. A. B., Barrera, G. A., Cuares, K. R. A., Cuison, M. J. L., Lazaro, M. K. D., Pati, K. K. M., & Sayson, Y. J. H. (2022). A Descriptive Correlational Study on the Physical Environment and Perceived Academic Performance of STEM Online Learners. Retrieved from https://animorepository.dlsu.edu.ph/conf_shsrescon/2022/paper_cli/3/

Beswick, K. (2021). Positive Experiences with Negative Numbers on Students In and Out of School Experiences. Retrieved from https://files.eric.ed.gov/fulltext/EJ936336.pdf

Bolyard, J., & Moyer-Packenham O. (2012). Making Sense of Integer Arithmetic: The Effect of Using Virtual Manipulatives on Students' Representational Fluency. *Journal of Computers in Mathematics and Science Teaching (2012) 31*(2), 93-113. Retrieved from https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1405&context=teal_facpub&httpsredir=1&referer=

Bowers, B. E. (2021). *Teachers identifying and responding to learner errors and misconceptions in Numbers, Operations and Relationships in the Intermediate Phase* (Doctoral dissertation, Stellenbosch: Stellenbosch University). https://hdl.handle.net/10019.1/109975

Bryant, B. *et al.* (2020). Mathematics Performance on Integers of Students with Mathematics Difficulties. *The Journal of Mathematical Behavior*, vol. 58. Retrieved from https://doi.org/10.1016/j.jmathb.2020.100776

Dubé, A. K., & Robinson, K. M. (2018). Children's understanding of multiplication and division: Insights from a pooled analysis of seven studies conducted across 7 years. *The British Journal of Developmental Psychology*, *36*(2), 206–219. https://doi.org/10.1111/bjdp.12217

Felício, A., & Policarpo, M. (2015). Foundation phase issues in mathematics: Addressing early learning barriers. *Early Childhood Education Journal*, *43*(2), 137-145.

Fitri, Y. (2020). Implementasi penerapan teori konstructuvusme dalam proses pembelajaran di sekolah dasar. SHEs: Conference Series 3, 3(4), 1300-1307. Retrieved from https://jurnal.uns.ac.id/SHES/article/view/55740

Fuadiah, N. F., & Suryadi, D. (2019). Teaching and Learning Activities in the Classroom and Their Impact on Student Misunderstanding: A Case Study on Negative Integers. *International Journal of Instruction*, *12*(1), 407-424. Retrieved from https://doi.org/10.29333/iji.2019.12127a

Hawes, Z., & Ansari, D. (2020). What explains the relationship between spatial and mathematical skills? A review of evidence from brain and behavior. *Psychonomic bulletin & review*, *27*(3), 465-482. https://doi.org/10.3758/s13423-019-01694-7

Ilham, M.F., & Fakhri, A.T.L. (2023). Implementasi teori belajar perspektif psikologi konstruktivisme dalam pendidikan anak sekolah dasar. *Multilingual, 3*(3), 380-391. https://doi.org/10.51675/jp.v15i2.530

Ismail, N. F. H., Shahrill, M., Asamoah, D. (2023) Learning through virtual manipulatives: Investigating the impact of Gizmos-based lessons on students' performance in integers. *Contemporary Mathematics and Science Education 4*(1), ep23009, 2023. https://doi.org/10.30935/conmaths/12857

Khalid, M., & Embong, Z. (2020). Emphasizing concrete representation to enhance students' conceptual understanding of operations on integers. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *11*(3), 762-773. Retrieved from https://turcomat.org/index.php/turkbilmat/article/view/248

Khalid, M., Ibrahim, M. B., Saad, S., Othman, J., Mohd Yussuf, Y., & Embong, Z. (2018). A Preliminary Study on Form 1 Students? Errors and Misconceptions in Operations of Integers. In *Proceedings of National Education Deans' Council Seminar* (pp. 115-124). Retrieved from https://api.semanticscholar.org/CorpusID:186312809

Kwakye, D. O., Aggrey, J. (2022). The teaching and learning of integer operations: The case of the number rule and conventional method. *Journal of Education and Practice Vol. 13*, No, 27. https://www.iiste.org/Journals/index.php/JEP/article/view/59554/61483

Makonye, J. P., & Fakude, J. (2016). A study of errors and misconceptions in the learning of addition and subtraction of directed numbers in Grade 8. *SAGE Open*, *6*(4). https://journals.sagepub.com/doi/pdf/10.1177/2158244016671375

Naufal, H. (2021). Model pembelajaran konstruktivisme pada matematika untuk meningkatkan kemampuan kogniyif siswa di era Merdeka Belajar. *Seminar Nasional Pendidikan Matematika, 2*(1), 143 - 152

Owusu, A., Bornaa, C. S., Kwakye, D. O., Iddrisu, A. B. (2023). Pre-service mathematics teachers' errors and misconceptions on integer operations. Journal of Statistics and Mathematical Concepts. Vol. 1, Issue 2, pp 1-19, 2023. https://doi.org/10.58425/jsmc.v1i2.127

Peconcillo Jr., L. B., Peteros, E. D., Mamites, I. O., Sánchez, D. T., & Suson, R. L. (2020). Structuring Determinants to Level Up Students' Performance. *International Journal of Education and Practice*, *8*(4), 638-651. https://doi.org/10.18488/journal.61.2020.84.638.651

Permata, N. D., Suswandari, M., Farida, N. (2024). Analysis of the Relationship between teacher assessment and constructivism learning theory in building sustainable

understanding at SDN Kenep 03. https://doi.org/10.32585/dikdasbantara.v7i1.5120

Peteros, E. D. (2022). Reciprocal Determinants of Students' Mathematics Performance in Two Boarding Schools in Cebu, Philippines. *Philippine Social Science Journal*, *5*(2), 83-92. https://doi.org/10.52006/main.v5i2.502

Peteros, E. D. (2024). Impact of pre-service teachers' self-regulation and self-efficacy on their mathematics performance in blended learning. *Journal of Education and Learning (EduLearn)*, *18*(2), 526-534. https://doi.org/10.11591/edulearn.v18i2.21074

Purwaningrum, J., & Bintoro, H. (2019). Miskonsepsi matematika materi bilangan pada mahasiswa calon guru sekolah dasar. Prosiding Seminar Nasional MIPA Kolaborasi, 1(1), 173-180. https://proceedings.unnes.ac.id/SNMIPA/article/view/193/157

Rahayu, R. (2022). Implementasi teori pembelajaran konstruktivistik di sekolah dasar. Pendidikan Nilai Kajian Teori dan Praktik di Sekolah, II(3), 1-8. https://repository.uhn.ac.id/handle/123456789/7061

Rinne, L. F., Ye, A., & Jordan, N. C. (2020). Development of arithmetic fluency: A direct effect of reading fluency?. *Journal of Educational Psychology*, *112*(1), 110. https://doi.org/10.1037/edu0000362

Romdhon, J., MAsrifa, M., Shiyama, N. M., & Suharyati, H. (2024). Applying constructivist learning theory to enhance student learning outcomes in elementary schools. *International Journal of Sustainable Development & Future Society, 2*(2), November 2024, pp. 62-69. https://doi.org/10.11591/edulearn.v19i1.21197

Rubin, R. J., Marcelino, J., Mortel, R., & Lapinid, M. R. C. (2014). Activity-based teaching of integer concepts and its operations. In *DLSU Research Congress* (pp. 6-8). Retrieved from https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2014/LLI/LLI-II-016-FT.pdf

Saga, E. S., Orongan, M. S., & Abarca, H. C. (2023). A Case Study of Students' Lost Learning in Mathematics on Post-Remote Learning. *International Journal of Multidisciplinary Educational Research and Innovation*, *1*(3). https://doi.org/10.5281/zenodo.8326009

Santos, M. S. M. D., Batiancila, R. M., Cabaral, J. O., Cabigas, M. B., & Peteros, E. D. (2025). Using Information and Communication Technology on Students' Mathematics Performance in National High Schools in the Philippines. *British Journal of Teacher Education and Pedagogy*, *4*(1), 12-26. https://doi.org/10.32996/bjtep.2025.4.1.2

Seng, L. S. (2013). Importance of integer operations in higher mathematics: Implications for teaching. *Journal of Mathematics Education, 6*(1), 55-69.

Sercenia, J. C., Ibañez, E. D., & Pentang, J. T. (2023). Thinking beyond Thinking: Junior High School Students' Metacognitive Awareness and Conceptual Understanding of Integers. *Mathematics Teaching Research Journal*, *15*(1), 4-24. Retrieved from https://eric.ed.gov/?id=EJ1391473