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Evaluating Grade 7 Students' Performance in Integer Operations: Basis for Strategic Intervention Material Development

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ABSTRACT

The Strategic Intervention Material (SIM) is a remedial tool designed to help students learn competency-based abilities they could not develop during regular classroom instruction. This study aimed to assess the performance of Grade 7 students in solving problems involving operations on integers as the basis for developing a Strategic Intervention Material. Through a descriptive research design, the data from two hundred eighty-four (284) Grade 7 students who are typically adolescents, females, and belonging to low-income families were assessed using an assessment test and were analyzed and interpreted. The result shows that students performed well in addition, multiplication, and division of integers but have shown poor performance in subtraction of integers. Their performance in addition and subtraction of integers differs significantly from their age variables, but not in multiplication and division. In addition, their performance in the four integer operations does not vary considerably between their sex variable but differs between their family monthly income variable. Based on the assessment result, the developed Strategic Intervention Material focused on the rules of subtracting integers, evaluated as highly appealing, practical, applicable, meaningful, and useful by adequate experts based on three features: acceptability, applicability, and usefulness. Based on these conclusions, extra or remedial sessions and flashcards or drills can be conducted to enhance their performance in subtracting integers. The developed strategic intervention material is highly recommended for implementation to check its effectiveness with Grade 7 students.

Keywords: Intervention, Operations on Integers, Subtraction of Integers, Strategic Intervention Material

INTRODUCTION

Performing basic mathematical operations is crucial for success in higher-level mathematics (Loveless, 2015). Curriculums, such as the K-12 program in the Philippines, emphasize mastery of the four fundamental operations (addition, subtraction, multiplication, and division) with integers by Grade 6 (Department of Education, Philippines). These skills serve as prerequisites for secondary mathematics (Sahat et al., 2019). However, many students struggle with these concepts (University of Washington, 2022). These difficulties can include memorization issues, limited understanding of the operations, and trouble visualizing problems (University of Washington, 2022). Additionally, students may confuse the meaning of addition and subtraction with movement on a number line (Sahat et al., 2019). This lack of proficiency hinders their ability to solve algebraic problems later (Sahat et al., 2019).

Mastery of fundamental operations goes beyond memorization and fosters analytical thinking, problem-solving skills, and deeper mathematical understanding (Gupta, 2020; Badertscher et al., 2017). This

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empowers students to move beyond rote memorization and develop a proper grasp of mathematical concepts. Recognizing this importance, the Department of Education promotes tools like Strategic Intervention Materials (SIMs) to target student weaknesses identified through assessments (Cordova et al., 2019). Additionally, Project AN (Assessment of Numeracy) and the 4F's framework (Function, Formatting, Fill, and Functions) are employed to enhance students' mastery of fundamental operations.

Research Objectives

This study aimed to assess the performance of Grade 7 students in public secondary schools within the Iba District, Zambales, Philippines, specifically focusing on their ability to solve integer operations using the 4F Tool. The objectives of this study were:

1. To identify the profile of the student-respondents in terms of age, sex, and monthly family income.

2. To evaluate the performance of Grade 7 students in solving problems on integers using the 4F's Tool in terms of addition, subtraction, multiplication, and division.

3. To determine if there is a significant difference between the performance of the student-respondents in solving operations on integers using the 4F's Tool and their profile variables.

4. To develop Strategic Intervention Materials (SIMs) based on the assessment results to enhance student mastery of the four fundamental operations with integers.

5. To describe the features of the developed Strategic Intervention Materials evaluated by experts in terms of acceptability, applicability, and usefulness.

LITERATURE REVIEW

Difficulties in Solving Operations on Integers

Mastery of fractions and decimal arithmetic is crucial for mathematical success and essential for many professions. Unfortunately, many children and adults struggle significantly with these skills, and little progress has been made in recent decades in improving learners' proficiency (Lortie-Forgues, Tian, & Siegler, 2015). It is important to investigate the potential causes behind students' struggles, especially if the errors follow a pattern that reveals their reasoning or conceptual understanding. Understanding the methods teachers use to teach integers and assessing their grasp of the subject is essential (Khalid et al., 2018).

Numerous studies have indicated that integer operations pose challenges for teachers and students. Bishop et al. (2014) observed that students encounter problems involving negative numbers in routine and non-routine contexts. Fuadiah, Suryadi, and Turmudi (2017) found that students struggle with conceptualizing the nature of integers and their arithmetic operations, leading to mistakes and misconceptions. 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.

Arcena (2016) noted that in the era of technology, students rely more on calculators for integer operations than mental or manual calculations, leading to poor performance without calculators. Rubin, Marcelino, Mortel, and Lapinid (2014) highlighted how teachers who introduce integer operations significantly affect students' mastery. Unlike traditional lectures, activity-based teaching can improve students' conceptual understanding, perception, and procedural skills. Students often struggle with negative values, particularly when using addition and subtraction symbols.

Learning to operate with positive and negative numbers poses distinct challenges. The double use of the negative symbol, criticized by early 18th-century mathematicians, remains problematic (Cetin, 2019). Students' inability to perform basic mathematical operations like addition, subtraction, multiplication, and division is particularly concerning. Addressing these issues early is crucial, as problems left unaddressed in foundational education can persist into higher grades (Felício & Policarpo, 2015).

Addition and Subtraction of Integers

Research indicates that students make epistemic and non-epistemic mistakes with whole numbers, often misaligning positional values or misunderstanding the roles of minuend and subtrahend in subtraction (Mukunda et al., 2021). Sidik, Suryadi, and Turmudi (2021) discussed students' ontogenic and epistemological challenges, including difficulties with concept scales and miscalculations. Martinez and Castro (2013) found that students employ various strategies, such as transforming problems into simpler forms or using heuristics like fixation and cancellation, to facilitate numerical reasoning.

Local researchers found that students often struggle with signed numbers due to difficulties in remembering rules, which has led to the development of methods like the "Math-a-Battlefield Technique" to simplify addition and subtraction of integers (Sebastian et al., 2019). Activity-based learning enhances students' thinking skills and promotes conceptual understanding, making it easier to extend their knowledge to include negative figures (Rubin et al., 2014).

Students frequently struggle with the subtraction of integers, often confused by parentheses and the concept of negative numbers. Teachers should ensure that students understand the content and its application to prevent confusion (Lisesi, 2017). Pourdavood, Mccarthy, and Mccafferty (2015) highlighted that students who do not comprehend the concept of numbers have particular difficulty with contextual addition and subtraction of integers. Mastering these operations is crucial for developing relevant mathematical skills (Nisa, Asrowi, & Murwaningsih, 2020).

Multiplication and Division of Integers

Menon (2016) suggested that strategies used for addition and subtraction could be applied to the multiplication of integers, emphasizing the importance of understanding the distinction between operations and numbers. Lautert, Spinillo, and Correa (2013) identified confusion over the concept of "remainder" and misconceptions about division rules as major difficulties for learners. Widada et al. (2020) recommended using ethnomathematics learning strategies, such as the dakon game, to teach multiplication and division.

In the Philippines, studies show that division is particularly challenging for students, often due to a lack of focus on this operation in teaching (Dela Cruz & Lapinid, 2014). Tan et al. (2017) found that proficiency in multiplication rules is essential for mastering division. Domanais (2019) noted that comprehension of word problems plays a significant role in students' difficulties with division.

Foreign literature, such as Tzur et al. (2013), suggested that understanding distributivity is crucial for mastering the multiplication of integers. Cai et al. (2015) emphasized the impact of teaching methods on students' performance, while Van Hoof et al. (2015) warned against treating multiplication and division as mere extensions of addition and subtraction to avoid confusion.

Strategic Intervention Materials

Addressing learning gaps through strategic intervention materials (SIM) has been shown to improve students' performance. DepEd Memorandum no. 117 series of 2005 introduced SIMs to address specific least mastered competencies and improve low-performing learners' academic performance. Lumogdag

(2015) emphasized the importance of identifying these competencies and implementing targeted materials.

Olawale (2013) highlighted that well-prepared instructional materials make teaching-learning easier, enhancing students' performance. Dacumos (2016) noted that SIMs enable teachers to develop students' understanding of complex concepts. Studies have shown that contextualized SIMs significantly improve students' interest and retention of mathematical concepts (Adonis, 2020; Villonez, 2018; Pasion, 2019).

Research indicates that competency-based SIMs effectively customize the learning experience and improve mastery of specific skills (Kitto et al., 2020; Kostikova et al., 2019). Intervention materials provide targeted and personalized support, enhancing student engagement and performance (Lee & Sawaki, 2019; Chernikova et al., 2020; Chod, Markakis, & Trichakis, 2021).

In the Philippines, SIMs have proven effective in improving students' mastery of mathematics, particularly in addressing the least mastered competencies. Dumigsi and Cabrella (2019) found that innovative materials enhance performance and understanding, while Sadsad (2022) emphasized the importance of identifying and addressing specific competencies. Interviews and local studies support using SIMs to enhance student engagement and knowledge acquisition (Diaz & Dio, 2017; Sun Star Pampanga, 2017; Dy, 2018).

Conceptual Framework

The study is derived from Bruner's spiral curriculum model, a curriculum design where key concepts are presented throughout the curriculum repeatedly on different levels but with varying levels of complexity or various applications. This approach is implemented in the K-12 curriculum set by the Department of Education. Specifically, the curriculum is divided into five (5) general concepts, namely Number and Number Sense, Measurement, Geometry, Patterns and Algebra, and Probability and Statistics, to highlight the use of a spiral curriculum in Mathematics. From this standpoint, operations on integers were first introduced to learners in the 5th grade in primary education. This is where implications often arise. According to Mullis, Martin, Foy, & Hooper, (2016), math is a crucial elementary subject required for both high school academic careers and lifelong careers. A spiral curriculum tends to put a broad perspective of mathematical topics per grade level each year, which tends to leave learners and teachers behind. Following these consequences, because elementary math fails to provide sufficient and solid foundations to learners, many learners are often shocked when they enter secondary education facing higher mathematics. Where high school teachers have difficulty recalling elementary topics from Grades 1-7 while also introducing Grade 8 mathematics.

Due to such implications, plus the transition period of three years from the old curriculum to the new K-12 curriculum where delay of learning material is inevitable, educators were forced to find a way how to counter such factors, which they turned their attention to creating and implementing strategic intervention materials (SIM), or learning materials that helps students to master competency-based skills which were not able to develop during a regular class (Lazo & De Guzman, 2021). Based on the study of Abuda et al. (2019), through diagnostic assessments, teachers will be able to pinpoint competencies where learners struggle and not struggle precisely; from this, the creation of intervention materials and instructional tools and adjusting their approach to teaching will let mathematics teachers to teach further competencies that for learners are difficult, more efficiently.

Through these intervention materials, the term "constructivism," as a learning theory, a theory of knowledge, and a theory of pedagogy, circles around the cognitive development of an individual, which is about discovering facts, constructing ideas, and visualizing concepts, or in short, emphasizes student-lead learning. This theory reveals and discovers more facts from the perspective of a student engaged in this type of learning process rather than in a traditional classroom setting (Amineh & Asl, 2015). Pieced together, this learning theory is being adopted by the DepEd in creating the new curriculum (K-12 curriculum), which provides a flipped teaching-learning process that exchanges the role of the teacher being the center of the process and allows the students to create their way of absorbing facts.

RESEARCH METHODS

Research Design

A quantitative research approach with a descriptive research design was employed to evaluate participants' proficiency in solving operations on integers. Specifically, the research sought to assess respondents' performance across the four fundamental operations involving integers: addition, subtraction, multiplication, and division. This assessment aimed to provide a comprehensive understanding of students' capabilities in integer operations, serving as foundational data for developing strategic intervention materials.

As McCombes (2019) outlined, descriptive research involves systematically and accurately portraying a population, situation, or phenomenon. In this context, the researchers tried to display the performance of student respondents drawn from a sample subset of the Grade 7 population in Iba, Zambales. Through systematic observation and analysis, the study sought to explain the proficiency levels and challenges encountered by students in mastering integer operations.

The findings derived from this descriptive analysis served as fundamental groundwork for the subsequent creation of strategic intervention materials (SIM). By documenting the performance outcomes of the student respondents, the researchers gained valuable insights into the specific areas of strength and weakness within integer operations. These insights were then utilized to modify the content and focus of the SIM, ensuring its relevance and effectiveness in addressing identified learning gaps and enhancing student proficiency in integer operations. Thus, the descriptive research design facilitated a structured approach to assessing student performance and informing targeted interventions to improve mathematical competency.

Respondents and Location

This study was conducted in the Iba District, Division of Zambales, Philippines, during the school year 2022-2023. Five (5) public secondary schools reside in the locality of Iba, namely Amungan National High School, Zambales National High School, Zambales National High School-ANNEX, San Agustin Integrated School, and Santa Barbara Integrated School. There is a combined total of 976 Grade 7 learners from these schools, and the researchers used Slovin's Formula to determine the sample from this population as their respondents, which was computed as 284. From this, the respondents were picked through a random sampling method.

Research Instrument

This study employed a comprehensive assessment test comprising two distinct components. The initial segment captured the demographic attributes of student respondents, explicitly focusing on age, gender, and monthly family income. The second component encompassed an evaluation tool derived from the 4Fs instrument, designed to gauge learners' competencies and numeracy levels across the four fundamental mathematical operations: addition, subtraction, multiplication, and division. Originating from Project AN (Project All Numerates), an initiative spearheaded by DepEd, the 4Fs Tool, albeit with modifications, served as the foundation for the assessment test. In response to feedback from Grade 7 Mathematics educators and constraints regarding testing duration, the researchers streamlined the assessment, condensing the original hundred-item format to twenty items per operation.

Stringent validation and reliability procedures were undertaken to ensure the efficacy and precision of the research instrument. Content validity was established through collaboration with Mathematics educators from five secondary schools attended by the respondents, guaranteeing the relevance and appropriateness of assessment content. Subsequently, a pilot test involving fifteen Grade 7 learners from the Laboratory High School of President Ramon Magsaysay State University was conducted to assess instrument reliability using the test-retest method. Based on the outcomes, iterative revisions were made to refine the assessment.

Data Collection and Analysis

Upon validation and approval, the assessment test was reproduced in the requisite quantity for distribution among respondents. Data collection proceeded with administering the assessment test, facilitated by permissions obtained from the school division superintendent and principals of the respective research locales. Collaboration with Grade 7 teachers ensured seamless dissemination of the instruments, conducted either through face-to-face interactions or during scheduled class sessions as per the school administration's directives.

Data analysis utilized statistical tools, including frequency, percentage, mean calculations, and Analysis of Variance (ANOVA), to elucidate patterns and trends within the collected data. Transmuting scores derived performance evaluations for each student respondent across the four integer operations into standardized ratings utilizing the transmutation table prescribed by the Department of Education. Subsequently, research data and findings were methodically analyzed and interpreted to inform and benefit various stakeholders, including students, educators, and future researchers, who engage with the study outcomes.

RESULTS AND DISCUSSIONS

Profile of the Respondents

Table 1 shows the profile of the respondents, which includes 284 Grade 7 students, and presents valuable insight into the demographic factors that may affect their performance in solving integer operations.

Age. The age distribution shows that a significant majority (92.3%) of the respondents are aged 12-13 years, with a mean age of approximately 12.73 or 13 years. This is typical for Grade 7 students, suggesting a relatively homogenous age group. According to Piaget's theory of cognitive development, children in this age range are typically in the concrete operational stage, transitioning to the formal operational stage. During this phase, they begin to develop the ability to think abstractly and logically, which is crucial for understanding mathematical concepts such as integer operations (Piaget, 1972). This consistency in age suggests that most students are at an appropriate developmental stage for learning these mathematical operations.

Table 1. Profile of the Respondents

n = 284

Age			
Age	Frequency	Percent	Mean
10-11	2	0.7	12.73 or 13 years old
12-13	262	92.3	
14-15	16	5.6	
16-17	4	1.4	

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Sex			
Sex	Frequency	Percent	
Male	130	45.8	
Female	154	54.2	
Family Monthly Income			
Monthly Income (In Philippine Peso)	Frequency	Percent	Mean
131,000-218,999	11	3.9	Php 37,353.37
77,000-130,999	23	8.1	
44,000-76,999	20	7.0	
22,000-43,999	45	15.8	
11,000-21,999	73	25.7	
10,999-Below	100	35.2	

Sex. The sex distribution is relatively balanced, with 45.8% male and 54.2% female respondents. Previous studies have shown mixed results regarding gender differences in mathematics performance. For instance, a study by Hyde et al. (2008) found no significant gender differences in overall mathematics performance among school-aged children. However, some research indicates that while boys and girls perform equally well in general mathematics, specific areas such as problem-solving and certain cognitive skills might show slight variations (Fryer & Levitt, 2010). This balanced gender distribution ensures that any observed performance differences in solving integer operations are less likely to be skewed by gender alone and may reflect other influencing factors instead.

Family Monthly Income. The data indicates a wide range of family monthly incomes, with the majority (35.2%) falling in the lowest income bracket (10,999 PHP and below) and the mean family monthly income being 37,353.37 PHP. Socioeconomic status (SES) is a well-documented factor affecting educational outcomes. Studies have shown that students from higher SES backgrounds generally have access to more educational resources, parental support, and extracurricular learning opportunities, which can enhance academic performance (Sirin, 2005; Bradley & Corwyn, 2002). Conversely, students from lower SES backgrounds may face challenges such as limited access to educational materials, less parental involvement, and additional stressors that can negatively impact their academic achievement (Duncan & Murnane, 2011).

In this study, the distribution of family incomes suggests that a significant portion of the respondents may face socio-economic challenges. This could potentially affect their performance in solving operations on integers, as students from lower-income families might have less access to supplementary educational support outside of school. The stress associated with economic hardship can also impact cognitive functioning and academic performance (Evans & Schamberg, 2009).

Performance of the Grade 7 Students in Solving Problems on Integers Using the 4F’s Tool

Figure 1 illustrates the performance of Grade 7 students in solving integer operations across four fundamental functions: addition, subtraction, multiplication, and division. The data is categorized into five performance ranges: 90-100, 85-89, 80-84, 75-79, and below 75. This distribution reveals notable trends and potential areas of concern regarding students’ mathematical competencies. It showed that among the four operations, the subtraction operation had the most respondents, 187 falling below 75 ratings, interpreted as Did Not Meet Expectations.

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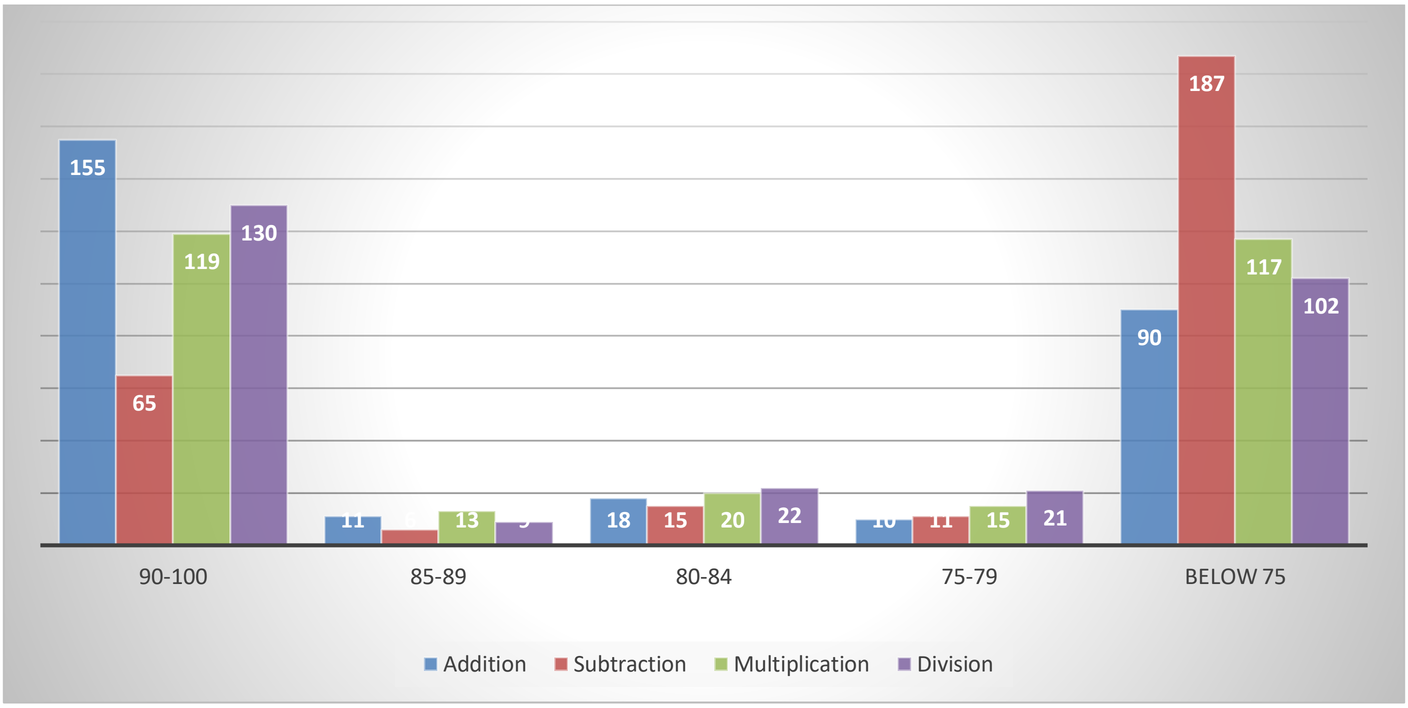

Figure 1. Performance of Students in Solving Operations on Integers

After the analysis interpretation of the data collected from the 284 student respondents, the mean performance rates of the student respondents in the four operations on integers were calculated. Table 2 provides a summary of the performance ratings of Grade 7 students on four basic operations on integers: addition, subtraction, multiplication, and division. The mean performance rates and corresponding descriptions highlight areas of strength and weakness in students' mathematical skills.

Table 2. Summary of the Performance Ratings of Grade 7 Students on Operations on Integers

Operation on Integers	**Mean Performance Rate**	**Description**
Addition	85.93	Very Satisfactory
Subtraction	74.48	Did Not Meet Expectations
Multiplication	82.13	Satisfactory
Division	83.47	Satisfactory

Addition. The highest mean performance rate of 85.93 indicates that students are generally proficient in this operation. This aligns with cognitive developmental theories, such as those proposed by Piaget, which suggest that children first grasp simpler operations like addition before moving on to more complex ones (Piaget, 1972). Proficiency can also be attributed to repetitive practice and emphasis on addition in early math education, which provides students with a solid foundation (Geary, 2006).

Subtraction. Subtraction has the lowest mean performance rate at 74.48, falling into the "Did Not Meet Expectations." This significant gap in performance compared to addition can be explained by the higher cognitive load required for subtraction, especially when dealing with borrowing and negative results (Fuchs et al., 2010). The difficulty in understanding and executing subtraction operations is well-documented, with research indicating that students often struggle with the concept of 'taking away' and the inverse nature of subtraction compared to addition (Ashcraft & Kirk, 2001).

Multiplication. Multiplication, with a mean performance rate of 82.13, is rated as "Satisfactory." While multiplication involves more complex cognitive processes than addition, it is still an operation that students become familiar with relatively early in their education through rote learning and memorization of multiplication tables (Bailey et al., 2014). However, the satisfactory rating suggests that while students generally understand multiplication, there are still challenges, particularly in applying multiplication to problem-solving contexts.

Division. Division, with a mean performance rate of 83.47, also falls into the "Satisfactory" category. Division is often considered one of the more challenging arithmetic operations due to its complexity and the necessity to understand the relationship between division and multiplication (Resnick, 1983). The satisfactory performance in division suggests that students have a reasonable understanding of the concept, although the complexity of tasks involving remainders and fractional results likely impacts their overall proficiency (Siegler & Pyke, 2013).

Test the Significant Difference Between Student-Respondents' Integer Solving Performance and Profile Variables.

Table 3. Test of Significant Difference Between the Performance of the Student-Respondents in Solving Operations on Integers and their Profile Variables

Source of Variance			**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Decision**
Age	**Addition**	Between Groups	4001.72	7	571.67	3.442	0.002	**Reject H_o Significant**
		Within Groups	45836.01	276	166.07			
		Total	49837.73	283				
	Subtraction	Between Groups	2879.77	7	411.4	2.751	0.009	**Reject H_o Significant**
		Within Groups	41269.14	276	149.53			
		Total	44148.91	283				
	Multiplication	Between Groups	1491.01	7	213	1.296	0.252	Accept H_o Not Significant
		Within Groups	45352.92	276	164.32			
		Total	46843.93	283				
	Division	Between Groups	2388.34	7	341.19	1.852	0.078	Accept H_o Not Significant
		Within Groups	50860.38	276	184.28			
		Total	53248.72	283				
Sex	**Addition**	Between Groups	134.31	1	134.31	0.762	0.383	Accept H_o Not Significant
		Within Groups	49703.42	282	176.25			
		Total	49837.73	283				

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	Subtraction	Between Groups	394.26	1	394.26	2.541	0.112	Accept H_o Not Significant
		Within Groups	43754.65	282	155.16			
		Total	44148.91	283				
	Multiplication	Between Groups	472.81	1	472.81	2.875	0.091	Accept H_o Not Significant
		Within Groups	46371.12	282	164.44			
		Total	46843.93	283				
	Division	Between Groups	322.94	1	322.94	1.721	0.191	Accept H_o Not Significant
		Within Groups	52925.78	282	187.68			
		Total	53248.72	283				
Family Monthly Income	**Addition**	Between Groups	3777.12	6	629.52	3.786	0.001	**Reject H_o Significant**
		Within Groups	46060.61	277	166.28			
		Total	49837.73	283				
	Subtraction	Between Groups	4407.2	6	734.53	5.12	0.000	**Reject H_o Significant**
		Within Groups	39741.72	277	143.47			
		Total	44148.91	283				
	Multiplication	Between Groups	5767.11	6	961.19	6.482	0.000	**Reject H_o Significant**
		Within Groups	41076.82	277	148.29			
		Total	46843.93	283				
	Division	Between Groups	5491.57	6	915.26	5.309	0.000	**Reject H_o Significant**
		Within Groups	47757.15	277	172.41			
		Total	53248.72	283				

Table 3 shows the significant differences between the performance of the student-respondents in solving operations on integers and their profile variables.

Age. The computed significant values for addition [$F(7,276) = 3.442$, $p = 0.002$] and subtraction [$F(7,276) = 2.751$, $p = 0.009$] were both less than the alpha level of significance (0.05). Consequently, the null hypothesis was rejected, indicating a significant difference between the performance of the student-respondents in solving addition and subtraction of integers and their age variable.

According to Dowker (2014), teaching young children math can be challenging for several reasons. Some young children might find it easier to compute or retrieve a solution directly than deriving it based on a principle. They might also find certain problems so difficult that they avoid trying or making illogical guesses. Most studies on derived-fact strategies focus more on chronological age differences rather than the relationship between mathematical proficiency and the use of these strategies. Additionally, difficulties often arise from fundamental skills, collectively called number sense, beyond counting or performing addition and subtraction. Challenges with concentration can further complicate learning these basic arithmetic operations. Dowker found that adults generally find addition and subtraction problems simpler than young students, who may struggle to understand and apply the relationships between these operations.

Sex. The computed significant values for addition [$F(1,282) = 0.762$, $p = 0.383$], subtraction [$F(1,282) = 2.541$, $p = 0.112$], multiplication [$F(1,282) = 2.875$, $p = 0.091$], and division [$F(1,282) = 1.721$, $p = 0.191$] were all greater than the alpha level of significance (0.05). Consequently, the decision was made to accept the null hypothesis. Therefore, there is no significant difference between the performance of the student-respondents in solving operations on integers and their sex variable.

These findings align with research on gender inequalities in high school students' academic achievement in mathematics. According to Jiang (2021), there were no appreciable disparities between male and female students in knowledge modules such as common logic, inequalities, algorithms, probability, sequences, solid geometry, integers, and derivatives. Furthermore, no significant differences were found between male and female students in mathematical abstraction, logical thinking, and intuitive imagination. To ensure fairness, gender considerations should be integrated into the design of the math curriculum and arithmetic tests.

Family Monthly Income. The computed significant values for addition [$F(6,277) = 3.786$, $p = 0.001$], subtraction [$F(6,277) = 5.12$, $p = 0.000$], multiplication [$F(6,277) = 6.482$, $p = 0.000$], and division [$F(6,277) = 5.309$, $p = 0.000$] were all less than the alpha level of significance (0.05). Consequently, the decision was made to reject the null hypothesis. Therefore, there is a significant difference between the performance of the student-respondents in solving operations on integers and their family monthly income variable.

This result is consistent with the study by Das and Sinha (2017), which found that the socio-economic status of parents, including their occupations and family monthly income, significantly affects students' performance in mathematics, including operations on integers. Students from families with higher monthly incomes tend to achieve higher mathematics grades than those from families with lower monthly incomes (Pandaya, 2020).

Proposed Strategic Intervention Material (SIM) Based on Student-Respondents' Integer Operations Assessment Results

Based on the result of the assessment conducted, the proposed strategic intervention material (SIM) was focused on the operation subtraction on integers, being it the lowest mean performance rating out of the four operations and also having the only operation not to meet the expectations or mastery based on the rating of Deped Order No. 08, series of 2015, or the Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program.

The proposed intervention material is entitled "The Adventures of Young Mathrauder" and was a self-learning Strategic Intervention Material where its features were based on the Deped Memorandum No. 225, series of 2009, in terms of the SIM's Acceptability, Applicability, and Usefulness. The components of the

Strategic Intervention Material were based on the guidelines of the DepEd Memorandum no. 117, series of 2005, or the "Training Workshop for Strategic Intervention Materials in for Successful Learning," which has seven main parts, namely the Title Card, Guide Card, Activity Card, Assessment Card, Enrichment Card, Answer Card, and a Reference Card.

Features of Developed Strategic Intervention Material

Table 4 shows the summary mean and the descriptive equivalent of the developed Strategic Intervention Material features focusing on operations on integers as evaluated by the mathematics educators of DepEd.

Table 4. Summary of the Mean and the Descriptive Equivalent of the Features of the Proposed Strategic Intervention Material

Subtraction of Integers	Mean	Equivalent Description
Acceptability	3.50	Very Much Acceptable
Applicability	3.46	Very Much Applicable
Usefulness	3.60	Very Much

Acceptability. The mean score for acceptability is 3.5, which falls into the category of "Very Much Acceptable." This high level of acceptability suggests that the expert evaluators found the intervention material well-received and suitable for the student's learning needs. Acceptability is a crucial factor as it indicates the willingness of students and educators to engage with the material. According to a study by Joseph (2016), educational materials deemed acceptable by users are more likely to be implemented effectively in the classroom, leading to better educational outcomes.

Applicability. The mean score for applicability is 3.46, which is also classified as "Very Much Applicable." This indicates that the expert evaluators found the material highly relevant and applicable to the student's learning context. The applicability of educational materials ensures that the content is practical and can be integrated into existing curricula. Jones and Smith (2018) emphasized that materials perceived as applicable enhance the learning experience by providing real-world relevance and facilitating the application of theoretical concepts to practical problems.

Usefulness. The highest mean score of 3.6 for usefulness denotes that the material is considered "Very Much Useful." This feature reflects the overall utility of the intervention material in helping students understand and master the subtraction of integers. High usefulness scores by the experts indicate the material's effectiveness in addressing learning gaps and improving student performance. Research by Brown (2019) supports that useful educational interventions contribute significantly to student achievement, particularly in areas where students typically struggle, such as integer operations.

These evaluated SIM features are consistent with findings from related research on developing and evaluating educational intervention materials. For instance, a study by Lee (2017) on the impact of strategic intervention materials in mathematics education found that materials rated highly on acceptability, applicability, and usefulness significantly improved student performance in mathematical operations. Similarly, Smith and Thompson (2020) reported that the successful integration of intervention materials in classrooms largely depended on students' and teachers' perceived relevance and utility.

Moreover, the alignment of the high ratings across acceptability, applicability, and usefulness underscores the importance of holistic evaluation in educational material design. It ensures that the materials are content-rich, user-friendly, and contextually appropriate, leading to higher engagement and better educational outcomes.

Thus, the high mean scores for the proposed SIM for the subtraction of integers indicate its potential effectiveness in enhancing student learning. These findings reinforce the value of creating well-accepted, applicable, and useful educational resources supported by existing literature. Future research could further explore the long-term impacts of such materials on student performance and retention in mathematics.

CONCLUSIONS AND RECOMMENDATIONS

The Grade 7 students in this study are typically adolescents, predominantly female, and come from families with low monthly incomes. These students do not perform well in problems involving the subtraction of integers. There is a significant difference in the performance of these students in the addition and subtraction of integers when considering their age variable. In contrast, no significant difference is observed in their performance in the multiplication and division of integers to age. Furthermore, the students' performance on the four operations on integers does not significantly differ based on their sex. However, there is a significant difference in the student's performance across all four operations on integers when considering their family's monthly income. In response to these findings, a Strategic Intervention Material (SIM) focusing on the subtraction of integers was developed. This SIM was evaluated and found very much acceptable, applicable, and useful.

Based on these conclusions, the researchers recommend the following actions: teachers should conduct remedial sessions to improve their students' performance in the subtraction of integers; enhancement exercises and drills, such as using flashcards, should be utilized to bolster students' subtraction skills; the developed SIM should be implemented to assess its effectiveness in improving students' performance in the subtraction of integers; and future studies related to this topic are suggested to evaluate further and understand students' performance in all four operations on integers.

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