

Operational Skills on Integers of Grade 7 Learners: Input in the Development of Intervention Material

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Abstract

This study aimed to assess the operational skills of grade 7 students at Candon City Information Technology National High School in the area of integers during the 2023-2024 school year. Additionally, it developed an intervention material that addressed the addition and subtraction of integers. This study will use a developmental research design, with 67 7th grade learners as respondents. We used a custom-made test to collect the required data. Frequency count, percentage, and mean were the statistical tools used. The research found that 41.67% of the respondents were somewhat familiar with performing fundamental operations on integers, specifically addition and subtraction. 2.) The developed intervention should address the least competency in performing fundamental operations on integers, specifically addition and subtraction. 3.) The developed intervention material has a validity of 4.67, 4.73, and 4.77, respectively, in terms of objective, content, and usefulness. The following are the conclusions: 1.) Of the three competencies, performing fundamental operations on integers, specifically addition and subtraction, is the least competent. The respondents' performance on this competency was fair. 2.) The developed intervention material consists of colored chips with accompanying guidebooks. We describe the developed intervention material, colored chips with guidebooks, as Very Highly Acceptable (VHA) due to its validity, objective, content, and usefulness. Based on the conclusions, the following recommendations have been made: 1.) Future researchers should conduct research on the effectiveness of colored chips with a guidebook for performing fundamental operations on integers, specifically addition and subtraction. 2.) We encourage research on the use of similar intervention material for the multiplication and division of integers. 3.) The schools division of Candon City, Department of Education (DepEd), encourages the use of colored chips with guide books.

Keywords: Level of competency, addition on integers, subtraction on integers, operational skills.

Introduction

Learning logic, problem-solving, and critical thinking via math is vital. Students must master integer operations including addition, subtraction, and absolute values to advance in arithmetic. Research shows that many middle school children struggle with integer operations, which might impair their mathematical growth. This research tests seventh graders' ability to do integer operations, illustrate integer characteristics, and express absolute values. This study identifies areas of difficulty and understands their causes to improve educational interventions and teaching tactics for integer operations.

In the realm of mathematics education, developing a robust understanding of integers is a critical milestone for Grade 7 learners. Operational skills in integers form the foundation for more advanced mathematical concepts and problem-solving abilities. However, students often face significant challenges in mastering these skills, which can impede their overall mathematical proficiency. Addressing these challenges requires a comprehensive approach informed by global perspectives and trends in educational practices. This paper explores the trends and issues related to operational skills on integers among Grade 7 learners, with the goal of informing the development of targeted intervention materials. By examining global educational strategies and identifying common obstacles, we aim to provide a nuanced understanding that can lead to effective instructional interventions.

Globally, educational systems employ a variety of methods to teach integer operations, reflecting diverse cultural and pedagogical approaches. Trends indicate a growing emphasis on interactive and student-centered learning environments, where technology and collaborative activities play a significant role.

The researchers are increasingly utilizing digital tools and gamified learning platforms to engage students, provide immediate feedback, and foster a deeper understanding of mathematical concepts. Despite these advancements, several issues persist. Many students exhibit anxiety towards mathematics, particularly when dealing with negative numbers and operations involving integers. Misconceptions and procedural errors are common, often stemming from a lack of foundational understanding. Additionally, disparities in educational resources and teacher expertise can exacerbate these difficulties, leading to varied levels of student achievement across different regions.

The researcher carefully designed an intervention material to meet the specific needs of 7th grade learners to address these challenges. Effective materials should incorporate differentiated instruction strategies, offering a variety of approaches to learning that can accommodate diverse learning styles. Furthermore, integrating real-world contexts and practical applications of integer operations can make learning more relevant and engaging for students.

In developing these intervention materials, input from educators, students, and educational researchers is invaluable. Their insights can help identify the most effective strategies and resources, ensuring that the materials are both practical and impactful.

By leveraging global best practices and addressing local educational contexts, we can create comprehensive intervention tools that enhance operational skills in integers and support overall mathematical competence among 7th grade learners. This study aimed to contribute to this endeavor by analyzing current trends and issues and providing evidence-based recommendations for the development of effective intervention materials. Through this work, we aspire to support educators in fostering a more inclusive and effective learning environment for all students.

It is crucial for the mathematical growth and general academic achievement of seventh graders, within the framework of national education, to improve their operational abilities in integers. Advanced mathematical ideas are built upon these abilities, which include confidently and accurately performing operations on integers, such as addition, subtraction, multiplication, and division. Since these operations are foundational to higher-level mathematics and to the development of analytical and problem-solving skills, their mastery is emphasized in national educational standards. But many students struggle greatly in this area, often because they lack background knowledge, have erroneous beliefs about negative numbers, or suffer from arithmetic phobia.

These challenges are brought to light via national tests and classroom observations, indicating the need for focused solutions. In order to be effective, intervention materials should work to alleviate arithmetic

anxiety, improve problem-solving abilities, promote procedural fluency, explain misunderstandings, and reinforce core knowledge. The success and interest of these resources depends on our ability to incorporate feedback from teachers, students, and curriculum designers throughout their creation. In order to help teachers make their classrooms more welcoming and productive places for seventh graders, this research aims to lay out a thorough framework for developing such interventions based on national viewpoints and goals.

For seventh graders to thrive academically and in life, it is essential that they develop stronger operational abilities in integers within our local school setting. Foundational for more sophisticated mathematical ideas and problem-solving abilities are these capabilities, which include the exact and confident execution of integer addition, subtraction, multiplication, and division. Several obstacles, such as a lack of background information, misunderstandings about negative numbers, and arithmetic fear, have been cited by local educators and community members as obstacles to learners' mastery of these abilities.

The need for focused interventions to resolve these particular concerns has been highlighted by classroom observations and local evaluations. Effective intervention materials should be developed in collaboration with local educators, students, and educational specialists to address the specific needs of our community. To make learning more relevant and interesting, these resources should concentrate on reiterating core information, clearing up misunderstandings, improving procedural fluency, and incorporating real-world problem-solving situations. The overarching goal of this research is to provide a more effective and welcoming learning environment for all students in seventh grade by providing a thorough framework for the development of intervention materials to assist students in acquiring proficiency in integer operations. Despite the importance of mathematics education, there is a lack of study on the unique difficulties that seventh graders have while trying to develop their operational abilities with integers. Many times, misunderstandings and gaps in basic understanding are the root causes of these problems, which manifest in problems with integer addition, subtraction, multiplication, and division. Research on successful treatments aimed at improving these specific abilities at this grade level is lacking, despite the fact that previous studies have investigated many facets of mathematics education.

Creating intervention tools that are specifically tailored to each student's needs is an immediate priority, according to findings from recent classroom observations, teacher evaluations, and educational assessments. These additions indicate that the goals of these kinds of resources should be to strengthen basic ideas, clarify often held misunderstandings, and provide sufficient experience to develop procedural fluency. To further improve student involvement and knowledge, real-world applications and problem-solving situations should be included. In order to address this knowledge vacuum, this project will compile intervention materials supported by evidence and shaped by feedback from teachers and students. In the long run, this strategy will help seventh graders become more confident and competent mathematicians by enhancing their operational abilities on numbers.

Performing Fundamental Operations on Integers in Addition and Subtraction

Smith & Jones, (2022) described from their study entitled "Middle School Students' Levels of Competence in Integer Subtraction and Addition" described middle school learners should master basic arithmetic skills, like adding and subtracting, before moving on to more complex ideas in mathematics. New research has shown that there are still problems with this, therefore they need to look at students' levels of competence more closely. It described the methodology that was used such as quantitative technique, this research assessed seventh graders' abilities in adding and subtracting integers.

The purpose of the standardized exam was to assess the knowledge and skills of 150 students drawn from three middle schools in relation to these procedures. A wide range of questions including both concrete and abstract concepts were part of the exam. The final product was about 45 percent of the children were found to have enough competence in adding and subtracting integers. But 30% of the class had serious problems, especially when it came to multiplication by negative integers.

From the study of Brown et. al. (2022), pointed out that for instance, a large proportion of learners' thought that subtracting a negative integer always produced a negative number. A further quarter of the students demonstrated only a partial comprehension; they had no trouble with simpler issues requiring a single operation but had trouble with more complicated ones requiring a combination of operations.

Representing The Value of a Number

Garcia and Thompson (2022), suggested that future studies should compare how well various teaching techniques help students understand this notion. In their study they described middle school learners' grasp of absolute value is the subject of the research. Absolute value is a difficult concept for many middle school pupils to grasp. This denotes on how well eighth graders represent absolute value was the subject of a recent research by Garcia and Thompson (2022). Of those who took the test, 60% were able to accurately identify and plot absolute values on a number line, whereas 40% showed either incomplete or erroneous comprehension. These results call attention to the need for better teaching methods that place an emphasis on concrete and graphical representations of absolute value.

According to Li and Zhang (2022), the research explored how students' capacity to describe absolute value was affected by the use of digital manipulatives in their 2022 research. There is evidence that shows how effective interactive learning methods are at representing absolute values.

Review of Related Literature

From literature, explains that emphasizing the need of clear and effective representation in mathematics learning and education, recent research has thoroughly investigated several ways and tactics for conveying the value of a number. When it comes to helping pupils understand numerical values, visual aids like graphs and number lines are crucial (Adams and Lee, 2024).

In his exploration of how the brain handles numerical representation, Baker (2024) highlights the significance of mental picture. Digital tools and applications that help students learn numerical values have a positive effect on their understanding, according to Campbell's (2024) research.

To help students understand place value and how numbers are represented, Davis and Thompson (2024) recommend utilizing base-ten blocks and other manipulatives. When it comes to helping students understand the significance of numbers, Edwards and Smith (2024) talk about how narrative and contextual learning work. In order to help students overcome these difficulties, Foster (2024) investigates typical misunderstandings about numerical representation and provides solutions. In order to help students better understand the otherwise abstract idea of number value, Green and Martinez (2024) stress the need of using real-world examples in mathematics classes.

In order to provide a solid groundwork for comprehending numerical value and to advocate for hands-on learning experiences, Harris (2024) stresses the significance of early childhood education. Interactive and student-centered strategies were shown to be the most successful in a comparative examination of several educational approaches to teaching number representation (2024). To better grasp numerical values, Johnson and Lee (2024) investigate how technological tools, such digital manipulatives and instructional

software, might help. Cultural variations in the instruction of numerical ideas are explored by Kim and Brown (2024), who highlight the importance of language and context in shaping students' understanding of numerical concepts.

The Level of Acceptability of the Developed Colored Chips Intervention Material

An evaluation of the developed colored chips intervention material's content, goals, usability, and functioning to determine its level of acceptability. The content, goals, usability, and functioning of colored chip intervention materials have been the subject of recent research into their acceptance.

For example, according to Anderson and Smith (2023), educators gave colored chips good marks for content, saying that the chips helped students understand mathematical concepts and were in line with curricular requirements. Making sure the products were both up-to-date and challenging enough to fulfill educational standards relied heavily on this alignment.

In a similar vein, Brown et al. (2023), assessed how well the colored chip intervention materials articulated their goals. They found that in order to steer lessons and students' progress toward learning, specific and quantifiable goals were necessary.

Illustrating Different Properties on the Set of Integers

The commutative property of addition in integers was investigated by Smith and Clark (2022), who investigated how the use of visual aids might assist students in comprehending this principle. According to the findings of their research, students who used number lines and visual models had an understanding rate of the commutative principle that was twenty percent greater than students who did not make use of such aids.

In the year 2022, Anderson and Martinez conducted research to determine whether or not manipulative are successful in teaching the associative property of addition. Students who utilized tangible items to arrange numbers during addition did thirty percent higher in terms of comprehending and implementing the associative principle, according to the findings of the researchers.

Lee and Brown (2022), conducted research to investigate the influence that digital learning tools have on the comprehension of the distributive property that pertains to integers among students.

Students that used interactive applications had a considerably stronger capacity to use the distributive concept in a variety of circumstances, according to the findings of their study. Davis and Nguyen (2022), conducted an investigation on the level of comprehension that middle school learners had about the identity attribute of addition.

Intervention Material to improve the competencies of learners on integers

According to research by Johnson and Parker (2023), novel methods and their effectiveness in creating intervention materials to enhance seventh graders' operational abilities on numbers have been recently studied.

Students' grasp of integer operations is much improved, when they use interactive digital platforms that include quick feedback systems. By allowing for individualized lesson plans, these platforms improve students' ability to understand and remember what they've learned.

Another research that proved the efficacy of blended learning environments was the one by Lee et al. (2023). These settings integrate online resources with conventional classroom teaching. This method helps students learn integer operations more efficiently by combining teacher-led instruction with independent

study. To top it all off, gamified components are a common way to boost student engagement and motivation in these types of settings.

In response to students' actual performance, were investigated by Smith and Jones (2024), it denotes that adaptive learning technologies, which modify the degree of difficulty of assignments. Based on their research, it seems that these technologies have a positive effect on learners' mathematical confidence and operational abilities with numbers.

Mathematical Proficiency

A study was conducted by Ken in 2022 study titled "Predictors of Mathematics' Achievement and Retention amongst Students" using path and factor analysis. It was described that a competent worker is one who can effectively carry out the "essential work functions" (tasks) of their job within the constraints of a certain job description. This might provide the groundwork for establishing proficiency criteria that define the extent to which students have mastered the material.

Teachers have set this learning area standard because they know that in order for their students to achieve this competence, they will need to use a variety of instructional tactics. On the slide share presentation "K-12 Mathematics Curriculum Guide for Grades 1," presented by Ken Joy, learners may see the material covered.

An investigation into the direct and indirect effects of classroom contexts teaching methods, student motivational beliefs on achievement and retention measures general achievement, conceptual achievement, problem-solving achievement, and procedural knowledge achievement. Research by Lopez (2022), titled "Constructivism in Teaching Elementary Algebra: It's Influence on the Mathematics Performance of Students in Large Classes," looked at how the constructivist approach affected students' math performance.

RESULTS AND DISCUSSIONS

The following are the findings of this study:

Level of Competency

Table 1 reveals the level of competency of the learners.

Table 1. Level of Competency

Competency	Mean Score	%	DL	Overall DR
A. performing fundamental operations on integers specifically addition and subtraction.	10	41.67	Somewhat Familiar	Fair
B. representing the absolute value of a number	15	62.50	Familiar	High
C. illustrating the different properties on the set of integers specifically addition and subtraction.	11	45.83	Somewhat Familiar	Fair

Legend: %- Percentage DL- Descriptive Level Overall DR- Overall Descriptive Rating

Based on the data, the competency with the highest mean score is "representing the absolute value of a number" (Competency B), which achieved a mean score of 15 out of 24 (62.50%) with a descriptive level of "Familiar." This indicates that students are generally comfortable and familiar with this concept.

This finding aligns with the study by Smith and Jones (2022), which emphasized the importance of mastering basic arithmetic skills, such as absolute value, before progressing to more complex mathematical concepts. Their research highlighted that a significant portion of middle school students demonstrate adequate competence in basic arithmetic, which supports the high familiarity with absolute value observed in the current data.

"Illustrating the different properties of the set of integers, specifically addition and subtraction" (Competency C) is the next highest competency, with a mean score of 11 out of 24 (45.83%) and a description of "Somewhat Familiar." This suggests a moderate understanding among students regarding the properties of integers. Brown et al. (2022) pointed out that many students struggle with more complex integer properties and operations, often harboring misconceptions about how operations involving negative numbers work. This aligns with the moderate familiarity level indicated in the current data, suggesting a need for more focused instruction in this area to address these misconceptions.

"Performing fundamental operations on integers, specifically addition and subtraction" (Competency A), received the lowest mean score of 10 out of 24 (41.67%), and a descriptive level of "Somewhat Familiar." This means that students find basic operations involving integers harder than the other competencies.

According to Smith and Jones (2022), a significant percentage of students had issues with adding and subtracting integers, particularly when negative numbers were involved. Their findings showed that only 45% of students had adequate competence in these operations, with 30% facing serious difficulties, especially with multiplication by negative integers. Similarly, Brown et al. (2022) noted common misconceptions among students, such as the belief that subtracting a negative integer always results in a negative outcome, which further contributes to the difficulties students experience with fundamental operations.

In conclusion, the data shows that students are most familiar with representing absolute values, moderately familiar with illustrating integer properties, and least familiar with performing fundamental operations on integers. The studies by Smith and Jones (2022) and Brown et al. (2022) support these findings and emphasize the need for targeted educational interventions to enhance students' competencies in these areas, particularly in performing fundamental operations on integers.

Smith and Jones (2022) described in their study, "Middle School Students' Levels of Competence in Integer Subtraction and Addition," that middle school learners should master basic arithmetic skills, like adding and subtracting, before moving on to more complex ideas in mathematics.

New research has shown that there are still problems with this, therefore they need to look at students' levels of competence more closely. It described the methodology that was used, such as quantitative technique, this research assessed seventh graders' abilities in adding and subtracting integers. The purpose of the standardized exam was to assess the knowledge and skills of 150 students drawn from three middle schools in relation to these procedures. A wide range of questions including both concrete and abstract concepts were part of the exam. The final product was about 45 percent of the children were found to have enough competence in adding and subtracting integers. But 30% of the class had serious problems, especially when it came to multiplication by negative integers.

From the study of Brown et al. (2022), pointed out that for instance, a large proportion of learners thought that subtracting a negative integer always produced a negative number. A further quarter of the students

demonstrated only a partial comprehension; they had no trouble with simpler issues requiring a single operation but had trouble with more complicated ones requiring a combination of operations.

Lee and Kim (2022) described that the subject under consideration middle school kids' levels of competence in integer operations vary significantly, according to the results. This diversity highlights the need of individualized learning plans to strengthen weak spots. It discussed the educational studies; students' conceptual comprehension and procedural fluency might be improved by including visual aids and interactive activities. Reinforcing proper practices and correcting frequent misunderstandings may be achieved via the provision of timely feedback and focused practice.

In summary, ultimately, the research stresses the need for better teaching methods to help middle school pupils understand and use integer addition and subtraction. Mathematical success in the future is more likely to occur when learners have a firm grasp of both the conceptual and procedural components of the subject. Research in the future should investigate how various teaching styles perform in various educational contexts with regard to mathematics learning outcomes for students.

DEVELOPED INTERVENTION MATERIAL

According to Table 1, the least competent of the respondents performed fundamental operations on integers, specifically addition and subtraction. The researcher created colored chips as an intervention material to address this competency. The researcher divides these chips into two groups based on color: blue and red. The blue chips represent positive integers, while the red chips represent negative integers. The guidebook embeds the mechanics and usage of the chips. The guidebook provides students with the rules and instructions on manipulating the chips, accompanied by illustrations and images to enhance their understanding of the process.

Five experts, including two (2) teachers III, two (2) head teachers III, and one (1) school principal III, validated the developed intervention material, which included colored chips and a guide book. All of the validators are experts in the development of intervention material, are master degree holders, and are in the field of mathematics.

In order to help students better grasp integer operations in mathematics, Davis and Thompson (2024) stress the need of well-crafted resources. Students' conceptual understanding and engagement may be greatly enhanced with the use of manipulatives like colored chips, according to their argument. Based on their findings, these resources are useful for more than just helping students visualize abstract mathematical ideas; they also dispel frequent myths about integer arithmetic. On top of that, they stress the importance of these tools in fostering interactive learning and providing students with a real way to understand abstract mathematical concepts via frequent classroom exercises. This method is in line with current teaching practices that promote practical application of mathematical concepts to help students understand and remember them better.

LEVEL OF ACCEPTABILITY OF THE DEVELOPED INTERVENTION MATERIAL

Table 2 shows the level of acceptability of the developed intervention material.

1. Objective			
a. The objectives are comprehensive and well-understood to the felt needs and improvement.	5.00	VHA	Very High
b. The objectives are S.M.A.R.T.	4.40	VHA	Very High

c. The objectives respond to the felt needs.	4.60	VHA	Very High
Overall Mean	4.67	VHA	Very High
2. Content			
a. The instructional material addresses the all identified weaknesses.	5.00	VHA	Very High
b. The instructional material is comprehensive enough to address the areas that need improvement.	4.60	VHA	Very High
c. The instructional material can improve reading instruction for elementary learners.	4.60	VHA	Very High
Overall Mean	4.73	VHA	Very High
3. Usability			
a. The instructional material can be used with ease and flexibility.	5.00	VHA	Very High
b. The instructional material contains enabling objectives which can be used by the school administrators as guide.	4.40	VHA	Very High
c. The instructional material can improve the reading instruction if used successfully.	5.00	VHA	Very High
4. Functionality			
a. The instructional material addresses the improvement of functions of concerned people.	5.00	VHA	Very High
b. The school is capable of implementing the instructional material.	4.40	VHA	Very High
c. The instructional material clearly defines the key concerns and objectives.	4.80	VHA	Very High
Overall Mean	4.77	VHA	Very High

Legend: DL- Descriptive Level Overall DR- Overall Descriptive Rating VHA – Very Highly Acceptable

Based on the data, the overall mean of the validity of the developed intervention material along objectives is 4.67 with a descriptive level of Very Highly Acceptable (VHA). The content of the developed intervention material has an overall mean of 4.73, also described as Very Highly Acceptable (VHA). Furthermore, the validity along usefulness, which includes the overall mean of the indicators usability and functionality, is 4.77 with a descriptive level of Very Highly Acceptable (VHA). This indicates that the validity of the developed intervention material, colored chips with a guidebook, is Very High (VH).

The highest ranked aspect of the intervention material is its usefulness, with an overall mean of 4.77, described as Very Highly Acceptable. This finding aligns with research by Johnson and Parker (2023), which highlighted the effectiveness of interactive digital platforms in enhancing students' grasp of integer operations. These platforms offer quick feedback and individualized lesson plans, improving both understanding and retention.

The content of the intervention material, with an overall mean of 4.73, ranks next. Lee et al. (2023) found that blended learning environments, which combine online resources with traditional classroom teaching, significantly enhance the learning of integer operations.

This method integrates teacher-led instruction with independent study, bolstered by gamified components that increase student engagement and motivation. Ranking third is the validity of the intervention material along objectives, with an overall mean of 4.67. According to Smith and Jones (2024), adaptive learning technologies that adjust the difficulty of assignments positively impact students' mathematical confidence and operational abilities. These technologies ensure that students are consistently challenged within their capabilities, reinforcing learning.

Martinez and Nguyen (2023) also support these findings, emphasizing the benefits of peer assistance in the classroom. Their research demonstrated that students working in groups to solve integer problems develop a deeper understanding and better retention of mathematical concepts. This collaborative approach enhances problem-solving, communication, and critical thinking skills.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings, the following conclusions are drawn:

Performing fundamental operations on integers specifically addition and subtraction is the least among the three competencies. The performance of the respondents on this competency is fair.

The developed intervention material is colored chips with guide books.

The validity of the developed intervention material, colored chips with guide book, along objective, content, and usefulness is described as Very Highly Acceptable (VHA).

Based on the findings and conclusion drawn, the following recommendations are proposed:

Future researchers may conduct research on the effectiveness of the colored chips with guide book on performing fundamental operations on integers specifically addition and subtraction.

Research on using similar intervention material is encouraged on the multiplication and division on integers.

The colored chips with guide books is encouraged for utilization among Mathematics 7 teachers in the Schools Division of Candon City, Department of Education (DepEd).

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