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PROJECT İSOLVE (INTEGERS SOLVED THROUGH VARİOUS EXERCİSES): A GAMİFİED APPROACH TO ENHANCE GRADE 7 STUDENTS' MASTERY İN ADDİNG AND SUBTRACTİNG INTEGERS

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ABSTRACT

This study explored the effectiveness of Project iSolve (Integers Solved through Various Exercises), a gamified instructional strategy designed to enhance Grade 7 students' mastery in adding and subtracting integers. Utilizing a mixed-methods approach, the researchers implemented a descriptive quantitative design alongside qualitative inquiry, involving 31 Grade 7 Amethyst students from Magatos Integrated School. A pre-test and post-test using the Negative Number Subtraction Operation Test assessed students' arithmetic skills before and after the intervention. The Shapiro-Wilk Test revealed a significant deviation from normality ($W=0.822$, $p<.001$), prompting the use of non-parametric analysis. The median score increased from 40% (IQR=7.50) in the pre-test to 70% (IQR=7.00) in the post-test. The Wilcoxon Signed-Rank Test confirmed a statistically significant improvement ($W=496$, $Z=4.860$, $p<.001$), and the rank-biserial correlation ($r=1.000$, $SE=0.203$) indicated a very large effect size, validating the practical impact of the intervention. To complement the quantitative results, in-depth interviews were conducted with selected students, revealing nine emergent themes: Sustaining Student Engagement in the Learning Process, Enhancing Learning through Interactive Game-Based Activities, Optimizing Activity Duration for Effective Learning, Needing for Instructional Clarity, Incorporating Visual Aids Enhances Engagement, Incorporating Real-life Applications Makes Learning More Meaningful, Simplifying Complex Concepts, Boosting Confidence in Solving Mathematical Problem, and Promoting Engagement through Group Participation. These findings highlight that Project iSolve not only significantly improved students' computational skills but also fostered greater engagement, motivation, and conceptual understanding, supporting its integration into regular classroom instruction to enhance mathematics learning.

KEYWORDS: *Project İsolve, Gamified İntervention, Adding And Subtracting, İnteger Operations, Philippines*

INTRODUCTION

Addition and subtraction of integers are fundamental skills that serve as the foundation for more advanced mathematical concepts, including algebra. Despite their importance, these operations often present challenges for students, particularly when negative numbers are involved. Many learners struggle with understanding how to subtract a larger number from a smaller one or how to correctly add positive and negative integers (Annisa, 2024). A strong grasp of these basic operations is crucial for students to progress confidently in mathematics. However, misconceptions at this foundational level can become significant barriers to learning more complex topics. Additionally, negative experiences with these early concepts can foster unfavorable attitudes toward mathematics as a whole, with some students failing to see its relevance to everyday life (Gyampoh et al., 2020). Sidik et al. (2021) found that many students struggle to comprehend problem statements, become confused by the order of operations involving positive and negative signs, and frequently make computational errors. These persistent difficulties highlight the ongoing need for targeted instructional strategies to help students master integer addition and subtraction.

Moreover, in the context of Pendidikan Indonesia, students face several learning obstacles in mastering integer operations, which include ontogenic, didactical, and epistemological challenges. Kurniasi et al. (2024) explain that the ontogenic obstacle arises from the gap in students' prior knowledge between natural number operations and integer operations. The didactical obstacle involves the use of inappropriate learning

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media and insufficient learning time, which impede effective learning. These obstacles hinder students' ability to fully grasp and apply integer operations in mathematics. Complementing this, Vlassis and Demonty (2022) emphasize the role of relational thinking in arithmetic as a critical factor influencing students' success with integer problems. Students who demonstrate the ability to manipulate numerical relationships flexibly and comprehend equations structurally exhibit stronger performance. This underscores the need to cultivate algebraic thinking from an early stage to support deeper mathematical understanding. Similarly, Kwakye et al. (2022) report that students in Ghana often struggle with the correct application of integer operations, particularly addition and subtraction, when instruction relies heavily on traditional, rote-based methods. These methods prioritize memorization over conceptual understanding, resulting in widespread confusion—especially regarding the use of positive and negative signs.

Furthermore, a study conducted at Ramon Magsaysay State University in the Philippines identified a key issue in Grade 7 students' understanding of integer operations, specifically highlighting a significant weakness in integer subtraction across all genders. This difficulty was further linked to socioeconomic disparities, as students from lower SES backgrounds faced challenges such as limited resources and support, which negatively impacted their performance in this area (Flores et al., 2024). In a related study, Aquiler (2023) examined the nature of students' errors in integer operations among 147 Grade 7 students from a private school in Metro Manila. The analysis revealed a variety of contributing factors, including carelessness, inadequate foundational knowledge, confusion in applying rules, and the misconception of integers as whole numbers. Additional issues such as poor mathematical language proficiency, misunderstandings about zero, instructional shortcomings, and time pressure also played a significant role in students' struggles. Moreover, research conducted at Tairan National High School – Basilan Division – BARMM-MBHTE explored the impact of modular learning on students' mastery of integer operations. Harun et al. (2023) found persistent misconceptions, particularly in subtraction and the handling of negative numbers. Despite achieving an "Average Near Mastery" level, with a Mean Percentage Score (MPS) of 50.56%, item analysis revealed common conceptual errors across both male and female students. These findings underscore the importance of targeted instructional interventions to address misconceptions and strengthen conceptual understanding.

In the Division of Davao del Norte, particularly at Magatos Integrated School, observations and performance records reveal that many students consistently struggle with the basic operations of integer addition and subtraction. These difficulties are evidenced by frequent and repeated errors in classroom exercises, quizzes, and examinations involving even the most fundamental problems. Interviews with teachers and classroom observations suggest that this struggle stems from several factors, including limited use of effective teaching strategies, lack of engaging and consistent practice activities, and students' generally negative attitudes towards mathematics. This lack of conceptual understanding and procedural fluency prevents learners from progressing in higher mathematical topics and fosters enduring misconceptions. These findings point to the urgent need for targeted instructional interventions that can address both the cognitive and affective barriers to learning integers.

The purpose of this study was to determine the improvement of the students' integer arithmetic abilities upon the implementation of Project iSolve and develop an intervention plan to further enhance the integer arithmetic mastery of the students. It highlights the pre-test to determine the students who were in low level of conceptual understanding. Also, the post-test determines the effectiveness of Project iSolve implementation. The researchers will then analyze the differences between the pre-test and post-test results to evaluate the impact of the intervention on Grade 7 Amethyst students. Additionally, in-depth interviews will be conducted to gather insights and feedback from the participants.

This study aimed to apply Project iSolve using the Negative Number Subtraction Operation Test in enhancing the integer arithmetic mastery of Grade 7 students. The researchers identified a gap in the study by highlighting the need for improved integer arithmetic abilities among Grade 7 section Amethyst students. The goal is to provide a foundation for schools' agendas and initiatives, ultimately enhancing intervention programs that address students' arithmetic difficulties, particularly in understanding integer operations.

At present, numerous studies focus on improving students' abilities in integer arithmetic using both statistical and qualitative data. In a study conducted by Hanifa et al. (2024), in their study "*Identification of the Difficulties of Middle School Students in Understanding the Mixed Operations of Integers*," emphasized student understanding and identified learning difficulties related to mixed integer operations. Similarly, Anggraeni et al. (2025), in their study "*Analysis of Students' Mastery Levels in Using Integer Operations in Elementary School Mathematics Learning*", aims to evaluate the mathematical problem-solving skills of elementary school students related to mixed integer operations. Additionally, a national study by Harun (2023), entitled "*Assessing Students' Mastery and Misconceptions in the Fundamental Operations on Integers*," explored student mastery and common misconceptions in performing integer operations. While these studies provide valuable insights, they do not address the specific challenges faced by Grade 7-Amethyst students at Magatos Integrated School, particularly in mastering integer operations. This study identifies a gap in the literature, which lacks sufficient focus on improving integer arithmetic skills within a localized context. Thus, the present research aims to fill this gap by implementing Project iSolve as an intervention, targeting the specific needs of students at Magatos Integrated

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School and contributing to the development of future intervention programs in basic mathematical operations.

RESEARCH QUESTIONS

The research questions below were formulated to investigate the reasons behind the difficulties Grade 7 students encountered in integer arithmetic and how these challenges could be addressed. The Negative Number Subtraction Operation Test served as the intervention to help learners overcome these difficulties. The research questions that guided this study were the following:

1. What is the level of mastery in adding and subtracting integers demonstrated by grade 7 students on the pre-test?
2. What is the level of mastery in adding and subtracting integers demonstrated by grade 7 students on the post-test?
3. Is there a significant difference between the pre-test and post-test scores of the grade 7 students?
4. What are the insights of the students on the effectiveness and areas for improvement of Project iSolve in mastering integer operations?

PROPOSED INTERVENTION PLAN

On the first day, students took a 20-item pre-test based on the Negative Number Subtraction Operation Test to assess their initial understanding of integer arithmetic, particularly addition and subtraction of integers. This pre-test served as a baseline to measure improvements after the lessons and activities. Following the assessment, the Project iSolve strategy was introduced through a fun and interactive learning tool called the Int-Board Game. In this activity, students rolled three dice to generate numbers and determine the operation, using counters to represent the numbers and physically demonstrate the process. Correct answers allowed players to move their pieces on the board, with the goal of reaching either +30 or -30 to win. This competitive and hands-on game encouraged active participation, reinforced integer rules, and helped students visualize integer interactions, making learning both enjoyable and effective.

On the second day, students engaged in active practice using the Int-Board Game that focused on the basic concept of adding integers. Each student received dice, counters, and chips to play both individually and in groups. Through repeated gameplay, students practiced integer addition while visualizing the operations using counters. Group activities encouraged collaboration and peer learning, creating opportunities to discuss strategies and solve problems together. This blend of individual and cooperative learning helped reinforce concepts and make learning more interactive.

On the third day, students focused on subtracting both positive and negative integers. Using new materials and the same game, they practiced subtraction individually and in groups. These activities supported hands-on learning, helping students understand subtraction rules while also improving their communication and thinking skills. On the fourth day, students practiced both addition and subtraction of integers in mixed problems using the game, helping them apply and connect both operations.

On the fifth day, they learned how to solve problems with integers that included variables. New game materials were used for individual and group practice, focusing on addition with variables. On the sixth day, students studied subtraction with variables through a gameplay. On the seventh day, they combined both addition and subtraction of integers with variables in practice activities using the Int-Board Game. These sessions helped build a stronger understanding and encouraged collaboration. On the eighth day, students worked on exercises involving mixed operations—adding and subtracting integers with and without variables—further improving their arithmetic skills through the game.

Finally, on Day 9, a 20-item post-test, parallel to the pre-test, was administered to evaluate the effectiveness of the Project iSolve strategy. The assessment measured the students' mastery in solving problems involving the addition and subtraction of integers, including those with variables. The results of this post-test served as a final evaluation of the impact of the intervention and provided valuable insights into how the strategy improved students' understanding of integer arithmetic over the course of the program.

Session	Estimated Time Duration	What will happen?
Session 1	1 hour	Students will be informed about the activities during the intervention period. After the orientation, they will take a 20-item pre-test based on the Negative Number Subtraction Operation Test to assess their initial understanding of adding and subtracting integers.
Session 2	1 hour	Students will engage in active practice using the Int-Board Game focused on the basic concept of adding integers. They will use dice, counters, and chips to play individually and in groups.
Session 3	1 hour	Students will focus on subtracting both positive and negative integers. They will use the same game with updated materials to practice subtraction individually and in groups.

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Session 4	1 hour	Students will practice both addition and subtraction of integers in mixed problems using the Int-Board Game. This helps them apply and connect both operations.
Session 5	1 hour	Students will learn how to solve problems involving integers with variables. New game materials will be used for individual and group practice, focusing on addition with variables.
Session 6	1 hour	Students will continue solving problems involving integers with variables, this time focusing on subtraction with variables. The activity will again involve the use of the game.
Session 7	1 hour	Students will combine both addition and subtraction of integers with variables in practice activities using the Int-Board Game.
Session 8	1 hour	Students will work on exercises involving mixed operations—adding and subtracting integers with and without variables—through the game to strengthen their skills.
Session 9	1 hour	A 20-item post-test, parallel to the pre-test, will be administered to assess the improvement in students' mastery of integer operations after the intervention.

METHODS

RESEARCH DESIGN

This study employed mixed methods incorporating both quantitative and qualitative design. A quantitative research was employed through a one-group pretest-posttest design, a type of pre-experimental approach. It assessed changes resulting from an intervention or project by comparing values before (baseline) and after the intervention (end-line evaluation). Unlike experimental designs, pre-experimental designs lack a control group for comparison; instead, they focus on changes within a single group over time. The observed differences between baseline and end-line values are attributed to the project, suggesting its impact on the outcomes (Wamunyima & Nyirenda, 2023). Alongside, qualitative data were gathered to explore students' learning behaviors, reactions, and challenges throughout the intervention. Employing this combined approach strengthens the research's ability to capture not only what works but also why it works within the specific classroom context (Onwuegbuzie & Hitchcock, 2021).

In the context of this study, the students underwent a pre-test and a post-test. The intervention was implemented between the interval of the two tests. Also, an in-depth interview to selected participants was conducted to reveal their insights about the implementation of the Project iSolve. Merging both quantitative and qualitative perspectives proved valuable in addressing the diverse and real-world nature of classroom settings. The Project iSolve was not only evaluated through numerical gains in test performance but also through observational data and student reflections, which revealed insights into their conceptual development and engagement.

RESEARCH RESPONDENTS

In purposive sampling, a non-probability sampling technique, researchers strategically select participants who possess specific characteristics relevant to the research objectives. This intentional selection process, also referred to as judgmental sampling, relies on the researcher's expertise in identifying individuals most likely to provide valuable and pertinent data, in contrast to probability sampling methods where selection is based purely on chance (Nikolopoulou, 2023).

In this study, 31 participants were purposively selected from the Grade 7 Amethyst students enrolled at Magatos Integrated School for the school year 2024–2025. Among the three Grade 7 sections, the Amethyst class was selected based on the cooperating teacher's recommendation, considering that this group would benefit most from additional support in mastering integer operations. These students, aged 12 to 14, were observed to encounter occasional challenges when adding and subtracting positive and negative integers, which are foundational skills for understanding more complex mathematical topics. The entire class was included to ensure consistency in the implementation of the intervention within a familiar learning environment. Other sections were not included to maintain uniformity in scheduling, instruction, and classroom dynamics during the course of the study.

RESEARCH INSTRUMENT

The researchers used the Negative Number Subtraction Operation Test to assess students' integer arithmetic abilities before and after the implementation of Project iSolve. This instrument was adapted from the study of Periasamy and Zaman (2011) and demonstrated high reliability, with a Kuder-Richardson (KR-20) value of 0.919544. The test consisted of 20 items, each worth one point, for a total of 20 points. It included five items on addition involving a positive and a negative integer, five items on addition involving a negative and a positive integer, five items on subtraction involving a positive and a negative integer, and five items on subtraction involving a negative and a positive integer. This structure ensured a balanced evaluation of students' skills across the four types of integer operations addressed in the intervention.

In assessing the scores of Grade 7 Amethyst students, the researchers utilized a scoring scale adapted from Meidiastuti and Safitri (2021). This scale was used to evaluate the students'

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total percentage scores in performing addition and subtraction of integers:

Range of Percentage Score	Descriptive Level	Interpretation
90% – 100%	Outstanding	This means the level of mastery in adding and subtracting integers of Grade 7 Amethyst students is outstanding.
72% – 89%	Highly Satisfactory	This means the level of mastery in adding and subtracting integers of Grade 7 Amethyst students is highly satisfactory.
54% – 71%	Satisfactory	This means the level of mastery in adding and subtracting integers of Grade 7 Amethyst students is satisfactory.
36% – 53%	Fairly Satisfactory	This means the level of mastery in adding and subtracting integers of Grade 7 Amethyst students is fairly satisfactory.
18% – 35%	Needs Improvement	This means the level of mastery in adding and subtracting integers of Grade 7 Amethyst students need improvement.
0% – 17%	Poor	This means the level of mastery in adding and subtracting integers of Grade 7 Amethyst students did not meet expectation.

PROCEDURE

Before conducting the intervention, the researchers first secured formal approval from the school principal by submitting a written request outlining the objectives, methodology, and potential benefits of the study. This request included a detailed intervention plan, consent procedures, and assurances that the activities would not disrupt regular school operations. Once the principal granted approval and issued a written letter of consent, the researchers proceeded with the study. They utilized questionnaires before and after the implementation of the intervention. The pre-test questionnaire measured the average number of students experiencing difficulty with integer arithmetic prior to the implementation. The post-test questionnaire assessed the pupils' knowledge and ability in adding and subtracting integers.

To gather the necessary data, the researchers followed these steps: First, they obtained approval from the school principal where the participants were enrolled. Next, they administered a pre-test to assess the initial scores of the students using the Negative Number Subtraction Operation Test. Afterward, the Project iSolve strategy was introduced, followed by a seven-day intervention period. At the conclusion of the study, a post-test was administered using a parallel set of the Negative Number Subtraction Operation Test to evaluate any improvements in the students' integer arithmetic abilities. The data from both the pre-test and post-test were then collected and analyzed.

Following data collection, the researchers tabulated the pre-test and post-test results. They gathered the completed questionnaires and transferred the data to a Microsoft Excel spreadsheet for recording. The assigned statistician then performed calculations, created tables, and analyzed the data with utmost care. The tabulated results served as the basis for assessing the effectiveness of the intervention.

Immediately after tabulation, the researchers conducted interviews with students from the specific section to gain deeper insights into their experiences and perspectives regarding the intervention. After the in-depth interviews (IDI), the researchers conducted a thematic analysis to identify and develop themes based on the students' responses.

STATISTICAL TREATMENT OF DATA

The data collected from the questionnaires were processed and analyzed using appropriate non-parametric statistical tools to determine students' performance levels and assess the effectiveness of the Project iSolve intervention.

Median. Used to determine the typical level of mastery in adding and subtracting integers demonstrated by Grade 7 students before and after the intervention.

Interquartile Range (IQR). Used to measure the variability or consistency in students' performance, focusing on the spread of the middle 50% of scores.

Wilcoxon Signed-Rank Test. Used to compare the pre-test and post-test scores, as the data violated normality assumptions, to evaluate the statistical significance of changes in performance.

Rank-Biserial Correlation. Used to determine the effect size of the difference between pre-test and post-test scores, indicating the practical impact of the Project iSolve intervention.

DATA ANALYSIS

The researchers employed **thematic analysis** to examine and interpret the qualitative data derived from the participants' responses (Braun & Clarke, 2006). The process began with **data reduction**, where responses were organized and

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simplified by clustering similar thoughts and ideas. These grouped responses underwent **coding**; wherein specific labels were assigned to represent patterns within the data. These codes were then organized into categories representing the shared **emerging themes**, each with a corresponding assigned code and theme label. To ensure the credibility of the findings, the assigned themes were reviewed and validated by experts familiar with qualitative analysis procedures.

ETHICAL CONSIDERATIONS

The participants of this study were Grade 7 Amethyst students from Magatos Integrated School. To ensure the ethical and responsible conduct of the study, appropriate ethical standards were observed throughout the research process.

Informed Consent. Informed consent includes two essential elements: being informed and giving consent, both of which require careful consideration. Participants were given complete information about the nature of the study, the tasks expected of them, how their data would be used, and any potential risks or consequences. They were required to provide explicit, active, and signed consent before participating. This agreement affirmed their rights to access their data and withdraw from the study at any point without penalty. In this study, the researchers included an informed consent statement on the printed survey form, asking students whether they were willing to participate despite any potential risks. Participation was entirely voluntary, and students had the right to decline. The researcher ensured that all participants willingly and enthusiastically participated in the study. Respondents were also informed of their rights, including the right to refuse to answer sensitive questions, ask questions about the study, terminate participation at any time without providing an explanation, and receive the study's results once it was completed (Denzin & Lincoln, 2011).

Risk of Harm, Anonymity, and Confidentiality. The researchers took careful steps to safeguard the identity and privacy of all participants. Confidentiality was strictly maintained, and anonymity was ensured by not disclosing any identifying information. All personal information and responses were handled with the utmost care to avoid any risk of social harm or liabilities. To protect respondent identity, any personally identifiable data such as names or addresses were removed from the dataset and stored separately in a secure location. The data will be kept private and destroyed three years after the completion of the study. These procedures aimed to create a secure and trustworthy research environment, ensuring that participation posed minimal risk to the students (Denzin & Lincoln, 2011).

Conflict of Interest. The researcher declared that the study was conducted independently and was free from any affiliations, financial interests, or relationships that could be perceived as a conflict of interest. According to Blanco (2023), any existing or prior affiliations that might influence a study must be declared for ethical review. In this case, no such conflicts existed. The researcher held no authority that could coerce or pressure the participants into joining the study, ensuring the research process remained unbiased and ethically sound. For example, there were no instances where the teacher threatened academic consequences to force students to participate.

RESULTS AND DISCUSSION

This section presents the findings and elaboration of results of Project iSolve as a strategy in enhancing the integer arithmetic mastery of Grade 7 Amethyst students of Magatos Integrated School. This section of the study presents the data gathered by the researchers, which was meticulously organized, presented, analyzed, and interpreted to achieve a comprehensive understanding of the collected information.

The section presented the data on the level of mastery in adding and subtracting integers demonstrated by grade 7 students on the pre-test; the level of mastery in adding and subtracting integers demonstrated by grade 7 students on the post-test; and significant difference between the pre-test and post-test scores of the grade 7 students.

Research Question No. 1: What is the level of mastery in adding and subtracting integers demonstrated by grade 7 students on the pre-test?

Table 1 presents the results of the pre-test, which reflected the integer arithmetic mastery levels of 31 Grade 7 Amethyst students prior to the implementation of Project iSolve. The median score was 40% (*IQR* = 7.50), corresponding to a descriptive level of "fairly satisfactory," indicating that the level of mastery in adding and subtracting integers of Grade 7 Amethyst students is fairly satisfactory. The highest score was 15 out of 20 (75%), achieved by 1 student (3.2% of the group), while the lowest score was 0, recorded by 4 students (12.9%), reflecting no demonstrated mastery. The most frequently occurring score was 10, achieved by 5 students (16.1%). These results suggested that, prior to the intervention, the students' performance in integer arithmetic was varied, with a tendency toward moderate proficiency. The relatively wide IQR indicates inconsistency in mastery levels across the class, highlighting the need for a targeted instructional strategy such as Project iSolve to support improved and more consistent learning outcomes.

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Table 1. Level of Mastery in Adding and Subtracting Integers of the Grade 7 Amethyst in Pre-Test

Pre-Test Scores	Frequency	Equivalent Percentage of Score	Descriptive Level	Percentage
0	4	0%	Poor	12.9%
1	3	5%	Poor	9.7%
2	1	10%	Poor	3.2%
4	1	20%	Needs Improvement	3.2%
5	3	25%	Needs Improvement	9.7%
8	3	40%	Fairly Satisfactory	9.7%
9	3	45%	Fairly Satisfactory	9.7%
10	5	50%	Fairly Satisfactory	16.1%
11	2	55%	Satisfactory	6.5%
12	1	60%	Satisfactory	3.2%
13	1	65%	Satisfactory	3.2%
14	3	70%	Satisfactory	9.7%
15	1	75%	Highly Satisfactory	3.2%
Total	31			100.00%
Median				45%
IQR				7.50
Description				Fairly Satisfactory

To support the findings, several recent studies have highlighted similar patterns in high school students' struggles with basic mathematical operations, particularly integer arithmetic. Catador and Fernando (2024) assessed the numeracy levels of junior high school students at Kapayapaan Integrated School in the Philippines and found that approximately 86% of the 2,303 learners demonstrated poor numeracy skills. A large proportion of these students struggled with foundational arithmetic operations, emphasizing the need for effective, targeted interventions to improve learning outcomes in mathematics.

Similarly, Flores et al. (2024) revealed that Grade 7 students consistently underperformed in tasks involving integer operations. Their findings led to the recommendation of developing Strategic Intervention Materials (SIM) tailored to the specific difficulties experienced by learners. These materials aimed to provide structured and contextualized support, helping students grasp fundamental arithmetic concepts through visual and hands-on strategies.

Additionally, Harun et al. (2024) conducted a quasi-experimental study among Grade 7 students, where pre-test results showed widespread misconceptions and low proficiency in adding and subtracting integers. Their study stressed the importance of focused intervention strategies in addressing these learning gaps. Together, these studies reinforce the conclusion that the pre-test performance in the present study mirrors a broader issue in mathematical learning among junior high school students. Thus, the implementation of interventions like Project iSolve is justified and necessary to enhance mastery and promote more consistent performance in basic mathematics.

Research Question No. 2: What is the level of mastery in adding and subtracting integers demonstrated by grade 7 students on the post-test?

Table 2 presents the results of the post-test, which reflected the integer arithmetic mastery levels of 31 Grade 7 Amethyst students after the implementation of Project iSolve. The median score was 70% (*IQR* = 7.00), corresponding to a descriptive level of "satisfactory," indicating that the level of mastery in adding and subtracting integers of Grade 7 Amethyst students is satisfactory. The highest score was 20 out of 20 (100%), achieved by 2 students (6.5%), while the lowest score was 1, recorded by 2 students (6.5%), showing minimal demonstrated mastery. The most frequently occurring score was 17, achieved by 5 students (16.1%). These results suggested that following the intervention, students performed at a higher and more consistent level, as reflected by the increase in the median score and slight reduction in score variability (*IQR*). This improvement indicates that Project iSolve was effective in enhancing both the typical performance and overall mastery of integer operations among the learners.

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Table 2. Level of Mastery in Adding and Subtracting Integers of the Grade 7 Amethyst in Post-Test

Post-Test Scores	Frequency	Equivalent Percentage of Score	Descriptive Level	Percentage
1	2	5%	Poor	6.5%
2	1	10%	Poor	3.2%
4	1	20%	Needs Improvement	3.2%
6	2	30%	Needs Improvement	6.5%
9	1	45%	Fairly Satisfactory	3.2%
10	2	50%	Fairly Satisfactory	6.5%
11	3	55%	Satisfactory	9.7%
13	2	65%	Satisfactory	6.5%
14	4	70%	Satisfactory	12.9%
15	3	75%	Highly Satisfactory	9.7%
17	5	85%	Highly Satisfactory	16.1%
19	3	95%	Outstanding	9.7%
20	2	100%	Outstanding	6.5%
Total	31			100.00%
Median				70%
IQR				7.00
Description				Satisfactory

To support the findings, recent studies have demonstrated the effectiveness of targeted and interactive interventions in improving students' performance and consistency in integer arithmetic. Jalandoni and Futalan (2024) explored the use of game-based strategies—specifically, the Integer Math Maze and Intego Card Game—with 41 Grade 10 students. Their findings revealed significant improvements in learners' ability to add and subtract integers following the intervention. The study suggests that interactive instructional tools not only enhance understanding but also promote stable and sustained learning outcomes.

Similarly, Bernal et al. (2024) conducted a review-based intervention with Grade 11 STEM students who previously exhibited difficulties in integer operations. The results showed that even a structured and focused review session led to notable improvements in their computational skills. This highlights the value of intentional, content-specific strategies in developing students' conceptual grasp and procedural accuracy, even at the senior high school level.

Additionally, Cañeda et al. (2024) designed and implemented an audio-visual Strategic Intervention Material (SIM) tailored for Grade 7 students struggling with fundamental integer operations. The use of multimedia-based instruction helped clarify complex concepts and significantly enhanced students' performance. These findings support the effectiveness of Project iSolve, which similarly employed structured, interactive strategies. The increase in median scores and reduction in variability in the current study further confirm that well-designed interventions can lead to both improved mastery and more consistent performance in basic mathematics.

Research Question No. 3: Is there a significant difference between the pre-test and post-test scores of the grade 7 students?

Table 3 presents the significant difference between the pre-test and post-test scores of the Grade 7 Amethyst students, which measured their mastery of integer operations before and after the implementation of the Project iSolve intervention. Prior to analysis, a Shapiro-Wilk test of normality was conducted, yielding $W = 0.822$, $p < .001$, which indicated that the data significantly deviated from a normal distribution. Due to this violation of the normality assumption, non-parametric statistical methods were used, focusing on medians and ranked scores rather than means.

The pre-test median score was 40% ($IQR = 7.50$), representing a "fairly satisfactory" level of performance with a relatively wide spread in students' scores. In contrast, the post-test median increased to 70% ($IQR = 7.00$), indicating improvement in performance and slightly more consistency across students after the intervention.

To determine whether this observed improvement was statistically significant, the Wilcoxon Signed-Rank Test was performed. Results showed a test statistic of $W = 496$, $Z = 4.860$, and $p < .001$, confirming a significant increase in scores following the Project iSolve intervention. The positive Z-score suggests that most students scored higher in the post-test than in the pre-test. To further assess the magnitude of this change, the rank-biserial correlation was computed as $r = 1.000$, with a standard error (SE) = 0.203, indicating a very large effect size. This result suggests a strong and practically meaningful impact of the intervention on students' mastery of integer operations, and the low SE value supports the reliability of this estimate.

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Taken together, these findings provide statistical and practical evidence that the Project iSolve strategy significantly enhanced the arithmetic skills of Grade 7 Amethyst students. The considerable increase in post-test performance highlights the effectiveness of structured, interactive interventions in improving students' ability to add and subtract integers accurately and confidently.

Table 3. Significant Difference Between the Pre-Test and Post-Test Scores of the Grade 7 Amethyst

Paired Sample T-test							
		W	**z**	**df**	**p**	**Rank-Biserial Correlation**	**SE Rank-Biserial Correlation**
Post-test	Pre-test	496	4.860		<.001	1.000	0.203

To support the findings, Yagmur (2020) emphasized the effectiveness of interactive and engaging strategies—such as games, manipulatives, and hands-on activities—in improving students' understanding and mastery of integer operations. These methods help make abstract mathematical concepts more concrete and promote active participation in learning.

Similarly, Listrianti et al. (2022) found that manipulation techniques, such as using counters, number lines, and colored chips, effectively support student understanding in integer addition. These tactile and visual tools encourage deeper conceptual learning, improve arithmetic accuracy, and build learners' confidence.

Furthermore, Loyola (2025) demonstrated the success of the "Be Highly Numerates" project, which employed gamified instructional strategies to improve Grade 7 students' proficiency in integer operations. The study highlighted how game-based activities, supported by visual aids and interactive tools, significantly enhanced students' engagement, critical thinking, and overall performance in arithmetic tasks.

Given the results of this study and the supporting literature, educators are encouraged to incorporate game-based and hands-on strategies like Project iSolve to enhance students' proficiency in fundamental mathematical operations.

Research Question No. 4: What are the insights of the students on the effectiveness and areas for improvement of Project iSolve in mastering integer operations?

To answer this research question, in-depth interviews were conducted with the participants probing questions were asked to elicit their concept regarding the insights about Project iSolve in mastering adding and subtracting integers. The major themes and supporting statements for research question number 4 were presented in Table 4. Participants had their responses to their own experiences and observation. From the answers of the participants, nine major themes emerged: (1) sustaining student engagement in the learning process; (2) enhancing learning through interactive game-based activities; (3) optimizing activity duration for effective learning; (4) needing for instructional clarity; (5) incorporating visual aids enhances engagement; (6) incorporating real-life applications makes learning more meaningful; (7) simplifying complex concepts; (8) boosting confidence in solving mathematical problem; and (9) promoting engagement through group participation.

Table 4. Insights that the Grade 7 Students Share about the Project iSolve in mastering integer operations

Emerging Themes	**Supporting Statements**
Sustaining Student Engagement in the Learning Process	• "Students found the Int-Board game most effective because it made learning fun and interactive." (IDI-03) • "The Int-Board game's engaging format and collaborative group work were most effective in helping me learn integer addition and subtraction; these aspects made learning fun and allowed for peer-to-peer clarification." (IDI-04) • "The engaging format of the Int-Board game made learning enjoyable and provided an opportunity for everyone to clarify things with one another." (IDI-05) • "For me, the most effective part of Project iSolve was the Int-Board game. It made learning fun and kept my attention in class." (IDI-06) • "For me, the most helpful part of Project iSolve was the game itself. It wasn't just fun, I was really able to understand how to add and subtract positive and negative numbers." (IDI-07) • "It wasn't just an ordinary game, because while I was enjoying, I was also learning. The group activities also helped a lot since we were able to discuss with our teammates." (IDI-08) • "Because while we were playing, I wasn't just having fun—I was also able to

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	practice solving integer problems." (IDI-10)
Enhancing Learning through Interactive Game-Based Activities	• "My confidence to explain to others was developed. The fun part was just secondary—what mattered most to me was that I was learning while helping and being helped." (IDI-09) • "I also learned from their explanations, and I enjoyed the learning experience" (IDI-01) • "What helped me the most was the excitement brought by the game." (IDI-02) • "The challenge cards with math problems helped students apply their knowledge. The interactive nature of moving around the board maintained student interest and provided ample practice without causing boredom." (IDI-03) • "The interactive game format maintained motivation and interest throughout the learning process." (IDI-04) • "The interactive format of the game kept the motivation and interest throughout the entire learning process." (IDI-05) • "I enjoyed it more and understood the lesson better because we were playing while learning. I enjoyed it because it was interactive, not just pure lecture." (IDI-07) • "It felt like an interactive style of learning—so it wasn't just listening to the teacher, you were really involved in the activity." (IDI-08)
Optimizing Activity Duration for Effective Learning	• "I think more time should be allocated for each activity. Sometimes, there isn't enough time to really practice what has been learned." (IDI-02) • They also suggested shortening the game to allow more time for post-game discussion." (IDI-03) • "The game's length could be shortened to allow for more post-game discussion and reflection." (IDI-04) • "The length of the game could be shortened to allow more time for discussion after the game…" (IDI-05) • "I also want the game time to be shorter because sometimes it can be tiring if it's too long." (IDI-06) • "And sometimes, the game lasts too long, stretching out the time, so it might be better to have rounds to avoid getting too tired." (IDI-07) • "Also, sometimes the game is a bit too long, so it gets tiring if it lasts too long. Maybe it would be better with shorter rounds or breaks in between." (IDI-08)
Needing for Instructional Clarity	• "There were parts of the instructions that weren't very clear, so it might be better to add more guidelines or examples before the practice." (IDI-01) • "The initial instructions lacked clarity and could benefit from simplification…" (IDI-04) • "The initial instructions lack clarity and could be improved by simplifying them…" (IDI-05) • "It might be better if there was a visual guide or video explaining the step-by-step process." (IDI-07) • "It might be better if there was a video or visual explanation to make it easier to understand." (IDI-08)
Incorporating Visual Aids Enhances Engagement	• "Students suggested incorporating more visual aids (…)." (IDI-03) • "Incorporating visual aids like diagrams would enhance engagement and motivation." (IDI-04) • " Incorporating visual aids such as diagrams would enhance participation and motivation." (IDI-05) • " It would also be great if there were posters or videos explaining the rules of the game." (IDI-06) • "Some of my classmates also prefer colorful materials so they don't look boring" (IDI-07) • "Colorful visuals and updated materials could help make it more interesting." (IDI-08)

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Incorporating Real-life Applications Makes Learning More Meaningful	• "If more real-life applications are included, students will better see the value of learning integers." (IDI-01) • "Students suggested incorporating more... real-life examples of integer problems." (IDI-03) • "Incorporating real-life examples would enhance participation and motivation." (IDI-05) • " I also want real-life problems to be included in the game so that we can see how integers are used in real life." (IDI-06) • "It could also include real-life word problems so we can see the practical use of integers." (IDI-08) • "Applying integers to real-world problems, like budgeting or temperature changes." (IDI-09)
Simplifying Complex Concepts	• "I think Project iSolve can help struggling students because it simplifies and clarifies the concepts of integers." (IDI-01) • "This would be especially helpful for visual learners and for those who don't easily understand the abstract concept of integers." (IDI-02) • "Students believe Project iSolve could help other learners better understand the rules of integer addition and subtraction..." (IDI-03) • "Project iSolve's interactive and engaging approach makes learning integer rules clearer and more accessible…" (IDI-04) • "The interactive and engaging approach of Project iSolve helps clarify the concept of integers..." (IDI-05)
Boosting Confidence in Solving Mathematical Problem	• "For me, Project iSolve was a big help (...) I didn't feel pressured while learning (...) I knew it was all part of the learning process." (IDI-06) • "It didn't feel like pressure because it was like playing, but you were actually learning." (IDI-07) • "I lost my fear of solving problems because the style was through a game." (IDI-08) • "It's a way to trick the brain into learning while having fun (...) even those who aren't confident in math are more likely to participate in this kind of activity." (IDI-09)
Promoting Engagement through Group Participation	• "I also like that it involves teamwork because I get to learn from my groupmates." (IDI-06) • "Teamwork and hands-on activities can make a big difference in understanding the lesson." (IDI-07) • "I really saw that some of my classmates who don't usually participate got actively involved because of this." (IDI-10)

The first theme that emerged was sustaining student engagement in the learning process. Students shared that the Int-Board game made learning fun and interactive, helping them stay focused while improving their understanding of integer operations. This relates to the claim that active learning strategies—such as hands-on tasks, group collaboration, and real-world applications—enhance student engagement, motivation, and academic performance by encouraging critical thinking and meaningful participation in the classroom (Mduwile & Goswami, 2024). Supporting this, a quasi-experimental study found that gamified learning approaches notably increased student engagement, improved academic performance, and fostered more positive attitudes toward mathematics (Maryana et al., 2024). By transforming traditional instruction into a dynamic and stimulating experience, gamification serves as an effective method for capturing students' attention and sustaining their enthusiasm for learning.

Furthermore, the second theme was about enhancing learning through interactive game-based activities. Students shared that they were more motivated and confident during lessons when the activities involved games rather than traditional lectures. They mentioned that the interactive features helped them absorb the content better while also enjoying the process. This relates to the claim that integrating game-based strategies in mathematics classes improved student performance, enhanced retention, and created meaningful and engaging learning experiences for junior high school students (Paglomutan, 2024). Another insight supports the claim that game-based learning not only improves students' academic performance but also positively impacts both their cognitive and affective domains, making mathematics more engaging and meaningful (Hui & Mahmud, 2023).

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However, the third theme that emerged was the importance of optimizing activity duration to ensure more effective learning. Several participants suggested that shortening the game-based activity or allocating more time for post-game reflection would allow for deeper conceptual understanding and better retention of mathematical ideas. They emphasized that adjusting the pacing of activities is crucial to maintaining student energy, preventing fatigue, and reinforcing key concepts meaningfully. This perspective is supported by recent findings showing that tailoring instructional time to students' cognitive capacities and learning needs significantly enhances learning outcomes, including academic performance, satisfaction, and self-efficacy (Liu et al., 2024). In addition, it was found that students who employ effective study strategies—aligned with optimized time management—are able to reach their learning goals more efficiently and experience less academic stress, suggesting that both the duration and quality of learning activities are critical to effective education (Theobald, 2024).

In addition, the need for instructional clarity emerged as a key theme from participant feedback. Some students expressed confusion about the game instructions and recommended the use of examples, visual aids, and step-by-step videos to help them better understand how to engage with the activity and learn effectively. This aligns with existing research demonstrating a strong positive correlation between instructional clarity and student achievement, particularly in mathematics. One study found that students who received clearer, more structured instruction performed significantly better and had a stronger understanding of expectations and concepts. The research emphasizes that improving instructional clarity—through explicit explanations, responsive teaching, and well-organized learning materials—can significantly enhance comprehension and academic outcomes in concept-heavy subjects like mathematics (Arends, 2021). Similarly, another study reported that students who experienced higher levels of teaching clarity—defined by the instructor's ability to explain content clearly, outline goals, and maintain lesson structure—exhibited greater academic motivation and engagement (Liang, 2023).

Moreover, the incorporation of visual aids emerged as a valuable strategy to further enhance student engagement. Students suggested the use of colorful materials, diagrams, posters, and videos to maintain attention and clarify mathematical rules and concepts. This recommendation aligns with research demonstrating a strong link between the quality of visual aids and student engagement in the classroom. A study conducted among Grade 10 students at Gov. Felicisimo T. San Luis Integrated Senior High School found that effective use of visual aids significantly increased learners' connection to the content, making lessons more engaging and easier to understand (Cuenca et al., 2024). The same study emphasized the importance of teacher training in visual aid utilization to maximize its benefits in the learning environment. Additionally, traditional teaching approaches have often been criticized for failing to capture students' interest or convey complex topics clearly. This highlights the need for innovative instructional strategies, including the use of visual aids, manipulatives, and gamified tools, to create more interactive, accessible, and meaningful learning experiences (Ahmed & Mikail, 2022).

Likewise, students expressed a strong preference for the integration of real-life applications into classroom activities. They believed that connecting integer problems to authentic, everyday scenarios would deepen their understanding and highlight the practical relevance of the mathematical concepts they were learning. Students emphasized that such contextualization enhances engagement, improves comprehension, and helps them see the value of mathematics beyond the classroom. Research supports this view, showing that learners value tasks that are relevant, practical, and linked to real-life or career-related contexts (O'Neill & Short, 2023). Moreover, students with weaker problem-solving skills often struggle not only with academic performance but also with applying mathematical concepts effectively in real-world settings. These findings emphasize the need for instructional strategies that integrate conceptual understanding with practical reasoning, making mathematics more meaningful and applicable in everyday life and future careers (Tan et al., 2023).

Whereas the simplification of complex concepts through Project iSolve was also observed. Students, particularly those who struggled with abstract ideas like integers, appreciated how the game-based approach made the topic easier to understand. The interactive format broke down the lesson into more manageable parts, helping learners grasp fundamental mathematical rules. This supports findings from a study on the use of Blooket, an engaging, game-based educational tool that improved students' comprehension of complex mathematics and statistics while also reducing anxiety. The study demonstrated that incorporating interactive elements into learning not only made difficult subjects more accessible but also enhanced student motivation, engagement, and overall academic success in challenging areas (Talpur et al., 2024). In fact, the use of algebra tiles (as physical manipulatives) helped make abstract integer operations more concrete and understandable for teachers. Through the Concrete-Representational-Abstract (C-R-A) approach, participants found the manipulatives effective in breaking down complex concepts, increasing their confidence to apply them in classroom instruction (Gurung & Rijal, 2024).

In any case, participants reported increased confidence in solving math problems after engaging in the activity. The game-based format reduced performance pressure and created a safe, supportive environment where students felt comfortable making mistakes and improving through repeated practice. This observation is consistent with research demonstrating that self-confidence significantly influences students' mathematical problem-solving abilities. One study identified a strong positive correlation between confidence levels and performance, suggesting that students with higher confidence are more

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capable and willing to engage in solving complex mathematical tasks (Muzaiyanah, 2025). Furthermore, research examining the effects of error analysis using GPT-4-generated solutions revealed that students gained both a deeper understanding of mathematical reasoning and improved confidence when reflecting on and correcting errors. This process not only strengthened their problem-solving skills but also boosted their self-assurance in applying mathematical concepts independently (Lin et al., 2024).

Lastly, the final theme identified was the importance of promoting engagement through group participation. Students reported that working collaboratively in teams fostered mutual support and encouraged active involvement, particularly among peers who were typically passive during class discussions. This collaborative dynamic created a sense of shared responsibility, ensuring that all group members remained engaged throughout the activity. Such observations align with findings that emphasize the value of active learning strategies—including group projects and peer collaboration—in enhancing student motivation and academic success. A study conducted in Tanzanian secondary schools found that group-based tasks, integration of technology, and hands-on learning experiences significantly contributed to creating more dynamic, inclusive, and motivating classroom environments, leading to improved student outcomes (Mduwile & Goswami, 2024). Similarly, another study published in the Journal of Applied Research in Higher Education highlighted that structured group work strategies effectively promote student engagement, facilitate interaction, and contribute to better academic performance by encouraging active participation and peer-to-peer learning (Alsebaie, 2023).

CONCLUSION

The results of the pre-test revealed that Grade 7 Amethyst students had a generally low level of mastery in adding and subtracting integers, with a median score of 40%, classified as "fairly satisfactory." Some students demonstrated very limited understanding, even scoring as low as 0%, which reflected substantial learning gaps in basic integer operations. These outcomes emphasized the urgent need for an engaging and targeted instructional approach to support students' development in foundational arithmetic skills. The variability in performance further indicated inconsistencies in comprehension that warranted the implementation of an intervention like Project iSolve.

After the Project iSolve intervention, the post-test results showed a marked improvement in the students' performance. The median score rose to 70%, falling within the "satisfactory" level of mastery. A greater number of students achieved higher scores, including those in the "highly satisfactory" and "outstanding" categories, and the overall consistency of performance increased. This improvement suggested that the intervention was successful in addressing the identified deficiencies. The hands-on and gamified format of Project iSolve played a vital role in making mathematical concepts more accessible and understandable, contributing to the substantial growth in students' arithmetic mastery.

Statistical analysis confirmed a significant difference between the pre-test and post-test scores following the Project iSolve intervention. The data violated the assumption of normality, as indicated by the Shapiro-Wilk Test, $W = 0.822$, $p < .001$. As a result, the Wilcoxon Signed-Rank Test was used, yielding $W = 496$, $Z = 4.860$, and $p < .001$, indicating a statistically significant improvement in students' integer arithmetic skills. Furthermore, the rank-biserial correlation was calculated to be $r = 1.000$ with a standard error (SE) = 0.203, reflecting a very large effect size. These results demonstrate not only a meaningful increase in student performance but also a strong and reliable impact of the intervention. The substantial rise in median scores—from 40% ($IQR = 7.50$) to 70% ($IQR = 7.00$)—supports the conclusion that Project iSolve was highly effective in enhancing both proficiency and consistency in adding and subtracting integers among Grade 7 students.

Insights gathered from student interviews further affirmed the effectiveness of Project iSolve. Students expressed that the interactive and game-based learning approach made lessons more enjoyable, reduced their anxiety toward mathematics, and improved collaboration with peers. They highlighted specific strengths of the intervention, such as sustained engagement and boosted confidence, while also suggesting areas for enhancement, including clearer instructions, shorter game durations, more visual aids, and the integration of real-life applications. These reflections underscored the program's success and provided valuable recommendations to refine the approach and maximize its impact on learning.

RECOMMENDATION

Based on the study's significant findings and student insights, it is recommended that Project iSolve be institutionalized as a regular instructional strategy in teaching integer operations, especially in classrooms where students exhibit low mastery of basic arithmetic skills. To further enhance the program's effectiveness, several improvements should be made. First, game instructions should be simplified and clarified using visual guides, step-by-step examples, or instructional videos to accommodate diverse learning styles and avoid confusion. Second, visual aids such as posters, colorful diagrams, and animated demonstrations should be integrated to boost engagement and support students who are visual learners.

Additionally, the duration and pacing of the Int-Board Game should be optimized. Shorter game rounds or scheduled breaks are recommended to prevent fatigue and maintain student focus. Time should also be allocated for post-game reflection or discussion, which will reinforce learning and allow students to process their experience. It is also advised that teachers incorporate real-life applications of integer problems, such as budgeting, temperature changes, or sports scoring, to make math more meaningful and relevant to students' lives.

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Furthermore, training programs for teachers should be conducted to equip them with skills in gamified instruction, including classroom management during gameplay, differentiation techniques, and formative assessment during interactive activities. The implementation of Project iSolve can also be extended to cover other mathematical topics beyond integer operations to promote consistent engagement across the curriculum. Lastly, it is recommended that future studies expand the intervention to a larger, more diverse student population and explore long-term effects on retention and mathematical confidence. These improvements aim to ensure that Project iSolve becomes a sustainable, scalable, and impactful part of mathematics instruction.

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