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SIGNS: A Tool in Enhancing the Skills of Grade 7 Students on Operation of Integers

Norveen S. Campanilla

Teacher 1, Department of Education, Matucay National High School, Allacapan, Cagayan, Philippines

Abstract

One of the most problematic areas of mathematics over the years has been the operation of integers; students' problem-solving skills regarding the application of positive and negative signs on integers still need extra support in order to become proficient in it. The following action research was carried out to verify the efficacy of SIGNS in developing a solving capability among Grade 7 learners in studying operations of integers under the theme of feeling no good at math, specifically using a quasi-experimental design with a one-group pre-test and post-test research design. Grade size of the 40 students, who were purposefully selected from diagnostic test scores for participating in the study. The results of this study also showed that there was a significant gain in the solving skills of the learners, which could be observed from the computed mean and standard deviation. This is why there was such a big difference in the mean pre-test and post-test scores of these participants. Results also demonstrated that the intervention had a massive effect on participants' performance. With this, it is further suggested that mathematics teachers utilize SIGNS in teaching operations of integers as well as encourage school administrators to collaborate with the SIGNS team for resource development, such as guided notes and simulations supported by guided inquiry-based materials contextualized according to curricular standards and intended learner performances regarding solving of integer operations. Additionally, it is also advised that a study of the same type but more extensive in range be performed to improve SIGNS.

Keywords: Integers, Operations of Integers, SIGNS, Guided Notes, Simulation

1. Introduction

Having a weak foundation is one of the worrying problems with Mathematics education that affects students' capacity to do mathematical operations. To be honest, this causes difficulties and obstacles in their everyday activities as well as in their academic pursuits. Even while they can see the reasoning behind it, they are unsure of when or how to apply these mechanics to solve mathematical issues.

Another factor is the COVID-19 pandemic epidemic, which resulted in the temporary closure of schools and the transition from in-person instruction to online instruction and other modalities. This then had a significant impact, decreasing their numeracy and literacy abilities. Sayekti et al. (2021) define numeration literacy as the ability to apply concepts of numbers and arithmetic operations in counting. Students must possess knowledge of number symbols, number sequences, and number operations to perform mathematical operations. Numerical literacy also pertains to how students apply these concepts to real-world objects and develop their ability to interpret quantitative data. The ability to organize facts, translate objects into symbols, and find the correct formula for calculating an object are all critical components of mastering numeracy literacy.

Deeper learning occurs when students consistently transfer and develop new knowledge through problem-solving. This forces students to think critically and abstractly about content and its application to real-life situations. Useful resources for designing and evaluating such tasks include the K–12 Mathematics Curriculum Guide's (2016), particularly on how students perform fundamental operations on integers (M7NS-Ic-d-1).

Here, to build more self-efficacy—the conviction that one can learn and perform well—and elevated expectations for success in more advanced mathematics, students must grasp the fundamentals of completing integer operations. These beliefs have the potential to predict success more accurately than measured aptitude and past performance. Further support for this came from Stankov and Le (2017), who discovered that self-beliefs may either function as facilitators (excellent calibration of self-efficacy and confidence) or as barriers (anxiety) to cognitive performance.

Relatedly, Simamora & Saragih (2019) demonstrated how learning materials-based guided discovery learning in the Batak Toba setting greatly increased students' capacity for solving mathematical problems and their sense of self-efficacy. The study's findings led them to recommend that math teachers try to certify their teaching resources and incorporate local culture into math classes. This is also connected to the research findings of Campanilla and Mendoza (2024) in which their study revealed that students excel in problem-solving in mathematics, but their errors are mainly in formulation. They need to improve their reading comprehension, conceptual knowledge, and reasoning skills. The study also found that students' attitudes towards mathematics were influenced by their sex but not their problem-solving performance.

Also, Alamian & Moghadam (2020), in their study, disclosed that the teaching method based on Bruner's theory has been effective in addressing and reducing many misconceptions. This was also heightened by Pratama & Setyaningrum (2018), when the students who were exposed to game-based learning within problem solving (PS+GBL) significantly outperformed their counterparts who were exposed to textbook-based problem solving (PS+TB). In addition, the findings show the positive effects of the PS+GBL method on lower and higher achievers.

Further, O. Kwakye et.al (2022) suggested that teachers employ the number rule to teach mathematical concepts, particularly the addition and subtraction of integers. The study is significant to teachers and teacher trainees as the result depicts the effectiveness of the use of manipulative (number rule) in teaching and learning integer additions and subtraction. Also, Krapf et. al (2022) reveals that students value guided notes as a tool to remain focused during the lecture, to process and store new information and to foster active engagement. Moreover, students prefer guided notes both compared to lectures without instructor-provided notes and with full notes.

Meanwhile, the 2018 PISA (OECD, 2019) results revealed that the Philippines scored 353 in Mathematics, 357 in Science, and 340 in Reading, all below the average of participating OECD countries. This was also reflected in the Regional MPS of the NAT 2018 (RO2, 2019), where learners' performance scaled at 35.34% and problem solving registered at 39.95%.

Also, in Matucay National High School, students recorded a 47.49 in Mathematics of the 2016-2017 NAT, where problem-solving was rated 51.51, information literacy was rated 46.35, and critical thinking was rated 44.6. Likewise, NAT 2017-2018 results showed a 38.89 rating, where problem-solving was rated 52.78, information literacy was rated 36.11, and critical thinking was rated 27.78. These NAT findings have demonstrated the impact of depletion on students' mathematical proficiency at MNHS, highlighting the need for remedies to fortify students' problem-solving foundations and competencies. Furthermore, Lee and Han (2018) demonstrated that teaching strategies centered on mathematical problem-posing

activities were superior to teaching strategies that emphasize problem-solving in terms of their favorable impact on students' mathematical success and the emotional aspects of mathematics. It looks at the kinds and frequency of mistakes, discusses why they happen, and offers suggestions for instructional interventions to assist students become more adept at solving problems. These challenged the researchers to develop an intervention to affect M7NS-Ic-d-1 (perform fundamental operations on integers).

With these, the researcher made use of SIGNS (*Solving Integers with Guided Notes and Simulations*) in Enhancing the Skills of Grade 7 Students in Solving Operation of Integers of Matucay National High School. SIGNS is logically based on Bruner's theory which introduced exploratory learning as one of the most well-known cognitive paradigms based on constructivism. This is aimed at developing the mastery solving skills of the Grade 7 along operation of integers.

1.1 Innovation, Intervention, and Strategy

This action research will investigate the effectiveness of SIGNS (*Solving Integers with Guided Notes and Simulations*) in Enhancing the solving skills in Operation of Integers of Grade 7 Students of Matucay National High School, Allacapan North District, Matucay, Allacapan, Cagayan.

Guided notes are structured outlines or summaries provided to students to scaffold their learning, often containing key concepts, definitions, and spaces for additional notes. Simulation activities, on the other hand, are interactive learning experiences where learners engage in simulated real-world scenarios to apply theoretical knowledge and develop practical skills. Guided notes can complement simulation activities by providing a framework for students to follow and organize their observations and reflections during the simulation. This integration fosters active engagement, deep understanding, and effective retention of concepts within experiential learning contexts.

SIGNS includes not only guided notes but also a series of activities and worksheets that are organized by degree and level of difficulty. It essentially means teaching or learning how to work with integers using a method where structured notes are provided to guide students through the process and simulations to provide opportunities for hands-on exploration and visualization, allowing students to deepen their understanding through interactive experiences. This approach can help students grasp the concepts more effectively by providing them with organized information and clear explanations to support their learning. Certainly, it follows the teaching strategy called SIGNS which consists of five processes below:

1. **S** - Set the Stage: Establish clear learning objectives, emphasize integers' operations, and engage students through real-life scenarios like temperature changes, financial transactions, and sports scores, emphasizing their importance in everyday life and various fields.
2. **I** - Introduce Guided Notes: Create structured notes on integers, breaking complex concepts into manageable chunks and demonstrating effective note-taking strategies, emphasizing active engagement and active engagement.
3. **G** - Guided Practice and Simulation: Lead students through practice exercises, scaffolding activities, and peer collaboration, creating a supportive learning environment. Utilize interactive simulations, virtual manipulatives, and experiment with scenarios to explore integer operations.
4. **N** - Nurture Understanding: Encourage students to reflect on their learning, apply their understanding of integers in problem-solving tasks, and receive constructive feedback to improve their problem-solving skills.
5. **S** - Summarize and Review: The lesson concludes by summarizing key concepts, promoting student review, consolidating learning through independent practice or homework assignments, and offering additional resources for those needing assistance

Following SIGNS, the students were expected to use their newly learned information and skills, which led to the last part, CREATIVE REFLECTION. This part contains concrete activities relating to the topic. As a result, the students demonstrated real-world applications of the concepts they had learned. Students improved their critical thinking and creativity by applying what they had learned. Students also shared their points of view through journal writing.

1.2 Statement of the Problem

This action research aimed to determine the effectiveness of the "SIGNS in enhancing the skills of Grade 7 students in solving Operation of Integers."

Specifically, it aimed to answer the following questions:

1. What are the mean pre-test and post-test scores of the students before and after the utilization of SIGNS?
2. Is there a significant difference between the pre-test and post-test scores of the students after the SIGNS?
3. What is the effect size of SIGNS in the performance of the students?

2. Methods

This study used the one-shot quasi-experimental design whereby the same group of participants received SIGNS Approach and administered using the pre-test and post-test.

2.1 Research Design

Using random selection, a total of 40 students, including 22 males and 18 females, participated in the study as Grade 7 students. The students' pre- and post-test results from Matucay National High School, Allacapan North District, Matucay, Allacapan, Cagayan, were compared and assessed for significant changes in order to establish the effect size of SIGNS Approach.

2.2 Research Procedure

A 30-item parallel quality assured researcher-made pre-test and post-test following the Revised Bloom's Taxonomy on Cognitive Domain for the second quarter, week 1 to 2, was the sources of primary data and was compared and analyzed using the appropriate statistical treatment.

The pre-test was given to the participants before the implementation of the SIGNS. Competencies taken from the curriculum guide for Grade 7 was administered on the scheduled SIGNS Sessions. The selected worksheets from the LRMDS portal and other teacher-related websites and teacher-made activities was utilized appropriately.

After completing the sessions, a 30-item parallel post-test was administered to the same group of students.

2.3 Sampling, Participants, and Locale of the Study

This study used the one-shot quasi-experimental design where the same group received the same treatment.

The experiment involved one group of participants by whom the researcher administered the pre-test and results were recorded, tabulated and analyzed. The same group of respondents was employed with SIGNS then post-test was administered. The scores in the pretest and post-test of the participants were tested and compared for significant differences to determine whether the use of SIGNS recorded an improvement or none.

To analyze and interpret the data gathered in this study, the following statistical tools were used:

1. Mean and standard deviation was utilized in analyzing the pre-test and post test result of both groups of the study.

2. Paired Sample T-Test was used in determining the significant difference of the pre-test and post-test results of the experimental and control group.
3. The Cohen's D was used to determine the effect size of SIGNS in enhancing the skills of Grade 7 learners in operating Integers.

2.4 Data Analysis

The researcher protected the participant's right to self – determination, anonymity and confidentiality. For this reason, the participants and their parents were oriented on the complete information on the nature of this study through a written informed consent which was distributed after the meeting was called upon. The data were gathered succinctly and kept confidentially while they [participants or their parents] were assured of their right to withdraw at any time. The data and information of the participants were solely for this purpose only. Letter permissions were forwarded to all officials concerned in this study following protocols ethically in the process by the researcher and proper dissemination followed through. Also, all sources and references were properly and correctly cited. Data gathered were treated with utmost confidentiality.

3. Results and Discussion

This study was conducted to determine the effectiveness of SIGNS Approach in enhancing the skills of Grade 7 Students along Operations of Integers. Thus, Mean, Standard Deviation, Paired Sample T-Test and Cohen's D were the statistical tools used to analyze the impact of the said intervention.

3.1 Respondents' Pre-Test and Post-test Scores

The table shows the mean pre-test and post-test scores of the respondents before and after the utilization of the SIGNS approach. It further shows that the pre-test scores of the respondents have a mean of 9.00 and a standard deviation of 3.50, while their post-test results have a mean of 26.20 and a standard deviation of 2.78. The table reveals that there is an increase in the post-test scores of the respondents, and their scores are closer to one another, exemplifying their homogeneity. This implies that the use of intervention has greatly boosted the respondents' post-test scores when compared to their pre-test results. This further implies that their exposure to SIGNS has greatly helped in the improvement of their skills in solving linear equations, which signifies that the posttest scores are more dispersed compared to the pretest score. Albeit the scattered scores, the students' post-test scores show an increase over the pretest scores.

The comparison implies that the students performed better in the post-test than in the pre-test. The study of Ayu Tunggal Rahayu et.al (2022) concluded that most students respond positively to the Guided Note Taking (GNT) learning method in learning mathematics because, based on the distribution of questionnaires, they obtained students' responses to the application of the Guided Note Taking (GNT) learning method, the percentage score obtained is 77% which is included in the strong category. In addition, students' understanding of mathematical concepts is included in the good category. The average value of students' mathematical concept understanding test results in the experimental class was 80.44, while the average value of the mathematical concept understanding test results in the control class was 75.67. This shows that the students' ability to understand mathematical concepts in the experimental class is better.

Likewise, Biggers, Bryan and Luo, Tian (2020) examined peer-reviewed research on guided notes for adult learners in general populations since 2009, understanding the effects of guided notes on student learning, the knowledge and content areas supported by guided notes, and the impact of modality. Results of the 22 included studies indicate that students perceive guided notes in a positive light, and guided notes

improve results in certain knowledge domains especially with complex content. However, modality does not influence the efficacy of guided notes. Implications for practice in teaching and learning and recommendations for research were provided. Further, the study of Simamora, & Siagian, (2021) pointed out that Guided-Discovery learning model with a scientific approach assisted by GeoGebra software and student attitudes in learning mathematics on the topic of Geometry improved the post-test of the participants. Taking into account all of the findings, results pointed out that there was a considerable increase in the performance level of the participants after the implementation of the modules, learning activity sheets, and performance tasks guided by the discovery approach.

Table 1: Mean Pre-test and Post-test Scores of the Respondents

Tests	N	Mean (x)	Standard Deviation
Pretest	40	9.00	3.50
Posttest	40	26.20	2.78

3.2 Test of Difference between Respondents' Pre-test and Post-test

Table 2 presents the difference between the respondents' pre- and post-test results. According to the test, there was a significant difference between the post-test and pre-test scores at the 0.05 level of significance, favoring the post-test. The probability value of 1.42E-25, which is less than 0.05, confirms this. This is further supported by the t-test's achieved absolute value of 24.932841, which is higher than the crucial value of 2.02. This suggests that the use of the intervention SIGNS improved grade 7 students' performance on the post-test.

The findings also support the research conducted by Feudel and Panse (2022), which specifically showed that while using guided notes might help with some of the issues students have taking notes in traditional math lectures, it can also create new issues that people should be aware of. This supports a study by Syafti (2021) that found that students using discovery learning models learn mathematics more effectively than those taught by conventional learning methods, and that students with low initial ability and students with high initial ability benefit more from using discovery learning models than do students with high initial ability. instructed by traditional education. It is also confirmed in the study of Saminanto (2021) which showed that guided discovery methods indicated the participants' significant difference in their ability to connect with daily life because of contextual learning. In summary, the above-mentioned findings were recapped that learners taught with self-learning materials guided by discovery learning approach were found to be of improved performance compared to those who were not taught with guided and discovery learning approach.

Table 2: Test of Difference between the Pre-test and Post-test of the Respondents

Test	N	Mean(x)	Df	t-value	t-citical	P-value	Decision
Pretest	40	9.00	39	24.932841	2.02	1.42E-25	Significant
Posttest	40	26.20					

Level of Significance: ***0.05***

**Data Processed by Campanilla (2024) Using SPSS*

3.3 Test of Effect Size

Table 3 shows the test of effect size using Cohen's D wherein it reveals that there is 5.44 value showing

a huge effect size of using the SIGNS approach as an intervention to the performance of the grade 7 learners in solving linear equations and inequalities.

This is in relation to the study conducted by Surya et. al (2020) on the development of teaching materials based on Batak Toba culture fulfills valid, practical, and effective criteria. Teaching materials can improve students' mathematical problem-solving. This is also supported by the study of Siregar & Hasratuddin (2020) which revealed that: (1) learning devices developed based on guided discovery met valid criteria based on expert judgment; (2) learning devices developed based on guided discovery met practical criteria, in terms of a) expert judgment and b) the results of observations of the learning device implementation; (3) learning devices developed based on guided discovery met effective criteria, in terms of a) the student learning completeness classically has been achieved in the trial II by 91.43% and the disseminated stage by 94.29%, b) the achievement of learning purpose has been achieved for each item, c) the learning time used does not exceed or equals the normal learning time, and d) the student responses positive to learning devices; (4) the students' mathematical reasoning ability increased with an average of N-Gain by 0.53 in the medium category; and (5) the students' self-esteem increased with an average NGain by 0.49 in the medium category.

Based on the results of the study by Ramdani et al. (2019), which showed the validation of the expert validator on the aspects of subject matter, performance, language, and concept evaluation in the module, it can be concluded that the modules developed were practical and valid, with an average of assessment results validator of 3.31. Based on the results of the first and second stages of the module trial, it can be concluded that the module display was interesting for students. In addition, the results of the evaluation of the trial subjects met the minimal completeness criteria, so it could be said that each of the subjects could understand the content presented in the module. From these results, it was known that the module was effective. Likewise, the study of Iannone et al. Al (2019) concluded that guided notes can be an appropriate way of teaching university mathematics, but on their own, they cannot make the pedagogical intentions of the lecturer clearer to the students. They also found that the educational environment plays a big part in all aspects of student learning, including decisions related to note-taking during lectures. In summary, all of the results confirm that produced instructional materials and discovery methodologies are legitimate and successful since they meet the growing demand for learners to be motivated in order to reach much greater levels of accomplishment.

Table 3: Test of Effect Size

Test	N	Mean	SD	Cohen's D value	Scale	Remarks
Pretest	50	9.00	3.50	5.44	Above 2.0 - Huge	**Huge**
					1.2 -1.19 - Very Large	
					0.80 - 1.19 - Large	
Posttest	50	26.20	2.78		0.50 - 0.79 - Medium	
					0.20 -0.49 - Small	
					0.01 - 0.19 - Very small	

**Data Processed by Campanilla (2024) Using SPSS*

4. Conclusion

4.1 Synthesis

This study addresses the enhancement of the competencies in solving operations of integers through SIG-

NS. It also intends to contribute to better learning and progress in the performance of the learners. The following summarizes the findings of this study in relation to the questions posted in the research questions of this paper:

1. The mean of the pre-test and post-test scores of the learners are 9.00 and 26.20 with a standard deviation of 3.50 and 2.78, respectively.
2. There is a significant difference in the pre-test and post-test scores of the students as revealed in the computed t-value of 24.932841 which is greater than the critical value of 2.02 at 0.05 level of significance.
3. With the use of Cohen's D, the effect size of using the intervention is huge as shown in the computed value of 5.44.

4.2 Conclusion

According to the study's findings and results, students' post-test mean scores significantly increased as compared to their pretest scores, suggesting that their performance had improved following the usage of SIGNS. Furthermore, the calculated t-value and probability value exhibit a considerable discrepancy. Furthermore, the intervention has a significant effect on the kids' performance. It can be concluded that SIGNS is a very successful method to help students in Grade 7 become more proficient at solving integer operations.

Moreover, by applying the SIGNS technique, pupils were able to enhance their learning capacities. Their answers to the survey sent out throughout the intervention's implementation confirmed that they were involved and enjoyed learning. The following are some of the comments made by the learners regarding the intervention: a) While answering the SIGNS, they expand their knowledge beyond using guided notes and simulations in solving operations of integers; b) They enjoy the activities because they give them a chance to learn and become proficient in particular techniques to be used in operations of integers; c) They value the worksheets' various levels of difficulty because they force them to use their creativity and higher-order thinking skills to solve challenging problems. In relation to this, SIGNS indeed greatly affects the learning competencies of Grade 7 students in solving problems involving linear equations and linear inequalities in one variable.

In summary, learners demonstrated improved performance following the implementation of SIGNS, and SIGNS is credited with the significant rise in post-test scores. Therefore, SIGNS is a highly useful method for improving the way that pupils in Grade 7 solve problems involving integer operations. As a result, educators may make the most of the aforementioned intervention.

4.3 Recommendation

In light of the previously presented and discussed findings and conclusions of this study, the following recommendations are hereby advanced:

1. Math teachers teaching operations on integers can use SIGNS to help students become more proficient in the subject by giving them a significant amount of engagement.
2. Teachers can create contextualized learning materials that address the competencies that students find most difficult to master, enabling students to acquire, master, and deepen their knowledge and skills.
3. Teachers can innovate by incorporating technology into their lessons to create the SIGNS Game App, which encourages students to learn in an interesting and engaging way.
4. Teachers who are also researchers can contextualize and replicate the usage of SIGNS in the classroom by doing comparable studies to corroborate the findings.

5. In order to provide high-quality instruction and learning, the school head may incorporate the use of variables in the school improvement plan.
6. School heads, district supervisors, and division education program supervisors may continuously conduct seminars, workshops, and training to guide and train all teachers in developing and producing instructional materials.

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