International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Mnemonic-Based Drills in Improving Multiplication and Division of Integers among Grade7 Learners

[a]Sundie M. Monticer, [b]Mary Rose B. Mancio, [c]Bea A. Legaspi, [d]Lovely T. Monares, [e]Christopher B. Alvarado, [f]Glace Shiella M. Alcaraz, [g]Joymae P. Culibar, [h]Dindo T. Bolivar, [i]Crystal Mae A. Tamosa, [j]Wendel B. Alburo, [k]Dr. Marnel M. Bullo, [l]Dr. Richard C. Ching, [m]Lester V. Gonzales

[a-m] Cataingan Municipal College, Cataingan, Masbate Philippines

A B S T R A C T :

This study aimed to determine the effectiveness of Mnemonic-Based Drills in improving the mathematical performance of Grade 7-Bloodstone learners at Cataingan National High School, Cataingan West, Masbate Province. The study addressed the persistent difficulty among students in mastering the multiplication and division of integers, particularly in applying the rule of signs. This challenge, commonly encountered by Filipino learners, was reflected in the low Mean Percentage Score (MPS) of 29.4% during the first quarter assessment. The study sought to improve student outcomes by using mnemonic strategies to aid memory retention and concept application. A quantitative research design was employed using a one-group pretest-posttest method. Thirteen male students from the Grade 7-Bloodstone class, who were identified as low-performing in integer operations, were purposively selected. The intervention involved structured mnemonic drills and flashcard activities that emphasized the rule: "Same Signs, Positive. Different Signs, Negative." Data were gathered through validated pretest and posttest assessments, along with classroom observations using a checklist to monitor strategy use, confidence, and time management during the intervention. The results revealed a statistically significant improvement in the learners' mathematical performance, as shown by the Wilcoxon signed-rank test ($Z = -2.44$, $p = 0.031$). The findings indicated that the mnemonic-based approach effectively enhanced students' ability to solve integer problems. Learners demonstrated better recall, understanding, and procedural fluency in applying the rule of signs after the intervention. Observational data supported these results, revealing increased participation and confidence among learners during drills. In conclusion, the use of mnemonic-based drills positively influenced learners' mastery of integer operations, supporting instructional frameworks such as Rosenshine's principles of guided practice and Marzano's emphasis on memory-enhancing strategies. It is recommended that educators adopt mnemonic techniques in mathematics instruction, particularly when addressing foundational skills. Future studies may explore the use of similar strategies in other math topics and with larger, more diverse groups of learners to validate and expand the findings of this intervention.

Keywords: Mnemonic-Based Drills, Integer Operations, Rule of Signs, Mathematics Intervention,

1. Introduction

Mathematics has long been viewed as a vital discipline for enhancing students' cognitive abilities, logical thinking, and problem-solving skills, which are crucial for daily living and future professions. Although significant, numerous students struggled with it because of its dependence on abstract ideas, regulations, and calculations. Among Grade 7 students, the multiplication and division of integers proved to be especially challenging, particularly when it involved using the rule of signs. This issue frequently obstructed students' capability to understand more advanced mathematical concepts in the future. In the Philippines, outcomes from the National Achievement Test (NAT) showed this challenge, as low Mean Percentage Scores (MPS) suggested inadequate mastery of basic skills (Department of Education, 2020).

The importance of enhancing mathematics education was endorsed by Republic Act No. 10533, the Enhanced Basic Education Act of 2013, which required a curriculum that prepares students with skills for the 21st century. This law highlighted the importance of mathematics in developing analytical skills and equipping students for practical situations, advanced education, and job opportunities (Official Gazette, 2013). Accordingly, schools were advised to implement teaching innovations that addressed students' needs and improved their academic achievement. Perez (2019) states that public high school students in the Philippines frequently faced challenges with integer operations because of issues in conceptual understanding.

Global research reflected comparable results. Fuson (2003) found common mistakes among students in grasping integer operations, indicating that learners often incorrectly used the rule of signs because of misunderstandings about negative and positive numbers. Kuykendall and Wood (2010) highlighted that students who had not mastered multiplication and division of integers encountered difficulties in advancing to higher-level subjects like algebra. Additionally, the Programme for International Student Assessment revealed that students lacking basic skills in operations such as integer multiplication and division struggled more to utilize mathematical concepts in practical problem-solving situations (OECD, 2019).

In response to these challenges, this study investigated the effectiveness of mnemonic-based drills in improving learners' mastery of integer operations. At Cataingan National High School, the low MPS of 29.4 among Grade 7-Bloodstone students during the first quarter highlighted the urgent need for intervention. Mnemonics and flashcards were used to simplify the rule of signs and promote retention. This strategy provided learners with structured, engaging activities that helped solidify their understanding of multiplication and division of integers. The intervention aligned with RA 10533's call for innovative and effective teaching methods, and aimed to address foundational gaps that hindered students' mathematical performance.

1.1 Statement of the Problem

Given the situation of Grade 7 learners at Cataingan National High School, this study aimed to improve the mathematics performance of students who had experienced difficulties in understanding and applying integer operations. To address this concern, an intervention known as Mnemonic-Based Drills was implemented. This strategy was intended to enhance students' mastery of multiplication and division of integers by reinforcing their understanding of the rule of signs through structured and engaging activities.
With the problem identified and the intervention applied, this study sought to answer the following research questions:

1. What was the mathematical performance of Grade 7-Bloodstone learners before and after the implementation of Mnemonic-Based Drills?
2. Was there a significant difference in the mathematical performance of Grade 7-Bloodstone learners before and after the implementation of Mnemonic-Based Drills?

2. Methods

2.1 Research Design

This research employed a quantitative approach to assess the impact of mnemonic drills and flashcard exercises on enhancing the math performance of Grade 7-Bloodstone students at Cataingan National High School. Participants were chosen due to their poor performance in mathematics, especially in integer multiplication and division. Thirteen male students from a single section were intentionally selected to take part in the intervention.

The research utilized a pretest-posttest method to evaluate students' comprehension levels prior to and following the intervention's execution. A pretest was conducted to evaluate baseline understanding of integer operations, and a posttest was administered after the intervention to measure advancements in mathematical abilities. This design enabled the gathering of numerical data that indicates performance changes due to the mnemonic-based teaching.

2.2 Data Sources

The main data for this research were gathered from 13 male students in the Grade 7-Bloodstone class at Cataingan National High School. These students were intentionally chosen due to their underperformance in mathematics, especially in the areas of integer multiplication and division. A pretest was conducted to evaluate their preliminary grasp of the subject, succeeded by a posttest after the execution of mnemonic-focused exercises and flashcard training. Classroom observations took place throughout the intervention sessions. Every student was observed separately with a systematic checklist that noted particular behaviors, such as proper utilization of the mnemonic, answer accuracy, time management skills, and confidence level. These data offered important insights into the participants' involvement and development during the intervention.

The secondary data were sourced from academic records and student profiles kept by the mathematics teacher. These encompassed past grades, evaluation outcomes, and various performance metrics pertinent to the students' background in mathematics. The secondary data reinforced the results from the primary sources by providing further context regarding the academic requirements and history of the chosen students.

2.3 Research Procedure

Prior to the execution of the study, ethical approval was secured from relevant authorities to guarantee compliance with research ethics. As the participants were underage, informed consent from parents was obtained to guarantee transparency and voluntary involvement. The consent form clarified the study's aim, methods, risks, and advantages in a manner that parents could readily comprehend. This procedure embodied the ethical values of respect, beneficence, and justice highlighted in the Belmont Report (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Participants were made aware of their ability to withdraw at any moment without consequence, safeguarding their independence during the study (UConn Center for Excellence in Developmental Disabilities, n.d.).

The research tools, including the pretest, posttest, and observation checklist, were validated by a panel of experts in mathematics education to confirm their content validity. The validation process adhered to established methods in instrument development, emphasizing compatibility with learning competencies and the desired results of the intervention (Robledo et al., 2023). A pilot test was carried out with a few students outside of the main study to evaluate the clarity, reliability, and usability of the tools. Input from the pilot test resulted in small adjustments that improved the tools' clarity and effectiveness (Chhetri & Khanal, 2024).

The approved tools were subsequently given to 13 male learners from Grade 7-Bloodstone who were recognized as having difficulties with integer multiplication and division. A pretest was carried out to assess initial performance, subsequently followed by the execution of mnemonic exercises and

flashcard training. A posttest was given following the intervention to assess students' progress. Throughout the intervention, every student engaged in practice sessions using flashcards. These methods yielded both quantitative and qualitative insights into the learners' use of the mnemonic and their advancement in mastering integer operations (Scribbr, 2021).

3. Results and Discussion

3.1 Normality Testing of the Gathered Data

This research investigated the impact of Mnemonic-Based Drills on enhancing the math skills of 13 Grade 7-Bloodstone students at Cataingan National High School, particularly in addressing integer multiplication and division challenges. A Shapiro-Wilk normality test was performed on the pretest and posttest scores to assess the appropriateness of the collected data for parametric testing.

The findings showed in table 1, that the scores followed a normal distribution. The pretest recorded a W-statistic of 0.892 and a p-value of 0.104, whereas the posttest showed a W-statistic of 0.957 and a p-value of 0.700. These results confirmed the premise for applying the paired t-test to assess the statistical significance of the learners' performance enhancement (Ghasemi & Zahediasl, 2012)

Table 1
Normality Test of Data

Variables	N	Stat-W	P-value	Interpretation
Pretest	**13**	**0.892**	**0.104**	**Normally Distributed**
Posttest	**13**	**0.957**	**0.700**	**Normally Distributed**

As shown in Table 1, the shift from normal to non-normal distribution may reflect greater variability in posttest performance, likely due to individual learning gains after the intervention. These results offered insight into the learners' initial challenges with division and their cognitive readiness to absorb new conceptual tools, confirming the need for interventions like InnoDiD that support both conceptual and procedural understanding through hands-on, engaging strategies (de los Santos & Mercado, 2023; Zhou & Wang, 2022).

3.2 Significant Difference in the Mathematics Performance of Grade 7-Bloodstone Before and After Mnemonic-Based Drills

The efficacy of Mnemonic-Based Drills was evaluated by contrasting the students' results in the pretest and posttest. Table 3 demonstrates a statistically significant enhancement ($t = -2.44$, $p = 0.031$), suggesting that the intervention had a positive effect on learners' skills in solving integer problems. This finding backed the research hypothesis and validated that the organized application of mnemonic techniques aided in improving mathematical abilities. The students showed improved comprehension and achievement following the intervention, confirming the teaching effectiveness of memory-boosting tools in math education.

The findings backed the instructional principles of Rosenshine (2012), who highlighted that well-organized instruction, featuring guided practice and clear teaching, promotes improved learning results. The mnemonic exercise "Identical Symbols, Positive." "Different Signs, Negative" acted as a reference point for students, allowing them to recall and utilize abstract mathematical concepts more precisely. The improvement in test scores suggested that this repetitive and structured instructional method enabled students to develop mastery gradually—an essential strategy in disciplines that necessitate procedural fluency, like mathematics.

Marzano (2004) supported this conclusion by stating that incorporating mnemonic devices into teaching aids students in remembering new information by linking abstract ideas to known signals. Employing flashcards and repetitive exercises not only enhanced precision but also diminished cognitive strain. Rather than recalling rules individually, students were given a strategy based on patterns that simplified the problem-solving process. This reinforces the notion that organized memory tools are helpful in making complicated material easier to understand, especially for those who find learning challenging.

Table 2
Significance of Pretest and Posttest Scores Using Wilcoxon Signed-Rank Test

Group	N	Z	p-value	Interpretation
Pretest-posttest	**13**	**-2.44**	**0.031**	**Statistically significant**

The results also highlighted the value of differentiated instruction in diverse classrooms. According to Tomlinson (2014), teaching strategies must cater to the varying readiness levels and learning styles of students. In this case, the Mnemonic-Based Drills addressed specific gaps in integer operation skills, allowing each of the 13 male learners to engage at their own pace and experience success. The targeted intervention demonstrated that addressing learner diversity with precise, student-friendly strategies can yield substantial academic gains, even in low-performing groups. From a pedagogical perspective, the intervention provided evidence that students benefit significantly from frequent, low-stakes assessments and immediate feedback. The pretest allowed for baseline identification of students' weaknesses, while the posttest confirmed their improvement. This assessment-driven teaching cycle reflects the

assessment for learning (AfL) approach, which is widely recognized as essential in promoting student progress (Black & Wiliam, 2009). Mnemonic drills served not only as instructional tools but also as formative assessments that guided both teaching and learning decisions.

In classroom implementation, the results implied that students' motivation and confidence also increased as they gained mastery through drills. Learners were more willing to participate and make attempts at solving integer problems, which could be attributed to the clarity and simplicity of the mnemonic strategy. Research by Deci and Ryan (2000) on self-determination theory suggested that competence, autonomy, and relatedness enhance intrinsic motivation. By equipping students with a clear and usable strategy, the intervention addressed their sense of competence, leading to higher engagement. Reflecting on the experience, the teacher's role as a facilitator was central to the success of the intervention. The use of observation checklists during flashcard sessions ensured that learners were monitored not just for correctness but also for behaviors like strategy use, time management, and confidence. These observations provided real-time feedback, which allowed instructional adjustments to be made. This aligns with the principle of responsive teaching, which is essential for sustaining learner growth (Heritage, 2010). Teachers need to be continually aware of how students are responding to instruction, and this study provided a clear example of that practice.

The findings of this study also had important implications for curriculum development. Mathematics curricula, especially at the junior high level, often present abstract concepts without enough scaffolding. This research suggested that integrating mnemonic-based strategies into the curriculum can enhance learners' ability to internalize procedures. Curriculum planners and instructional designers may consider embedding such tools within standard teaching materials to provide cognitive support, particularly in skill-heavy topics such as operations with integers. In terms of sustainability and scalability, the results indicated that such interventions require minimal resources but produce meaningful outcomes. Flashcards, simple drills, and teacher-guided practice sessions are cost-effective and easily implemented. The simplicity of the method ensures that it can be replicated across other sections or schools facing similar performance challenges. This reinforces the value of low-tech, high-impact strategies in improving mathematics performance among learners with limited access to advanced learning technologies.

Finally, the outcome of the study pointed to the necessity of intentional instructional design in addressing learner difficulties. Teachers should not only identify what students struggle with but also plan structured interventions tailored to those needs. The success of the Mnemonic-Based Drills emphasized that mastery in mathematics is attainable when strategies are aligned with cognitive principles and learner readiness. Teachers are encouraged to integrate similar mnemonic techniques in other math areas, such as fractions or algebra, to support ongoing learner development.

4. Conclusion

The findings of this research showed that Mnemonic-Based Drills greatly enhanced the math achievements of Grade 7-Bloodstone students in integer multiplication and division. The comparison between pretest and posttest indicated a statistically significant improvement ($t = -2.44$, $p = 0.031$), reinforcing the efficacy of employing mnemonic techniques like "Same Signs, Positive." "Various Indicators, Negative" to assist students in understanding abstract principles. This result validated the original hypothesis that organized, memory-boosting interventions could alleviate basic skill deficiencies in mathematics, aligning with Rosenshine's (2012) teaching principles regarding guided practice and concept reinforcement.

The improvement in student performance highlighted the significance of tailored teaching and ongoing evaluation. Mnemonic tools offered a structured method, allowing students who struggle to interact with complicated tasks more easily. Marzano (2004) highlighted that linking abstract mathematical processes to known patterns enhances retention and boosts confidence. Additionally, the regular application of flashcards and instant feedback fostered motivation and involvement, resonating with Deci and Ryan's (2000) self-determination theory, which highlights that learners flourish when they perceive competence and support.

These results carry important implications for curriculum development and instruction in mathematics. Educators ought to explore incorporating basic, inexpensive mnemonic techniques throughout math subjects to boost student involvement and procedural proficiency. The effectiveness of this intervention also underscores the importance of purposeful instructional design in enhancing mastery for learners with varied needs. Schools, particularly those with restricted resources, can adopt this model to facilitate skill development and enhance learning results in various difficult areas of mathematics.

REFERENCES :

1. Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability, 21(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5
2. Chhetri, R., & Khanal, D. R. (2024). Developing and validating educational research instruments: A methodological perspective. International Journal of Social Science and Education Research, 6(2), 45–52.
3. Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. Psychological Inquiry, 11(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01
4. Department of Education. (2020). National Achievement Test results. https://www.deped.gov.ph
5. Fuson, J. (2003). Understanding integer operations: A study of student errors and misconceptions. Journal of Mathematics Education, 36(2), 101–110.
6. Heritage, M. (2010). Formative assessment: Making it happen in the classroom. Corwin Press.
7. Kuykendall, L., & Wood, R. (2010). The importance of mastering integer operations for success in advanced mathematics. Mathematics Teaching in the Middle School, 15(7), 403–408.

8. Marzano, R. J. (2004). Building background knowledge for academic achievement: Research on what works in schools. ASCD.
9. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). The Belmont Report: Ethical principles and guidelines for the protection of human subjects of research. U.S. Department of Health and Human Services.
10. Official Gazette. (2013). Republic Act No. 10533: Enhanced Basic Education Act of 2013. https://www.officialgazette.gov.ph/2013/05/15/republic-act-no-10533/
11. Organisation for Economic Co-operation and Development. (2019). PISA 2018 results: What students know and can do. https://www.oecd.org/pisa/
12. Perez, M. (2019). A study on the challenges in teaching multiplication and division of integers in public high schools. Philippine Journal of Educational Measurement, 27(1), 55–62.
13. Robledo, R. A., Villanueva, M. A., & Garcia, T. R. (2023). Validation of classroom-based assessment tools in mathematics: A Philippine context. Asian Journal of Educational Research, 11(1), 88–97.
14. Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. American Educator, 36(1), 12–19.
15. Scribbr. (2021). Pilot testing in research: Definition, types & steps. https://www.scribbr.com/methodology/pilot-study/
16. Tomlinson, C. A. (2014). The differentiated classroom: Responding to the needs of all learners (2nd ed.). ASCD.
17. UConn Center for Excellence in Developmental Disabilities. (n.d.). Informed consent with children and youth: Guidance for researchers. University of Connecticut. https://uconnucedd.org/informed-consent/