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EFFECTIVENESS OF MATH BUDDY IN ENHANCING GRADE 7 LEARNERS' SKILLS IN INTEGER OPERATIONS

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ABSTRACT
This study determined the effectiveness of the Math Buddy intervention in improving the integer operations performance of Grade 7 learners at Bo. Obrero National High School, Iloilo, during School Year 2025-2026.The participants of the study were twenty-one (21) low proficient learners, utilizing the quasi-experimental pretest–posttest design. A standardized Enhanced Regional Unified Numeracy Test (ERUNT) was used to gather data before and after the implementation of the intervention. Results revealed a significant improvement in learners' performance after exposure to the Math Buddy intervention. Statistical analyses confirmed that there was a significant difference between the pretest and posttest scores. Furthermore, the magnitude of the effect suggests that the intervention had a substantial impact on learners' performance. Qualitative findings also showed that learners experienced increased peer support, improved understanding of concepts, and positive learning behaviors during the implementation of the intervention. The study concludes that the Math Buddy intervention is an effective instructional strategy in enhancing performance in integer operations.

KEYWORDS: *Grade 7 Learner, Integer Operation, Math Buddy, Performance, Peer tutorial*

I. INTRODUCTION

Integer operations are fundamental competencies in mathematics, particularly at the Grade 7 level, where learners transition from basic arithmetic to more complex algebraic concepts. Mastery of addition, subtraction, multiplication, and division of integers is essential, as these skills serve as a foundation for higher-order mathematical thinking and problem-solving. However, many learners experience persistent difficulties with signed numbers, often leading to poor performance and misconceptions that hinder further learning.

Recent educational reports highlight that a significant number of learners fail to achieve minimum proficiency in mathematics, especially in performing routine procedures and applying them in familiar contexts. In the Philippine setting, this concern has been intensified by learning gaps resulting from instructional disruptions, underscoring the need for targeted, effective interventions to support struggling learners.

One promising approach to address these challenges is the use of peer-assisted learning strategies. Grounded in social constructivist principles, peer-assisted learning allows learners to engage collaboratively, where more capable peers provide guidance, immediate feedback, and support. This interaction fosters not only cognitive development but also increased engagement and confidence in learning mathematics. In this context, the Math Buddy intervention was developed as a structured peer-assisted strategy designed to enhance learners' performance in integer operations through guided practice and collaboration.

This study aims to determine the effectiveness of the Math Buddy intervention in improving the integer operations performance of Grade 7 learners. Specifically, it examines learners' performance before and after the intervention, the significance of improvement, and their learning experiences during its implementation.

II. RELATED LITERATURE AND STUDIES

In educational settings, peer tutoring is not a recent development; rather, it has long been integrated with other approaches such as cooperative and collaborative learning. Two commonly recognized forms of peer tutoring are cross-age tutoring and same-age tutoring. Cross-age tutoring involves learners from different grade levels, where older or more advanced students guide younger or less experienced ones (Alegre et al., 2020). This approach allows higher-level students to support those at lower educational stages (Kalkowski, 1995).

2.1 Studies on Peer-Assisted Learning in Mathematics

International literature consistently positions peer-assisted learning as a structured instructional approach capable of improving mathematics outcomes, particularly for learners who require additional support. Rather than functioning as informal collaboration, peer-assisted learning involves clearly defined roles, guided interaction, and systematic feedback. Meta-analytic evidence indicates that such approaches can produce meaningful gains in academic performance, especially among learners who are academically at risk (Moeyaert et al., 2021).

Systematic reviews further show that peer tutoring contributes not only to academic achievement but also to social and cognitive development. The interactive nature of peer learning encourages explanation, reflection, and immediate correction, creating conditions that support deeper engagement with mathematical tasks (Hidayat et al., 2023). Controlled studies in middle school settings also demonstrate that structured peer interaction can improve both performance and learner confidence, highlighting its potential as an instructional strategy for addressing persistent learning difficulties (Moliner & Alegre, 2022).

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At the same time, international research emphasizes that the effectiveness of peer- assisted learning depends on implementation quality. Studies highlight the importance of clear routines, accurate feedback, and consistent monitoring, noting that unstructured peer interaction may fail to produce meaningful learning gains or may even reinforce misconceptions (Barahona, 2023). These findings underscore that peer-assisted learning must be carefully designed to function as an instructional mechanism rather than a purely social activity.

In the Philippine context, these insights are particularly relevant given the need for scalable instructional strategies that can support learners with varying levels of proficiency. Local applications of peer-assisted approaches suggest that structured peer interaction can increase engagement and provide additional opportunities for practice, especially in classrooms where teacher time is limited. While local studies may not always employ rigorous experimental designs, they consistently indicate that peer- assisted learning can serve as a practical means of extending instructional support and addressing specific skill gaps.

2.2 Studies Combining Peer Assistance and Drill Practice

International research that integrates peer-assisted learning with structured drill practice provides the most direct support for interventions such as Math Buddy. These studies conceptualize peer interaction as a mechanism for delivering high-frequency, feedback-rich practice, rather than as an exploratory activity. This combination is particularly effective for developing procedural fluency, as it increases opportunities for correct responding while ensuring that errors are addressed immediately.

Additional evidence from applied school-based studies highlights the feasibility of peer-delivered interventions within real classroom conditions. Research involving trained student tutors shows that structured routines can be implemented effectively even under practical constraints, provided that procedures are clearly defined and monitored (Powell et al., 2024). This demonstrates the potential of peer-assisted approaches to extend instructional capacity without compromising learning quality.

Studies combining peer tutoring with structured learning resources further illustrate how practice can be enhanced through guided interaction. Evidence from middle school contexts indicates that integrating peer support with clearly defined tasks and feedback mechanisms can improve mathematics achievement (Moliner et al., 2022). These findings reinforce the importance of ensuring that practice activities include immediate verification and correction, prevent the reinforcement incorrect procedures.

In the Philippine context, the convergence of these principles is particularly significant. Local instructional conditions often require approaches that are both effective and feasible within resource constraints. The integration peer assistance with structured drill aligns with these needs, offering a practical strategy for increasing practice opportunities while maintaining instructional quality. As local studies continue to document persistent difficulties in foundational skills such as integer operations, the adoption of peer-assisted drill interventions becomes increasingly justified as a context- responsive solution.

III. PURPOSE OF THE STUDY

This study aimed to determine the effect of the Math Buddy intervention on the integer operations performance of Grade 7 learners with low proficiency at Bo. Obrero National High School during the School Year 2025 – 2026. Specifically, it sought to determine the pretest performance level of the Grade 7 learners in integer operations prior to the implementation of the Math Buddy, the posttest performance level of the Grade 7 learners in integer operations after the implementation of the Math Buddy, the significant difference between the pretest and posttest mean scores of the Grade 7 learners in integer operations performance after the implementation of the Math Buddy, is the mean gain between the pretest and posttest scores of Grade 7 learners in integer operations after exposure to the Math Buddy and the experiences of Grade 7 learners in integer operations during the implementation of the Math Buddy.

IV. THEORETICAL FRAMEWORK

This study was anchored on Vygotsky's Social Constructivist Theory, particularly the concept of the Zone of Proximal Development (ZPD), and on principles derived from Deliberate Practice Theory, both of which provide a strong theoretical basis for the use of in improving integer operations performance. Vygotsky posited that learning occurs most effectively when learners engage in tasks slightly beyond their independent capability but achievable with guidance from a more knowledgeable other, whether an adult or a peer. Within the ZPD, social interaction functions as a mechanism through which cognitive development is scaffolded, allowing learners to internalize strategies and procedures that they are initially unable to perform independently. Recent empirical work continues to affirm the relevance of social constructivist principles in mathematics learning, particularly for procedural skills that require guided practice and corrective feedback (Schunk & DiBenedetto, 2020; Kirschner et al., 2022).

In the context of this study, the Math Buddy operationalizes the ZPD by pairing low-performing Grade 7 learners with peers who can provide immediate assistance, clarification, and modeling during structured integer operations exercises. Through this interaction, the peer buddy serves as a scaffold, helping the learner bridge gaps in understanding and procedural execution. Studies conducted within the last five year indicate that peer-assisted learning arrangements in mathematics can significantly enhance learners' procedural accuracy and confidence, especially when interactions are structured and aligned with clearly defined learning goals (Rohrbeck et al., 2021; Zeneli et al., 2022). These findings support the premise that peer-mediated feedback, when systematically embedded in instructional routines, can facilitate the internalization of mathematical procedures.

Complementing the social constructivist perspective, Deliberate Practice Theory provides an additional explanatory lens for the effectiveness of the Math Buddy intervention.

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Deliberate practice emphasizes sustained, focused, and goal-oriented practice activities designed to improve performance through repetition and feedback rather than mere exposure or rote repetition. In mathematics education, deliberate practice has been linked to gains in procedural fluency, accuracy, and speed, particularly for foundational skills such as integer operations (Ericsson, 2021; Schneider et al., 2022). Recent research underscores that repeated engagement with well-defined tasks, coupled with immediate corrective feedback, is essential for automating basic mathematical procedures and reducing cognitive load during more complex problem-solving (Star et al., 2021).

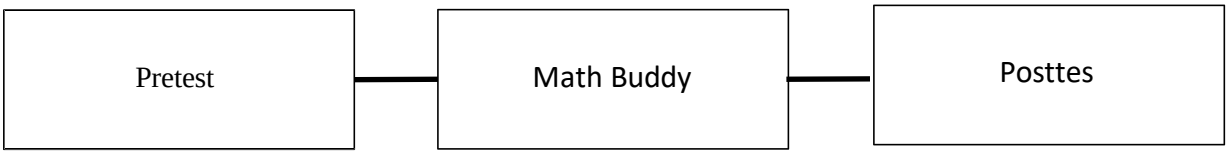
The Math Buddy integrates the core features of deliberate practice by providing learners with frequent, focused opportunities to perform integer operations within a structured time frame. The repetitive nature of the drills targets accuracy and fluency, while peer feedback ensures that errors are identified and corrected promptly, preventing the reinforcement of misconceptions.

V. CONCEPTUAL FRAMEWORK

Figure 1 illustrates the paradigm of the study.

Figure 1

Paradigm Showing the Interrelationship Between the Independent Variables and the Dependent Variable



The paradigm of the study illustrates the use of Math Buddy intervention which can contribute to the Integer Performance of Grade 7 learners. The independent variable is of the pretest in enhanced regional unified numeracy test, the intervening variable is the Math Buddy while the dependent variable is the posttest in enhanced regional unified numeracy test

VI. METHODOLOGY

This chapter deals with the description of the research design, participants of the study, data gathering instrument, data gathering procedure, data processing, and ethical consideration.

6.1 Research Design

This study employed a quasi-experimental research design. Quasi-experimental design is a type of research that seeks to evaluate causal relationships between variables but does not use random assignment of participants to groups. Instead, intact groups or naturally occurring classes are studied, which makes this design especially useful in educational settings where randomization is often impractical or unethical (Campbell & Stanley, 1963).

By using a one-group pretest–posttest approach to examine the effectiveness of Math Buddy in improving the integer operations performance of Grade 7 learners of Bo. Obrero National High School year 2025-2026, the design was selected to allow the measurement of learners' performance at two distinct points in time, prior to and after exposure to the intervention, thereby enabling a direct comparison of changes in performance within the same group.

Figure 2.

Pretest and Post-test Design O_1 — X — O_2

Where:

O_1 – Pretest (baseline measurement)

X – Math Buddy Intervention

O_2 – Posttest (outcome measurement)

According to John W. Creswell (2014), the one-group pretest–posttest design is commonly used in educational research to determine the effect of an intervention by comparing measurements taken before and after its implementation. This design enables researchers to assess changes in participants' performance over time within a single group.

Monitoring student progress through pre- and post-assessment is a key component of effective teaching and learning practices (John Hattie, 2020).

6.2 Participants of the Study

The participants of the study consisted of twenty-one (21) Grade 7 learners identified as Low proficient. These learners were identified based on their performance in integer operations, specifically those whose scores fell within the ranges of 0–9 and 10–19, which correspond to the classifications of Not Proficient and Low Proficient. The group included thirteen (13) male and eight (8) female learners who demonstrated difficulty in performing basic integer operations. The selection of participants was purposive, focusing on learners who required immediate instructional support in this foundational mathematical skill. In targeting this group, the study ensured that the intervention addressed a clearly identified learning gap rather than applying a generalized instructional approach.

6.3 Data Gathering Instrument

The primary instrument used in this study was the standardized Enhanced Regional Unified Numeracy Test (ERUNT),

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specifically designed to assess learners' proficiency in fundamental mathematical skills, including integer operations. The test was selected to ensure alignment with curriculum standards and to provide a reliable measure of learners' performance across the four basic operations involving integers: addition, subtraction, multiplication, and division. The instrument consisted of forty (40) items that measured procedural accuracy and fluency. The content coverage was limited to integer operations to maintain consistency with the study's focus and to ensure that the assessment directly reflected the targeted skill domain. The use of a standardized instrument ensured uniformity in administration and scoring, thereby supporting comparability between pretest and posttest results.

The posttest, referred to as the Post-ERUNT (Enhanced Regional Unified Numeracy Test), was administered after the implementation of the Math Buddy intervention to measure the learners' level of performance in integer operations. It was designed as a parallel test to the pretest, known as the Pre-ERUNT, ensuring that both assessments measured the same competencies, difficulty level, and content coverage.

Parallel forms reliability involves the use of two equivalent test versions that measure the same competencies, maintain similar levels of difficulty, and yield comparable results when administered to the same group of learners (Number Analytics, n.d.;). This approach ensures that differences in test scores reflect actual learning gains rather than familiarity with test items.

6.4 Data Gathering Procedure

The data gathering process was carried out in three phases: pre-intervention, intervention, and post-intervention.

During the pre-intervention phase, permission to conduct the study was obtained from the Schools Division Superintendent of the Schools Division of Iloilo City. A copy of approved letter was furnished to the school principal of Bo. Obrero National High School, Lapuz Iloilo City. Subsequently, the researcher obtained permission from the school principal to carry out the study. Consent forms were given to the learners and their parents or guardians to get their permission for participation.

The standardized Enhanced Regional Unified Numeracy Test was then administered as a pretest to establish baseline performance in integer operations. Enhanced Regional Unified Numeracy Test is a numeracy assessment to determine the numeracy level and to profile the learners of the public schools from across grade levels (Grade 1 -11) for implementation of immediate and appropriate intervention programs. (DepEd Region VI, 2022).

After the completion of the intervention period, the post-intervention phase was conducted. The parallel test was administered as a posttest under conditions similar to those of the pretest. This ensured comparability of results and allowed for an accurate measurement of changes in performance following the intervention.

The results of the pretest were used to identify participants who met the criteria for inclusion in the study. Following the pretest, the intervention phase was implemented over one academic quarter. The Math Buddy was conducted through structured pairing of learners, where each participant under low proficiency worked with a designated peer with higher proficiency. The sessions, which focused on guided practice in integer operations and began with a brief class discussion, were conducted on a regular basis within the allotted teaching time. In order to ensure that each Math Buddy-Coach was capable of teaching, the teacher gave the necessary training and created a workbook for each pair to utilize.

6. 5 Data Processing Technique

The data collected from the pretest and posttest were organized, coded, and analyzed to address the research questions of the study. Descriptive statistics were used to summarize learners' performance, including mean scores, standard deviation, and distribution across proficiency levels. These measures provided an overview of learners' performance before and after the intervention.

To determine the mean gain, the difference between pretest and posttest scores for each learner was computed. This allowed for an assessment of individual and group-level improvement in integer operations performance.

To determine whether the observed changes in performance were statistically significant, the Wilcoxon Signed-Rank Test was employed. This non-parametric statistical test is appropriate for comparing two related sets of scores obtained from the same group of participants, particularly when the assumption of normality is not met (Andy Field, 2018). The level of significance was set at 0.05. All statistical computations were performed using the Statistical Package for the Social Sciences (SPSS).

The analysis of learners' experiences during the implementation of the Math Buddy intervention was conducted through qualitative description, utilizing thematic analysis to identify and examine recurring patterns in learners' responses and reflections throughout the intervention period.

1.6 Ethical Consideration

As to the ethical issues, the researcher secured a permit to conduct the study from the Schools Division Superintendent of the Schools Division of Iloilo City. After the approval, the School Principal of Bo. Obrero National National High School, Lapuz, Iloilo City, was given a copy of the approved letter. Parent consent was also distributed to the participants to determine whether they would be allowed or not to participate in the said study. All of these assured that the data gathered and results taken could not affect other academic performance and were kept confidential.

VII. RESULTS AND DISCUSSION

This chapter examines the data collected in order to evaluate the effectiveness of the Math Buddy in enhancing the integer operations performance of Grade 7 learners.

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Pretest Performance of Grade 7 Learners in ERUNT: Table 1 presents the pretest performance of Grade 7 learners in integer operations prior to the implementation of Math Buddy intervention.

Table 1

Pretest performance of Grade 7 learners in integer operations prior to the implementation of Math Buddy intervention

Categories	N	Mean	Description	SD
Pretest	21	13.24	Low	1.76

Note: Interpretations are based on the following scale: Very High (36.00-40.00); High (30.0-39.99); Average (20.0-29.99); Low (10.00-19.99); Very Low (0.00-9.99)

The participants of the study consisted of 21 Grade 7 learners from Bo. Obrero National High School who were identified as low proficient based on their pretest results using the Pre-ERUNT. The selection of participants followed a purposive sampling technique, where only learners who demonstrated low performance in integer operations were included in the study. This approach ensured that the intervention was directed toward learners who most needed academic support.

The pretest results revealed that all participating learners were classified within the Low Proficiency level, with a mean score of 13.24 and a relatively low standard deviation of 1.76. This pattern of results points to a uniformly limited level of mastery in integer operations prior to the implementation of the intervention.

Rather than exhibiting a wide range of abilities, the learners' scores clustered within a narrow band of low performance, suggesting that difficulties in handling signed numbers were not isolated to a subset of students but were instead pervasive across the group

Posttest Performance of Grade 7 Learners in ERUNT

Table 2 presents the posttest performance of Grade 7 learners in integer operations after the implementation of Math Buddy intervention.

Table 2

Posttest performance of Grade 7 learners in integer operations after the implementation of Math Buddy intervention

Categories	N	Mean	Description	SD
Posttest	21	31.38	High	2.38

Note: Interpretations are based on the following scale: Very High (36.00-40.00); High (30.0-39.99); Average (20.0-29.99); Low (10.00-19.99); Very Low (0.00-9.99)

Table 2 shows the posttest performance of Grade 7 learners following the implementation of the Math Buddy intervention. The results show a substantial improvement, with a mean score of 31.38 (SD = 2.38), classified under the High Proficiency level. This marked increase reflects a significant shift from low to high performance, indicating that learners were able to develop stronger procedural understanding and accuracy in integer operations. The slightly higher standard deviation suggests a broader spread of scores; however, performance remained generally concentrated within higher proficiency levels.

The improvement implies that the Math Buddy intervention effectively addressed learners' prior misconceptions and difficulties by providing structured practice, immediate feedback, and peer support. These conditions likely facilitated better understanding and retention of integer operation rules.

Difference in the Pretest and Posttest of Integer Operations Performance

The table 3 represents the difference in the pretest and posttest scores of Grade 7 integer operations performance with exposure to Math Buddy intervention.

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Table 3

Wilcoxon Signed-Rank Test Result of Pretest and Posttest Scores Grade 7 Learners with exposure to Math Buddy intervention.

Category	N	Z	p-value	Effect Size (r)	Interpretation
Pretest	21	-4.025	0.000	0.88	Significant
Posttest	21				

Note: Interpretations are based on the following label: Significant ($p<0.05$) and Not Significant ($p>0.05$)

Table 3 presents the results of the Wilcoxon Signed-Rank Test used to determine whether there is a significant difference between pretest and posttest scores. The results revealed a statistically significant improvement in learners' performance ($Z = -4.025$, $p < 0.001$).

The computed effect size ($r = 0.88$) indicates a very large effect, suggesting that the observed improvement is not only statistically significant but also practically meaningful. This implies that the Math Buddy intervention had a substantial impact on learners' integer operations performance.

The use of a non-parametric test strengthens the validity of the findings, particularly given the small sample size. The results consistently confirm that the improvement in scores was not due to chance but can be attributed to the intervention.

Mean Gain in Performance of Grade 7 Learners

Table 4 represents the computed mean gain to determine the extent of improvement in learners' performance.

Table 4

Mean, Standard Deviation, and Mean Gain of Pretest and Posttest Scores in Integer Operations

Variable	Mean	Standard Deviation	Mean Gain
Pretest Scores	13.24	1.76	18.14
Posttest Scores	31.38	2.38	

The data presented in Table 4 presents the mean gain between pretest and posttest scores. The computed mean gain of 18.14 indicates a substantial increase in learners' performance after the intervention.

This magnitude of improvement reflects more than incremental progress; rather, it suggests a meaningful transformation in learners' procedural competence.

Narrative Experiences of the Grade 7 Learners

This section presents the qualitative findings of the study based on the experiences of the experience of the Grade 7 learners during the implementation of the Math Buddy intervention.

The analysis revealed three major themes: peer support, improved understanding, and positive learning behavior. These themes collectively explain how the Math Buddy intervention influenced learners' academic performance and classroom engagement.

Peer Support. The most dominant theme identified is peer support. Learners consistently described their Math Buddy as helpful, responsive, and supportive. Several participants emphasized that their buddies actively checked on their needs and provided immediate assistance. One learner shared, "My Buddy is helpful," while another stated, "My Buddy always asks me if I need help and assists me every time."

experiences of the Grade 7 learners during the implementation of the Math Bud.

The responses were analyzed using thematic analysis following Braun and Clarke (2006), which involves systematic coding, categorization, and identification of recurring theme.

Improved Understanding. Another prominent theme is improved understanding. Learners reported that their comprehension of integer operations improved through explanations and examples provided by their buddies. One participant noted, "My Buddy helps me understand the lesson well," while another expressed, "My buddy is giving me examples for me to understand the lesson."

Positive Learning Behavior and Attitudes. The third theme identified is positive learning behavior and attitudes. Although less frequently mentioned, learners highlighted qualities such as patience, kindness, and willingness to help. For instance, one participant stated, "My Buddy is patiently teaching me," while another shared, "She's always kind in helping me." Interestingly, one learner mentioned, "He gets mad but still helps me," suggesting that despite minor interpersonal challenges, the willingness to support peers remains evident.

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Overall, the qualitative findings indicate that the Math Buddy intervention created a collaborative and supportive learning environment that enhances both cognitive and affective aspects of learning. The dominance of peer support highlights its central role in facilitating understanding, while improved comprehension and positive learning behaviors further reinforce the effectiveness of the intervention.

VIII. SUMMARY OF FINDINGS

The following were findings of the study:

The pretest results of Grade 7 learners demonstrated a low level of performance in integer operations prior to the implementation of the Math Buddy intervention.

After the implementation of the Math Buddy intervention, the posttest results showed a significant improvement in learners' performance. The mean score increased to 31.38, indicating that learners reached the proficient level in integer operations.

A significant difference existed between pretest and posttest mean scores of the Grade 7 learners in integer operations performance after the implementation of the Math Buddy, implying that the learners performed better in their posttest.

The mean gain between the pretest and posttest scores was computed to be 18.14, indicating a substantial increase in learners' performance after exposure to the Math Buddy intervention. This result demonstrates that learners showed considerable improvement in their ability to perform integer operations.

The qualitative findings revealed that learners had generally positive experiences during the implementation of the Math Buddy intervention. Three major themes emerged from the analysis: Peer Support Enhances Learning, Improved Understanding Through Explanation and Examples, and Positive Learning Behavior and Attitudes. Learners highlighted positive behaviors such as patience, kindness, and willingness to help, which contributed to a more supportive learning environment.

IX. CONCLUSIONS

Based on the findings gathered and observations made by the researcher, the following conclusions were drawn:

The Math Buddy intervention is effective in improving the integer operations performance of Grade 7 learners.

The significant difference between pretest and posttest scores confirms that the improvement in learners' performance is not due to chance but is a result of the intervention.

3. The large effect sizes indicate that the intervention has a strong and meaningful impact on learners' academic achievement.

4. Peer-assisted learning, as implemented through the Math Buddy approach, enhances not only cognitive understanding but also promotes collaboration and active participation among learners.

5. The qualitative findings confirms that the Math Buddy intervention is a holistic
instructional strategy that improves both academic performance and learning experiences.

X. RECOMMENDATIONS

In light of the findings and conclusions of the study, the following recommendations are proposed:

It is recommended that teachers integrate structured peer-assisted learning strategies, such as the Math Buddy approach, into regular classroom instruction, particularly when teaching foundational topics like integer operations.

School administrators should adopt peer-assisted learning programs be as part of school-based intervention. Providing time, resources, and professional support for the implementation of structured peer-assisted strategies can enhance instructional effectiveness and contribute to improved learning outcomes.

Learners should be encouraged to take active roles in the learning process by engaging meaningfully with their Buddies. This will establish accountability mechanisms, such as peer evaluation, reflection logs, or performance tracking, may further enhance engagement, responsibility, and ownership of learning.

For future researchers, it is recommended that similar studies be conducted using more rigorous experimental designs, such as the inclusion of control groups, to further examine the causal effects of peer-assisted drill interventions. Additional research may also explore the long-term impact of such interventions, their applicability to other areas of mathematics, and their effectiveness across different learner populations and educational contexts.

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