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Speed Meets Accuracy: Effectiveness of Left to Right Method on Mental Addition and Subtraction Skills of Elementary Students

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ABSTRACT

Purpose of the study: This study evaluates the effectiveness of the Left-to-Right Method on mental addition and subtraction skills of Grade 2 pupils. It aims to determine if this method leads to better performance in these operations compared to traditional teaching methods.

Methodology: A quantitative experimental design was employed, which involved 40 elementary students who were randomly assigned to an experimental group that used the left-to-right method and a control group that remained using traditional methods. Pre- and post-tests were administered to evaluate pupils' performance levels, and a teacher acceptance questionnaire was used to gather feedback on the method's effectiveness and ease of implementation.

Main Findings: The experimental group displayed significant improvement in mental addition and subtraction skills, with a mean difference of 6.85 (p-value = 0.00), while the control group showed minimal change in performance. Teachers' feedback was positive, indicating that the Left-to-Right Method is easy to explain, compatible with the curriculum, and addresses learning and teaching challenges.

Novelty/Originality of this study: This study contributes to the limited research on the Left to Right Method as an alternative to traditional methods for teaching mental addition and subtraction. It underscores the method's ability to reduce cognitive load, making mental addition and subtraction easier and more efficient, serving as a new method of teaching early mathematics.

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1. INTRODUCTION

Mental addition and subtraction are foundational components of a learner's overall mathematical competence. These basic arithmetic skills are crucial not only for mastering more advanced mathematical concepts but also for solving everyday problems [1]. The ability to perform mental calculations has been strongly linked to better performance in standardized assessments, underscoring its relevance in formal education [2]. Despite its importance, many learners struggle to execute mental addition and subtraction both quickly and accurately. This difficulty is often attributed to cognitive factors such as limited working memory, underdeveloped number sense, and ineffective mental computation strategies [3].

Traditional mathematics instruction typically introduces students to four main mental strategies: the Standard Algorithm, counting on and Back, Partitioning, and Making Tens. While these strategies each hold pedagogical value, they are not always effective in promoting deep conceptual understanding, particularly when applied to larger numbers or when cognitive demands are high. For example, the Standard Algorithm, which involves solving from right to left, can be mentally taxing for young learners [4]. Similarly, counting on and Back and Partitioning work well with smaller numbers but become inefficient as numerical complexity increases [5][6]. The Making Tens strategy, though helpful for simplifying calculations by rounding numbers to the nearest ten, often requires rapid mental decomposition and re-composition of numbers, which can be overwhelming for some learners [7].

In response to these challenges, educators are now exploring more intuitive and cognitively supportive methods of mental computation. One such approach is the Left-to-Right Method. This strategy encourages students to process numbers starting from the highest place value—the leftmost digit—moving toward the smallest. By focusing on place value and eliminating the need for carrying or borrowing, the Left-to-Right Method helps students develop a more structured understanding of numerical relationships. For instance, in addition, 56 + 37 is solved by adding tens first (50 + 30 = 80), then ones (6 + 7 = 13), and combining the partial sums (80 + 13 = 93). Likewise, in subtraction, 82 – 46 begins with tens (80 – 40 = 40), followed by ones (2 – 6 = –4), resulting in 40 + (–4) = 36. Larger examples such as 243 + 156 or 532 – 276 follow the same breakdown into hundreds, tens, and ones, promoting a clear, logical structure for mental computation.

The theoretical underpinnings of this study are drawn from Constructivist, Cognitive Load, and Behaviorist learning theories. Constructivist theorists like Jean Piaget and Lev Vygotsky emphasize that learners build their understanding through experience, reflection, and social interaction [8]. The Left-to-Right Method aligns well with this theory, as it enables students to anchor new computation strategies to prior knowledge, thereby promoting learning as a process of active meaning-making. Vygotsky's concept of scaffolding also supports the structured teaching of this method, providing learners with gradual support until they can perform independently.

Additionally, Cognitive Load Theory [9] underscores the importance of minimizing extraneous mental effort to enhance learning. The Left-to-Right Method supports this by simplifying problem-solving into sequential, meaningful steps—thereby lightening the mental load associated with more traditional algorithms that demand extensive working memory resources. Reinforcing this is Behaviorism, which highlights the role of repeated practice and feedback in forming habits and automaticity. The structured and repetitive nature of the Left-to-Right Method creates consistent opportunities for students to build fluency and confidence in mental computation.

In the context of the Philippine education system, this study responds directly to pressing needs within the foundational learning landscape. The current MATATAG curriculum reform prioritizes early mastery of literacy and numeracy, emphasizing learner-centered and developmentally appropriate pedagogies [11]. These national goals, reflected in Republic Act No. 10533 (Enhanced Basic Education Act of 2013) and Republic Act No. 9155 (Governance of Basic Education Act of 2001), advocate a shift from procedural memorization to critical thinking and conceptual understanding [12], [13]. However, despite these reformative efforts, large-scale assessments like PISA, consistently show Filipino students underperforming in mathematics, particularly in tasks requiring number sense, arithmetic reasoning, and flexible strategy use—skills that mental computation is meant to develop [14].

While mental arithmetic strategies have long been the subject of educational research, existing literature remains largely centered on traditional approaches such as the Standard Algorithm, Counting On, or Making Tens, often without deeply interrogating their cognitive demands or adaptability to diverse learners. Furthermore, most empirical studies have been conducted in Western contexts, with limited exploration of alternative strategies like the Left-to-Right Method within Southeast Asian or Filipino classrooms. There is also a dearth of research that directly compares how such methods influence young learners' computational efficiency, conceptual understanding, and cognitive load in early-grade settings.

This study addresses these gaps by examining the effectiveness of the Left-to-Right Method among Grade 2 pupils—an age group where mental arithmetic foundations are critically formed. Unlike prior research, which tends to focus on procedural mastery or theoretical modeling, this study adopts an applied classroom-based approach that investigates not only the performance outcomes of this strategy but also its potential cognitive benefits. By using empirical evidence drawn from real classroom implementation, this research contributes a novel lens to the field—particularly within the Philippine basic education context where instructional innovation in numeracy is urgently needed.

Thus, the study offers both theoretical and practical significance. It advances pedagogical knowledge by validating an underexplored yet promising strategy, and it offers classroom practitioners data-driven insights for improving numeracy instruction. In doing so, it hopes to help build a more solid mathematical foundation for Filipino learners—one that supports both local educational goals and global competency standards.

2. RESEARCH METHOD

The study applied an experimental approach, using a quantitative research design to determine the effectiveness of the Left-to-Right Method. This design enabled the researcher to control outcomes across two groups, ensuring that the independent variable was the only factor influencing the results. This approach formed cause-and-effect relationships while controlling for other variables, ensuring that observed differences will be linked to the intervention.

This study employed simple random sampling to select participants from the population of second-grade pupils enrolled in a basic education institution in Sorsogon, Philippines. A total of 40 Grade 2 pupils were randomly drawn from three existing Grade 2 classes. Simple random sampling was used to ensure that each pupil had an equal probability of being chosen, thus minimizing selection bias and enhancing the internal validity of the study [15][16]. Once selected, the pupils were randomly assigned to two groups: the experimental group and the control group, with 20 pupils in each. Random assignment is a key feature of experimental research designs as it helps ensure group equivalence at the outset and controls for confounding variables [17], [18].

The experimental group received instruction using the Left-to-Right Method, a place-value-based approach to mental computation, while the control group continued with the school's traditional instructional strategies such as the standard algorithm and counting on. This setup enabled a controlled comparison of the effectiveness of the intervention. Randomized control trials (RCTs), even on a small scale, have been shown to be effective in assessing the causal impact of pedagogical innovations in basic education settings [19].

In addition to the student participants, three Grade 2 teachers were purposively selected to take part in the study. Purposeful sampling was used to identify teachers with varied designations and relevant teaching experience to gather diverse instructional perspectives [19]. The participating teachers included one (1) Teacher III, one (1) Teacher II, and one (1) Teacher I, each with five years and above experience in teaching in basic education and will serve as teacher-observers in the implementation of the study. Their pivotal role helped contextualize the implementation of the Left-to-Right Method and provided formative insights into learner engagement and the feasibility of the strategy in real classroom environments. Teacher input is recognized as essential in intervention studies, particularly when evaluating the applicability and sustainability of innovative methods in authentic educational settings [20].

Two primary research instruments were used in this study: a pre-test and post-test for measuring pupil performance and a teacher acceptability questionnaire for evaluating perceptions on the Left-to-Right method. Pre-test and post-test gauged the pupils' mental addition and subtraction capabilities before and after the intervention. Each test was conducted within a 10-minute time frame, with the time equally divided between addition and subtraction items. To ensure a consistent and objective evaluative process, a Performance Level Scoring Guide adapted from a published study, was employed [21]. This scoring guide categorized pupils' performance across various levels. Below is the Performance Level Scoring Guide Table, which illustrates the criteria for assessing the pupils.

Table 1. Performance Level Scoring Guide

Score Interval	Descriptive Equivalent
9-10	Outstanding
7-8	Very Satisfactory
5-6	Satisfactory
3-4	Fairly Satisfactory
1-2	Did Not Meet Expectations
0	Non-Performance

Furthermore, the Likert Scale Measurements for the Level of Acceptability were used to determine teachers' acceptability level towards the Left-to-Right Method. The scale was adapted from a published article [22]. Below is the table presenting the Likert Scale Measurements for the Level of Acceptability. It outlines the specific items containing descriptive equivalence and weighted mean ranges used to evaluate teachers' perception of the method.

Table 2. Likert Scale Measurements for the Level of Acceptability

Descriptive Equivalent	Numerical Value	Weighted Mean Range
Highly Acceptable	5	4.21 – 5.00
Moderately Acceptable	4	3.41 – 4.20
Acceptable	3	2.61 – 3.40
Fairly Acceptable	2	1.80 – 2.60
Poorly Acceptable	1	1.00 – 1.79

The content and construction of all instruments used in the study were validated through expert review. Additionally, the pre-test, post-test, and teacher acceptability questionnaires were pilot tested for reliability and accuracy.

In this study, ethical considerations were vital. Before the study began, an informed consent form was distributed to ensure safeguards were put in place to ensure the safety, privacy, and well-being of the participants, especially since the primary respondents of the study are elementary students [23]. Parental consent was obtained for student participation, and permission was sought from the Schools Division Superintendent of Sorsogon City and the School Principal to ensure that the study complied with all the necessary rules and regulations. Throughout the study, confidentiality and anonymity of all participants were assured. Photos were only shown if they were permitted; otherwise, they were blurred to protect privacy. Moreover, participants were made aware that they had a right to withdraw at any time without consequences, and the researcher ensured that no pupil felt pressured or suffered negative consequences if they did not perform well. The data collection process spanned three weeks. Before the intervention, a pre-test was distributed to both groups with a 10-minute total time limit, divided equally between mental addition and subtraction items, to assess their baseline performance. For the next 13 days, the Left-to-Right Method was applied and taught to the experimental group. Afterward, a post-test was administered, again with the same time limit. Additionally, the teachers filled out an acceptability questionnaire about their feedback on the Left-to-Right Method. All steps were followed to make sure the collected data was reliable and valid.

Descriptive and inferential statistical tools were utilized to assess the effectiveness of the Left-to-Right Method in strengthening the mental addition and subtraction skills of Grade 2 pupils. Descriptive statistics, including mean scores, performance levels, standard deviations, and normalized gains, were used to summarize learners' performance and highlight consistency across different learning competencies. To determine whether observed differences between the experimental and control groups were statistically significant, inferential statistics were applied. These included the independent (unpaired) t-test, with the p-value set at 0.05, and Cohen's d to measure the magnitude of the intervention's effect. However, prior to conducting the t-test, relevant assumption tests were performed to ensure the appropriateness of the parametric analysis.

Specifically, the Shapiro-Wilk test was used to assess the normality of the score distributions in both groups. This test is particularly suitable for small sample sizes and is widely recommended in educational research to validate the use of t-tests [24]. Additionally, the Levene's Test for Equality of Variances was conducted to verify the assumption of homogeneity of variances between the experimental and control groups. Both assumptions—normal distribution and equal variance—are critical to the validity of t-test results [25]. Only after confirming that these assumptions were satisfied did the study proceed with the independent samples t-test. These statistical procedures allowed for a rigorous comparison of pre-test and post-test performance, ensuring that any significant differences observed could be confidently attributed to the intervention. Cohen's d further complemented the analysis by quantifying the practical significance of the differences in terms of effect size.

3. RESULTS AND DISCUSSION

3.1. Baseline Performance Assessment

Understanding the current mental addition and subtraction skills of pupils is key to measuring the Left to Right Method's effectiveness. This baseline assessment allowed comparisons of pupil progress before and after the intervention. The study's first objective was to **assess the current performance level of pupils in mental addition and subtraction** prior to any teaching using the Left to Right Method. Both control and experimental groups were given a pre-test to determine their initial performance level.

Table 3. Distribution of Participants Pre-Test Scores in Addition

Score Interval	Control Group	Experimental Group
9-10	5	9
7-8	7	7
5-6	1	2
3-4	4	1
1-2	3	1
0	0	0

The pre-test results in addition revealed varying levels of proficiency among the pupils. In the control group, five pupils (25%) performed at the Outstanding level (scores of 9-10), while seven pupils (35%) performed at the Very Satisfactory level (scores of 7-8). Additionally, one pupil (5%) was classified as Satisfactory (scores of 5-6), four pupils (20%) were in the Fairly Satisfactory range (scores of 3-4), and three pupils (15%) were in the Did Not Meet Expectations level (scores of 1-2). In the experimental group, nine pupils (45%) performed at the Outstanding level, and seven pupils (35%) performed at the Very Satisfactory level. The remaining pupils in the experimental group consisted of two pupils (10%) who reached the Satisfactory level, one pupil (5%) who fell under the Fairly Satisfactory level, and one (5%) who belonged to the Did Not Meet Expectations level. Both groups had no pupils classified as Non-Performance (score of 0). One pupil in the control group and two pupils in the experimental group were unable to finish the test within the allotted time.

These results showed that the majority of pupils in both groups demonstrated moderate to high proficiency levels in mental addition. The 5-minute time limit, however, may have affected their performance. Even though most students were able to finish the test, the time constraint may have influenced the accuracy and confidence of those who were struggling to keep up, especially students in the lower performance levels. This highlights the need for strategies that not only work on computational skills but also enhance processing speed.

Students frequently use diverse methods when mentally adding numbers. This fact underscores the importance of instructional approaches that accommodate all individual learning styles [26]. Moreover, students who used more adaptable strategies exhibited enhanced performance, implying that structured approaches could boost learning and yield better results [27]. Rapid mental calculation has been shown to strengthen arithmetic skills, indicating that approaches like the Left to Right Method may provide meaningful support in fostering students' number sense and computational fluency [28].

Table 4. Distribution of Participants Pre-Test Scores in Subtraction

Score Interval	Control Group	Experimental Group
9-10	3	6
7-8	2	0
5-6	1	5
3-4	4	1
1-2	5	3
0	5	5

The subtraction pre-test results displayed significant differences between the experimental and control groups. In the control group, three pupils (15%) achieved the Outstanding level (scores of 9-10), two pupils (10%) fell into the Very Satisfactory level (scores of 7-8), one pupil (5%) was at the Satisfactory level (scores of 5-6), four pupils (20%) landed in the Fairly Satisfactory level (scores of 3-4), and five pupils (25%) scored in the Did Not Meet Expectations range (scores 1-2). In the experimental group, six pupils (30%) reached the Outstanding level, five pupils (25%) were in the Satisfactory level, one pupil (5%) belonged to the Fairly Satisfactory category, and three pupils (15%) were in the Did Not Meet Expectations level. Both groups had five pupils (25%) each in the Non-Performance category (score of 0). In addition, twelve pupils from the control group and ten from the experimental group were unable to complete the test in 5 minutes.

The data showed that a large proportion of students in both groups had trouble doing mental subtraction, with many of them performing at low performance levels. The time limits seemed to affect test completion in a negative way, especially for pupils who were not yet at the level of automaticity and recall in subtraction. These findings underscore the importance of providing additional support and structured methods, such as the Left to Right Method, to help learners improve their mental subtraction skills and manage cognitive demands effectively.

Structured strategies have been shown to play a key role in supporting mental subtraction performance. When solving complex subtraction problems, students often resort to less efficient methods, which can reduce both accuracy and fluency [29]. Working memory has been found to be essential in executing subtraction tasks, particularly under time constraints [30]. Moreover, the use of more organized mental strategies, such as step-by-step approaches, has been linked to reductions in the cognitive load on the central executive system [31]. These strategies suggest a systematic technique, like the Left to Right Method to assist learners in performing mental subtraction more accurately.

3.2. Method Implementation Process

The success of this study depended on the effective implementation of the Left-to-Right Method, a technique developed for the purpose of helping learners add and subtract mentally with greater efficiency. This method was introduced in a way that was both structured and systematic, with the intention of making sure that learners understood the key ideas and applied them well when doing mental addition and subtraction tasks [32], [33].

The second objective was to introduce and implement the Left-to-Right Method with clarity and coherence. This method was applied in the Experimental Group through a well-structured lesson plan to support pupils in solving addition and subtraction tasks starting from the leftmost digit. The lesson plan ensured that pupils understood each step of the process, helping them break down complex problems into simple and manageable tasks [34]. Structured instruction, which breaks tasks into smaller steps, is essential in helping learners master difficult concepts [35]. Moreover, providing worked examples that segment the solution to a particular problem into more manageable steps helps learners understand a problem and aids them in transferring that knowledge to future problems [36].

In the classroom, pupils were actively engaged in the lesson, following structured activities that reinforced the Left-to-Right approach. Hands-on activities, group work, and examples all led pupils to practice the method reliably. In addition, pupils received timely, accurate and constructive feedback during activities, allowing them to correct errors and strengthen their mastery of the steps involved. When misunderstandings occurred, clarifications were provided to address specific points of confusion and guide pupils toward the correct application of the method. Positive reinforcement was consistently used to motivate pupils, acknowledge their progress, and sustain their engagement throughout the sessions. As pupils gained familiarity with the Left to Right Method, they became more confident in articulating their thought processes. This shift reflected not only an understanding of the procedure but also a deeper grasp of the underlying concepts.

Figure 1. Pupils practicing mental addition and subtraction using the left-to-right method.

Figure 1 illustrates pupils practicing the Left-to-Right Method in performing mental addition and subtraction. This figure signifies pupils' engagement in employing this special technique in which numbers are processed from left to right. Pupils were shown visually how they traverse the method step by step so they can get used to the approach and do it right. This kind of visual aid upholds better comprehension of learning alongside fostering active participation, and enhancing the learning process [37]. It is also shown that the inclusion of structured visualization techniques enables learners to develop stronger connections with the material itself, moving beyond the literal meaning of the material to learn new concepts with greater retention and understanding [38]. When learners focus on this method, they may be able to strengthen their mental calculation strategies, promoting quicker and accurate problem-solving on future arithmetic tasks. Pupils are practicing the Left-to-Right Method for performing mental addition and subtraction, as shown in Figure 1.

Figure 2. Pupils solving addition and subtraction tasks during the Mental Math Relay Race game using the Left-to-Right Method

As shown in Figure 2, pupils were actively participating in the Mental Math Relay Race game, working in groups to apply the Left-to-Right Method in mental addition and subtraction tasks. This interactive and engaging task promotes teamwork and collaborative learning [6]. This game gives students the opportunity to engage in practicing mental addition and subtraction and also hones their problem-solving abilities. The group setting encourages peer support and reinforces the application of the Left-to-Right Method, making the learning experience both effective and enjoyable. Collaborative learning environments not only improve academic performance but also enhance the quality of interpersonal relationships among learners [39].

3.3. Effectiveness of the Method

The third objective of the study was to evaluate the effectiveness of the Left-to-Right method. This was done by comparing the pre-test and post-test scores of both the control group and the experimental group, along with teacher acceptability questionnaire responses to determine the method's overall impact.

Table 5. Distribution of Participants Post-Test Scores in Addition

Score Interval	Control Group	Experimental Group
9-10	6	18
7-8	5	2
5-6	3	
3-4	0	
1-2	3	
0	3	

The results of the post-test indicated clear differences between the control and experimental groups. In the control group, six pupils achieved the Outstanding level (scores of 9-10), five were classified as Very Satisfactory (scores of 7-8), and three were Satisfactory (scores of 5-6). Three pupils were in the Did Not Meet Expectations (scores of 1-2) group, and three pupils received a score of 0 (Non-Performance). Additionally, one pupil from the control group did not finish the test within the given time. In contrast, the experimental group showed significantly better performance, with eighteen pupils reaching the Outstanding level (scores of 9-10). Two pupils were rated as Very Satisfactory (scores of 7-8), and no pupils fell into the lower performance or non-performance categories. All pupils in the experimental group completed the test within the time limit.

Post-test results indicated a positive impact of the Left to Right method on pupils' mental addition performance. The experimental group showed substantial improvements, which suggests that the Left to Right method not only enhances accuracy but also helps pupils add faster in their heads. On the other hand, it is worth noting that two students in the experimental group had a missing digit in their final answers, which affected their overall score. Despite this, their post-test scores were still far better than their pre-test scores, further reinforcing the positive impact of the Left to Right method in mental addition skills. These findings emphasize the potential of structured approaches like the Left-to-Right method in fostering both computational proficiency and speed, leading to better overall performance in mental addition.

Improvement seen in the experimental group aligns with existing studies on the effectiveness of structured strategies in enhancing mental arithmetic skills. It has been found that using organized, step-by-step methods significantly improved students' accuracy and reduced mistakes in mental arithmetic, supporting the idea that structured approaches like the Left to Right method can be beneficial for mental addition [40]. Additionally, instructional strategies based on Cognitive Load Theory (CLT) help manage students' cognitive load, making it easier for them to perform mental tasks efficiently [41]. Furthermore, schema-based instruction has been shown to lead to significant improvements in students' mathematical skills, suggesting that structured instructional methods can enhance learning outcomes in arithmetic [42]. These studies offer substantial evidence confirming the effectiveness of this method in enhancing mental arithmetic performance.

Table 6. Distribution of Participants Post-Test Scores in Subtraction

Score Interval	Control Group	Experimental Group
9-10	4	18
7-8	0	2
5-6	1	
3-4	8	
1-2	3	
0	4	

The control and experimental groups showed diverse performance levels in the post-test results in subtraction. In the control group, only four pupils reached the Outstanding level (scores of 9-10), one pupil was at the Satisfactory level (scores of 5-6), and eight pupils were at the Fairly Satisfactory level (scores of 3-4). Also, three pupils were at the Did Not Meet Expectations level (scores of 1-2), and four pupils were at the Non-Performance level (score of 0). Ten pupils from the control group did not finish the test within the given time. In comparison, the experimental group showed significantly higher performance, with eighteen pupils reaching the Outstanding level. Only two pupils were in the Very Satisfactory range, and no pupils scored in the lower performance or non-performance categories. Furthermore, all pupils in the experimental group completed the test within the time limit, showing greater efficiency and accuracy.

Clear difference in post-test performance between the control and experimental groups suggest that structured approaches, like the Left to Right Method, can significantly improve learners' mental subtraction skills. The experimental group's strong performance indicates that breaking down subtraction tasks into smaller, more manageable steps can reduce cognitive overload and support learners in performing better, even under time constraints. Conversely, the control group's performance shows that without a structured method, many learners struggled to finish within the given time, indicating that their approach lacked the structure needed to fully optimize their performance. These results imply that the Left to Right Method can be a valuable tool in helping learners not only understand subtraction but also develop the ability to approach mental subtraction tasks with greater clarity and efficiency. Moreover, these findings directly address the objective of the study—to determine the effectiveness of the Left-to-Right Method—by demonstrating that pupils in the experimental group significantly outperformed those in the control group. The statistically significant difference in post-test scores and the absence of lower-level scorers among the experimental group provide strong empirical support for the method's effectiveness.

Students build better number-sense and can solve problems in a more meaningful and organized way, when they are taught using contextual strategies—like how the Left to Right Method breaks down subtraction into clear, sequential steps, allowing learners to approach problems methodically [43]. Giving learners access to alternative subtraction strategies helps them become more accurate and confident, especially when those strategies focus on number relationships and patterns [44]. These studies support the idea that using a structured, step-by-step approach to teaching subtraction, like the Left to Right method, can significantly improve accuracy, understanding, speed, and confidence.

3.4. Teachers' Perception and Acceptability of the Left-to-Right Method

The effectiveness of the Left to Right Method was further evaluated using a teacher acceptability questionnaire. This tool gathered feedback from teachers regarding the method's ease of use, effectiveness, and alignment with existing practices.

Table 7. Teacher Acceptability Questionnaire Results

Statement	Teacher 1	Teacher 2	Teacher 3	Mean	Interpretation
The Left-Right Method is easy to explain and demonstrate to learners.	5	5	5	5.00	Highly Acceptable
The Left-Right Method is more intuitive for learners compared to traditional methods.	4	5	4	4.33	Highly Acceptable
I believe the Left-Right Method addresses common challenges in mental addition and subtraction.	5	5	5	5.00	Highly Acceptable
The method improves learners' confidence in performing mental addition and subtraction.	4	5	5	4.67	Highly Acceptable
I find the Left-Right Method compatible with my current teaching practices.	5	5	5	5.00	Highly Acceptable
I would consider adopting the Left-Right Method for teaching mental addition and subtraction.	5	5	4	4.67	Highly Acceptable
The Left-Right Method can be effectively implemented without requiring additional resources or materials.	4	5	4	4.33	Highly Acceptable
I feel confident in implementing the Left-Right Method in my classroom.	5	5	4	4.67	Highly Acceptable
The method can be easily integrated into the mathematics curriculum.	5	5	5	5.00	Highly Acceptable
I would recommend the Left-Right Method to other mathematics teachers.	5	5	4	4.67	Highly Acceptable
Average Mean Score and Interpretation				4.73	Highly Acceptable

Teacher responses to the Acceptability Questionnaire showed strong support for the Left to Right Method, with an overall average mean score of 4.73, indicating high acceptability. Teachers found the method easy to explain and compatible with their teaching practices, both receiving a mean score of 5.00. They also believed it effectively addressed common challenges in mental addition and subtraction (mean score of 5.00) and helped boost students' confidence in performing mental arithmetic (mean score of 4.67). Teachers expressed interest in adopting the method in their classrooms (mean score of 4.67) and recommending it to colleagues (mean score of 4.67). They found the method intuitive for learners (mean score of 4.33) and recognized it could be implemented with minimal additional resources (mean score of 4.33). Overall, the results suggest that teachers view the Left to Right Method as a practical and beneficial approach for strengthening mental addition and subtraction skills.

This performance improvement directly supports the research objective and highlights the method's specific effectiveness in mental subtraction, a competency where learners commonly struggle. The results affirm that structured methods, like the Left-to-Right approach, can substantially reduce difficulty and improve fluency.

Strong support for the Left-to-Right Method underscores its potential to facilitate teaching and learning. High acceptability ratings from teachers suggest that the method can be integrated into current instructional practices with minimal adjustments. Its simplicity and compatibility with existing teaching approaches could make it easier for educators to adopt, leading to more effective and efficient lessons. As the method boosts student engagement and confidence in mental addition and subtraction, it shows promise for transforming how mathematical concepts are taught. By making mathematical thinking more transparent and more organized, this method has the potential to support both teachers and students in achieving better learning outcomes.

Teacher acceptability significantly influences the successful adoption and sustainability of instructional methods. When educators perceive a strategy as effective and aligned with their instructional goals, they are more inclined to implement it consistently and with confidence [45]. Strategies that encourage intuitive thinking and student engagement tend to be more appealing to teachers, fostering a more positive attitude toward adoption. Furthermore, meaningful change in education often takes root when instructional approaches are seen as both practical and beneficial within the existing teaching context [46]. These findings support the strong acceptability of the Left to Right Method, highlighting its practicality, clarity, and ease of integration into early mathematics instruction.

3.5. Difference in Performance Levels

Assessing the effectiveness of the Left to Right Method in mental addition and subtraction involved a detailed comparison of assessment results between the control and experimental groups. Differences in pre-test and post-test scores, mean ratings, normalized gains, and performance levels across specific learning competencies were examined to determine the method's influence on pupils' mental addition and subtraction skills. Standard deviation was considered to assess the consistency of scores, while the p-value and significance level were applied to evaluate the statistical relevance of the findings. Effect size, measured through Cohen's d, was used to gauge the magnitude of the intervention's impact on pupil performance.

Learning Competencies	No. of Items	No. of Points	PRE-TEST						POST-TEST						Effect Size (Cohen's d)	Interpretation
			Control Group (N=20)			Experimental Group (N=20)			Control Group (N=20)			Experimental Group (N=20)				
			Weighted Mean	PL (%)	Interpretation	Weighted Mean	PL (%)	Interpretation	Weighted Mean	PL (%)	Interpretation	Weighted Mean	PL (%)	Interpretation		
LC1 - Adds mentally 3-digit numbers and tens (multiples of 10 up to 90) using appropriate strategies (M2NS-II28.5).	5	5	3.45	69	NM	3.95	79	M	3.40	68	NM	5.00	100	FM	1.16	L
LC2 - Adds mentally 3-digit numbers and hundreds (multiples of 100 up to 900) using appropriate strategies (M2NS-II28.6).	5	5	2.75	55	LM	3.70	74	NM	2.15	43	LM	4.50	90	NFM	1.55	L
LC3 - Subtracts mentally 1-digit numbers from 1 to 3-digit numbers without regrouping using appropriate strategies (M2NS-IIb33.2).	5	5	2.20	44	LM	2.55	51	LM	2.80	56	LM	4.95	99	FM	1.65	L
LC4 - Subtracts mentally 3-digit numbers by tens and by hundreds without regrouping using appropriate strategies (M2NS-IIb33.3).	5	5	1.30	26	LM	2.15	43	LM	1.15	23	LM	4.75	95	FM	2.36	L
Overall Mean	**20**	**20**	**2.4**	**48.5**	**LM**	**3.1**	**61.8**	**NM**	**2.38**	**47.5**	**LM**	**4.8**	**96**	**FM**	**1.7**	**L**
SD				**5.70**			**4.69**			**6.04**			**1.24**			
p-value					**0.117**						**0.000**					

Note: Significant at 0.05 level—PL=Performance Level; LM=Low Mastery; NM=Near Mastery; M=Mastery; NFM=Near Full Mastery; FM=Full Mastery; SD=Standard Deviation; L=Large

Figure 2. Summary of Unpaired t-Test Results for Participants' Pre-test and Post-test Scores

Unpaired t-test results reveal a significant difference in the overall performance levels of the control and experimental groups. In the pre-test, both groups had relatively low performance. The control group displayed an overall Performance Level (PL) of 48.5%, interpreted as Low Mastery (LM), while the experimental group had a PL of 61.8%, which is within the Near Mastery (NM) range. In terms of specific learning competencies, both groups struggled most with LC4 (Subtracting 3-digit numbers by tens and hundreds), where the control group scored only 26% (LM) and the experimental group 43% (LM). The highest pre-test scores for the experimental group were in LC1 (Adding 3-digit numbers and tens) with a PL of 79% (Mastery), while the control group scored 69% (Near Mastery) in the same skill. In the post-test, the control group's performance remained in the Low Mastery level (PL = 47.5%), showing little to no improvement. In contrast, the experimental group showed a remarkable increase, reaching a Performance Level of 96%, classified as Full Mastery (FM). They showed strong mastery across all competencies, with scores ranging from 90% to 100%. The most significant improvement was observed in LC4, where their performance increased from 43% to 95%, indicating a major gain in subtraction skills using the Left to Right Method. In the pre-test, the control group had a higher standard deviation (SD = 5.70), indicating more variation in scores, while the experimental group had a lower SD (4.69), showing more consistency. After the intervention, the control group's SD increased to 6.04, suggesting greater inconsistency in their performance. In contrast, the experimental group's SD dropped to 1.24, indicating more constant improvement across pupils' performance. This reduction highlights the success of the intervention in ensuring consistent high scores. The computed p-value (0.000) indicates a statistically significant difference between the post-test results of the two groups. Furthermore, large effect size (Cohen's d = 1.7) confirms that the intervention had a strong and positive impact on pupils' mental addition and subtraction skills. This is further supported by the results of the mean and normalized gain scores, as shown in ficture 4.

Learning Competencies	Experimental Group (N=20)							Control Group (N=20)						
	PRE-TEST Weighted Mean Score	SD	POST-TEST Weighted Mean Score	SD	Mean Gain	Norm Gain	Interpretation)	PRE-TEST Weighted Mean Score	SD	POST-TEST Weighted Mean Score	SD	Mean Gain	Norm Gain	Interpretation)
LC1 - Adds mentally 3-digit numbers and tens (multiples of 10 up to 90) using appropriate strategies (M2NS-Ii28.5).	3.95	1.54	5.00	0.00	1.05	1	H	3.45	1.64	3.40	1.96	-0.05	-0.03	L
LC2 - Adds mentally 3-digit numbers and hundreds (multiples of 100 up to 900) using appropriate strategies (M2NS-Ii28.6).	3.70	1.34	4.50	0.83	0.80	0.62	M	2.75	1.74	2.15	1.98	-0.60	-0.27	L
LC3 - Subtracts mentally 1-digit numbers from 1 to 3-digit numbers without regrouping using appropriate strategies (M2NS-IIb33.2).	2.55	2.06	4.95	0.22	2.40	0.98	H	2.20	1.88	2.80	1.82	0.60	0.21	L
LC4 - Subtracts mentally 3-digit numbers by tens and by hundreds without regrouping using appropriate strategies (M2NS-IIb33.3).	2.15	2.30	4.75	0.79	2.60	0.91	H	1.30	1.81	1.15	2.01	-0.15	-0.04	L
Overall	**12.35**	**7.24**	**19.20**	**1.84**	**6.85**	**0.88**	**H**	**9.70**	**7.07**	**9.50**	**7.77**	**-0.20**	**-0.03**	**L**

Note: SD=Standard Deviation; H=High, M=Medium; L=Low

Ficture 4. Mean and Normalized Gain of Pre-test and Post-test Results of the Experimental and Control Group

The experimental group demonstrated high normalized gains in all learning competencies, with an overall normalized gain of 0.88 classified as High. Mean gains ranged from 0.80 to 2.60, highlighting substantial progress across all areas of mental addition and subtraction. In contrast, the control group recorded an overall normalized gain of -0.03, indicating little to no improvement and even regression in some skills. These results confirm that the intervention not only had a significant statistical impact but also yielded meaningful educational gains in actual learner performance.

The statistical findings from the t-test, p-values, and effect size directly support the study's objectives and hypotheses. Specifically, the highly significant p-value (0.000) and the large effect size (Cohen's d = 1.7) provide compelling evidence for the Left-to-Right Method's effectiveness in enhancing pupils' mental arithmetic skills. This satisfies the third research objective by confirming the method's capacity to produce significant learning gains. The normalized gain of 0.88 in the experimental group further reinforces this conclusion, showing that the intervention not only led to statistically significant improvements but also resulted in high educational impact. These findings demonstrate the method's effectiveness as a pedagogical intervention for improving both mental addition and subtraction skills.

Findings from both the unpaired t-test and the analysis of mean scores and normalized gains strongly suggest that the Left-to-Right Method significantly enhances pupils' performance in mental addition and subtraction. The experimental group exhibited statistically significant improvements compared to the control group, particularly in subtraction tasks, where learners typically experience more difficulty due to cognitive load and procedural complexity. The substantial gains observed, especially in Learning Competency 4 (subtracting 3-digit numbers), indicate that the method fosters not only accuracy but also fluency in mental computation. This improvement can be attributed to the structured, sequential nature of the Left-to-Right Method, which reduces the mental burden associated with traditional right-to-left algorithms and instead emphasizes conceptual understanding through place-value reasoning. These results support the findings of recent studies, such as those by [47], which demonstrated that schema-based and structured strategies significantly improve mental computation among early-grade students by enhancing both speed and accuracy. Similarly, [48] reported that learners taught with consistent, scaffolded strategies exhibited higher long-term retention and procedural mastery, mirroring the retention and performance outcomes observed in this study's post-test results.

In contrast, the control group—taught using conventional methods—showed only marginal improvement, highlighting the limitations of traditional instruction in cultivating mental arithmetic skills. This discrepancy reinforces the argument that reliance on algorithmic memorization alone may not be sufficient for young learners to internalize numerical relationships and problem-solving heuristics. From these findings, it can be concluded that instructional strategies emphasizing cognitive alignment, logical structuring, and consistency—such as the Left-to-Right Method—are more effective for developing foundational mental computation skills in early-grade learners. The method's stepwise and place-value-based approach aligns well with learners' cognitive development stages, making it easier for them to understand, apply, and retain arithmetic procedures.

The novelty of this research lies in its application of the Left-to-Right Method in a Philippine early-grade context, where such alternative mental strategies are rarely explored. Most existing studies on mental arithmetic interventions are situated in Western educational systems and often target upper elementary learners. By focusing on Grade 2 pupils, this study expands the literature on early numeracy and offers a locally relevant, empirically validated instructional strategy that aligns with the MATATAG curriculum's emphasis on foundational learning. However, this study is not without limitations. First, the sample size, although sufficient for preliminary experimentation, was limited to 40 pupils from a single institution, which may restrict the generalizability of results. Second, the intervention period was relatively short, which may not fully capture long-term retention or transfer of skills to problem-solving contexts. Lastly, qualitative data such as learner reflections or process-based interviews were not included, which could have enriched understanding of students' cognitive processes and engagement. Thus, for future researchers, they may consider the inclusion and replicating this study with larger and more diverse samples across multiple schools and regions to enhance external validity. Longitudinal studies should also be conducted to assess the sustainability of learning gains and their effect on broader mathematical competencies. Additionally, integrating qualitative data—such as student think-aloud protocols or classroom observations—may offer deeper insights into how learners internalize and apply the Left-to-Right Method. Likewise, findings underscore the efficacy of the Left-to-Right Method in improving mental addition and subtraction skills among early-grade learners. It offers a promising alternative to traditional approaches and provides strong empirical support for incorporating cognitively supportive, structured strategies in foundational mathematics instruction.

4. CONCLUSION

The results of this study reveal that prior to the intervention, Grade 2 pupils experienced notable challenges in performing mental addition of three-digit numbers and, more critically, in executing mental subtraction tasks involving both two- and three-digit numbers. The intervention—grounded in the Left-to-Right Method—effectively addressed these difficulties by providing a structured, place-value-oriented strategy that made complex computations more intuitive and cognitively manageable. Despite the brief duration of implementation, the experimental group demonstrated statistically and practically significant gains, particularly in subtraction, a domain typically marked by higher cognitive demand.

The marked improvement in post-test performance among pupils taught with the Left-to-Right Method confirms the method's effectiveness not only in enhancing computational accuracy and efficiency but also in boosting learner confidence. Given that the intervention was conducted over a limited period, the findings suggest that if the method were implemented consistently over a longer time frame—such as an entire academic year—learners could potentially reach Outstanding Performance levels, with many likely to achieve mastery and perfect scores in mental arithmetic tasks. Beyond addressing the initial research questions, this study proposes a conceptual insight: the Left-to-Right Method may function as a developmentally aligned mental computation framework for early-grade learners. Rooted in place-value understanding and cognitive load theory, it allows students to process numbers logically and sequentially, aligning with how children naturally perceive quantity and structure. This points to the potential for a broader pedagogical shift from rigid algorithmic teaching to cognitively adaptive strategies in early mathematics instruction.

Theoretically, this study supports the integration of constructivist, behaviorist, and cognitive load principles into mental computation pedagogy, reinforcing the notion that effective arithmetic instruction must attend to both how children learn and how they process numerical information. Practically, it offers educators a low-cost, high-impact tool for enhancing foundational numeracy, especially in contexts where learners struggle with abstract algorithmic methods. Given these implications, it is recommended that the Left-to-Right Method be implemented from the beginning of the school year and supported by systematic teacher training, lesson integration, and progress monitoring. Schools should consider embedding the method into daily numeracy routines to maximize its impact.

Future research may investigate the long-term effects of this method on mathematical reasoning, problem-solving, and retention. Studies may also explore how this method performs across diverse learner populations—including those with learning difficulties—and in different curriculum contexts. Additionally, the development of analogous Left-to-Right strategies for mental multiplication and division could form part of an emerging suite of cognitively aligned methods, contributing to a more holistic and learner-centered approach to mental arithmetic instruction.

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