The International Review of Multidisciplinary Research
Volume 1, Issue 4, April 2026, pp. 729-738
https://doi.org/10.5281/zenodo.19953460

Manipulative-based activities and number sense development of Grade 1 learners of Tucanon Elementary School

[1]Ruby Lacuesta-Tamayo, [2]Jenifer Raymond R. Tallungan
[1]Tucanon Elementary School, [2]Nueva Vizcaya State University
[1]ruby.tamayo001@gmail.com, [2]jenz2319@gmail.com

Article Details:

Received: 9 March 2026
Revised: 5 April 2026
Accepted: 15 April 2026
Published: 30 April 2026
Corresponding Email:
jenz2319@gmail.com

Recommended Citation:

Tamayo, R.L. & Tallungan, J.R.R. (2026). Manipulative-based activities and number sense development of Grade 1 learners of Tucanon Elementary School. The International Review of Multidisciplinary Research. 1 (4), 729-738. https://doi.org/10.5281/zenodo.19953460

Index Terms:

early mathematics education, Grade 1 learners, manipulative-based activities, number sense, numeracy development

Abstract. This study investigated the effect of manipulative-based activities on the development of number sense in Grade 1 learners, providing evidence-based insights for strengthening early numeracy instruction. The study employed a sequential explanatory mixed-methods design involving 18 Grade 1 learners from Tucanon Elementary School. Quantitative data were collected using a validated Number Sense Test administered as a pretest and posttest and analyzed through descriptive statistics and paired sample *t*-tests. Qualitative data were obtained from classroom observations and analyzed using thematic analysis to capture learners' engagement, experiences, and challenges during the intervention. Results revealed that learners initially demonstrated a very satisfactory level of number sense with a mean score of 16.33. After the implementation of manipulative-based activities, the mean score increased to 18.94, interpreted as excellent. Statistical analysis indicated a significant improvement between pretest and posttest scores with $t(17) = -3.01$, $p = .008$, confirming the positive effect of manipulative-based activities. Qualitative findings further revealed increased learner engagement, motivation, and participation during mathematics activities, although challenges such as time constraints and initial transitions from concrete to abstract tasks were observed. The findings indicate that manipulative-based activities significantly enhance the number sense development of Grade 1 learners. Integrating structured and guided hands-on learning strategies in early mathematics instruction is therefore recommended to strengthen foundational numeracy skills.

Introduction

Number sense goes beyond simple number recognition; it includes understanding numerical relationships, accurate counting, comparison of quantities, pattern recognition, estimation, and basic operations such as addition and subtraction. Strong number sense enables young learners to think flexibly, solve problems confidently, and build readiness for more advanced mathematical concepts. Research consistently shows that early number sense predicts later achievement not only in mathematics but also across other academic areas, while early deficiencies often lead to persistent learning difficulties.

Despite its recognized importance, many young learners—particularly in the Philippines—exhibit weak number sense. National and regional assessments, such as the 2019 Southeast Asia Primary Learning Metrics, reveal low numeracy performance, indicating gaps in foundational mathematical skills. These challenges are often linked to instructional practices that rely heavily on rote memorization and symbolic manipulation rather than conceptual understanding.

To address these gaps, educators increasingly employ manipulative-based activities, which use concrete materials like counters, blocks, and number cards to make abstract concepts tangible. Grounded in Piaget's Constructivist Theory and Bruner's Theory of Instruction, manipulative-based activities align with children's cognitive development stages by emphasizing hands-on experiences, guided discovery, scaffolding, and progression from concrete to abstract understanding. Empirical studies and meta-analyses confirm that structured and guided use of manipulative-based activities improves conceptual understanding, problem-solving skills, and long-term retention.

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

In the Philippine context, the Department of Education (DepEd) supports manipulative-based and activity-oriented instruction through the K to 12 curriculum, particularly in Grade 1 mathematics. Local studies further validate the effectiveness of such approaches. This research is aligned with national frameworks such as the DepEd Basic Education Research Agenda and the National Research Agenda for Teacher Education, as well as global commitments like the United Nations Sustainable Development Goal 4 on Quality Education. However, implementation remains inconsistent, especially in rural and under-resourced schools, due to limited materials, large class sizes, and insufficient teacher training.

Despite the growing body of research supporting the effectiveness of manipulative-based activities in mathematics learning, several gaps remain in the literature. Many international studies have examined the use of manipulative-based activities improving conceptual understanding and problem-solving skills among young learners; however, empirical investigations focusing specifically on the development of number sense in early-grade learners within the Philippine public-school context remain limited. Moreover, previous studies have often focused primarily on quantitative outcomes, with fewer studies exploring both the measurable effects and the classroom experiences associated with manipulative-based activities. In rural and resource-limited school settings, where instructional resources and teacher training opportunities may vary, there is still insufficient localized evidence on how manipulative-based activities influence learners' numeracy development and engagement. Addressing these gaps is essential to better understand how hands-on instructional approaches can be effectively implemented in Philippine elementary classrooms.

Given these conditions, the study aimed to determine the effect of manipulative-based activities on the number sense development of Grade 1 pupils. Specifically, it sought to assess pupils' number sense before and after the intervention, identify significant differences in performance, and document challenges and successes experienced during implementation. The null hypothesis stated that there was no significant difference between pre-test and post-test scores. The study is significant for multiple stakeholders. Pupils may benefit from improved understanding, engagement, and confidence in mathematics. Teachers may gain practical strategies for effective, learner-centered instruction. School administrators may receive evidence to support resource allocation and professional development. Curriculum developers may gain insights for strengthening early mathematics curricula, while policymakers and planners may use the findings to inform evidence-based decisions that support educational equity. Future researchers may build upon the study's framework and findings to further explore early numeracy development.

Furthermore, this study contributes to the academic field by providing localized empirical evidence on the impact of manipulative-based activities on the development of number sense among Grade 1 learners in the Philippine public-school context, addressing gaps in both quantitative outcomes and classroom-based experiences. Methodologically, the use of a mixed-methods sequential explanatory design allowed for a comprehensive analysis of pretest-posttest performance while capturing rich observational data on engagement, motivation, and instructional dynamics. This dual approach strengthens the validity of the findings and offers a model for future research in early numeracy interventions. Practically, the study offers actionable insights for teachers, school administrators, and curriculum developers by demonstrating how structured, guided manipulative-based activities can enhance conceptual understanding, accuracy, problem-solving, and learner confidence, even in resource-limited settings. The findings inform strategies for implementing hands-on, activity-oriented learning aligned with DepEd policies, support evidence-based resource allocation, and highlight the importance of scaffolding and teacher guidance. Hence, this research bridges the gap between theory and practice, providing a framework that can improve early mathematics instruction, support professional development, and guide policy decisions to strengthen foundational numeracy in Philippine elementary education.

The research is delimited to Grade 1 pupils of Tucanon Elementary School in Aritao, Nueva Vizcaya, during the academic year 2025–2026. It focused on number sense competencies—such as number recognition, counting, basic operations, comparison, place value, and simple word problems—using specific manipulative-based activities over one academic quarter. Guided by Piaget's and Bruner's theories and supported by established number sense frameworks, the study aimed to provide empirical evidence on how well-designed, manipulative-based activities may enhance early numeracy and inform classroom practice, teacher training, and educational policy.

Theoretical Framework

This study was grounded in Piaget's Constructivist Theory and Bruner's Theory of Instruction, which explain how young learners develop mathematical understanding through active, guided learning. Piaget emphasized that children construct knowledge through concrete experiences; Grade 1 pupils learn best by manipulating physical objects before understanding abstract symbols. Manipulative-based activities support assimilation and accommodation, helping learners build accurate number concepts appropriate to their developmental stage.

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Bruner complemented this by highlighting the role of instruction through the spiral curriculum, modes of representation (enactive, iconic, symbolic), and scaffolding. Learners first act on objects, then visualize, and finally use symbols, while teachers guide them gradually toward independent understanding.

Together, these theories justify manipulative-based activities as both developmentally appropriate and instructionally effective. Hands-on experiences allow pupils to construct number sense, while guided teaching ensures meaningful connections between concrete actions and abstract mathematics, leading to deeper and lasting learning.

Conceptual Framework

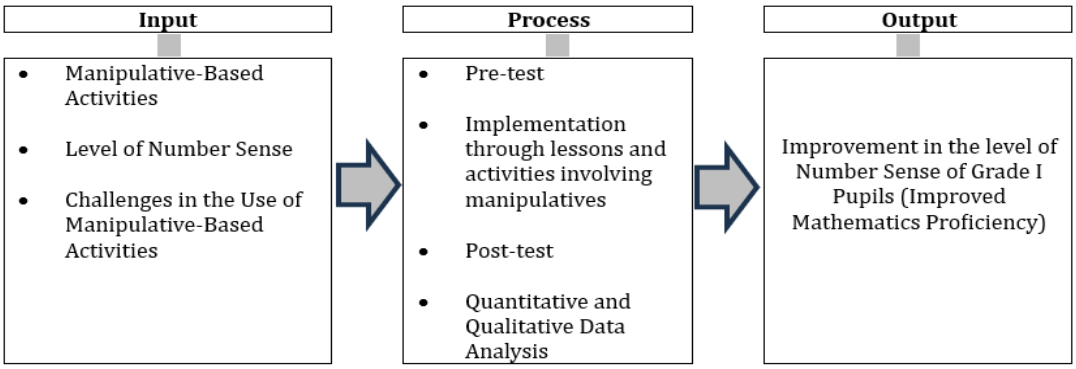

Figure 1. Conceptual Paradigm of the Study

This study was characterized by concepts as shown in Figure 1. The constructs included in the framework were provided by the study's input, process, and output, discussed thoroughly in the succeeding section.

Manipulative-based activities refer to instructional practices that use physical objects such as counters, blocks, number cards, beads, and other hands-on tools to teach mathematical concepts. These concrete tools enable learners, especially young children, to visualize, explore, and internalize abstract mathematical ideas by engaging their senses and motor skills. The process of the study referred to how manipulative-based activities were integrated into the teaching and learning process. Effective implementation involved designing lessons and activities that encouraged active exploration, problem-solving, and guided discovery. The expected output of this study was the improvement in the level of number sense of the respondents.

Statement of the Problem

Early mathematical proficiency largely depends on the development of number sense; however, many young learners continue to demonstrate weak foundational numeracy skills. National and regional assessments indicate low mathematics performance among Filipino learners, suggesting that basic concepts such as counting, comparing quantities, and understanding numerical relationships are not sufficiently mastered in the early grades. Despite the Department of Education's advocacy for activity-based and manipulative-supported instruction, classroom practice in many public schools still relies heavily on rote and symbolic teaching approaches. Limited materials, insufficient teacher training, and contextual classroom constraints hinder the consistent integration of manipulatives in mathematics instruction. As a result, learners may fail to develop conceptual understanding, which can negatively affect their later academic achievement and overall mathematical proficiency.

Given these concerns, it became necessary to examine instructional approaches that could strengthen foundational numeracy skills in the early grades. Manipulative-based activities have been widely recognized as effective strategies for helping young learners connect concrete experiences with abstract mathematical concepts. However, evidence on how such strategies influence the number sense development of learners in specific local classroom contexts remains limited. In response to this need, the present study investigated the effect of manipulative-based activities on the number sense development of Grade 1 learners.

This study sought to answer the following questions:

1. What is the level of number sense of Grade 1 learners before the implementation of manipulative-based activities?
2. What is the level of number sense of Grade 1 learners after the implementation of manipulative-based activities?

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

3. Is there a significant difference in the number sense development of learners before and after the implementation of manipulative-based activities?
4. What challenges and successes are encountered by the teacher and learners in implementing manipulative-based activities?

Hypothesis of the Study

The study tested the following null hypothesis at the 0.05 level of significance:
H_0: There is no significant difference in the number sense development of Grade 1 learners before and after the implementation of manipulative-based activities.

Review of Related Literature and Studies

Recent literature emphasizes the effectiveness of manipulative-based activities in strengthening early mathematics learning. Manipulative-based activities enable learners to connect concrete experiences with abstract mathematical representations, thereby improving conceptual understanding and problem-solving skills. Research indicates that when learners physically manipulate objects while discussing numerical relationships, they develop deeper mathematical reasoning and stronger retention of concepts (Uttal et al., 2021). Similarly, classroom-based studies demonstrate that structured manipulative activities significantly enhance numeracy skills, including counting, pattern recognition, and basic operations among early grade learners (Carbonneau et al., 2013).

Studies also highlight that the effectiveness of manipulative-based activities depends largely on instructional strategies. Teachers must provide scaffolding and explicitly link concrete materials with symbolic representations to maximize learning outcomes (Fyfe et al., 2022). When guided appropriately, manipulative-based activities promote active engagement, improve mathematical communication, and support the transition from concrete to abstract thinking.

In the Philippine context, activity-based mathematics instruction continues to be promoted in early grade education. Local classroom interventions report that the use of culturally relevant manipulative-based activities—such as counters, number cards, and everyday objects—improves learners' engagement and comprehension of mathematical concepts (Tagalog & Oco, 2025). These approaches align with the DepEd's emphasis on contextualized and learner-centered pedagogy.

Recent literature also underscores the importance of number sense as a strong predictor of later mathematics achievement. Number sense includes understanding numerical magnitude, relationships between numbers, estimation, and flexible strategies for solving problems. Empirical studies show that early number sense significantly predicts learners' later mathematical performance and can help identify learners at risk for mathematics difficulties (Lin et al., 2022; Zhang et al., 2025). Longitudinal research further confirms that early competencies such as counting accuracy, cardinality, and magnitude comparison strongly influence later mathematical achievement (Cahoon et al., 2025).

Synthesis. Current research consistently shows that manipulative-based activities strengthen number sense and improves early numeracy outcomes. When supported by explicit instruction and contextualized materials, hands-on learning enhances engagement, conceptual understanding, and mathematical confidence. Strengthening number sense in the early grades is therefore essential for building a solid foundation for future mathematics learning.

Methodology

Research Design

The study employed a mixed-methods sequential explanatory design, in which quantitative data were collected and analyzed first, followed by qualitative data collection to further explain and support the quantitative results. This design was considered appropriate because the study sought to measure changes in learners' number sense development quantitatively while also examining classroom experiences and learning processes qualitatively.

In the quantitative phase, a quasi-experimental pretest–posttest design was utilized to determine whether manipulative-based activities significantly improved the number sense development of Grade 1 learners. The same group of participants completed a pretest before the intervention and a posttest after the intervention.

In the qualitative phase, classroom observations were conducted to document learners' engagement, participation, challenges, and learning behaviors during the implementation of manipulative-based activities. The qualitative findings helped explain how and why the intervention influenced learning outcomes.

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

The integration of quantitative and qualitative findings provided a more comprehensive understanding of the effectiveness and practical implementation of manipulative-based activities in early mathematics learning.

Population and Sampling

The participants of the study consisted of 18 Grade 1 learners enrolled at Tucanon Elementary School in Aritao, Nueva Vizcaya during the School Year 2025–2026. The respondents were selected using purposive sampling, as the class was accessible to the researcher and appropriate for implementing the manipulative-based activities.

To ensure representation, stratified sampling based on sex was also considered, resulting in 10 male learners (55.56%) and 8 female learners (44.44%). The selected class served as the experimental group that participated in the manipulative-based mathematics activities.

The sample size was considered appropriate because the study focused on classroom-based activities intended to examine the effectiveness of manipulative-based instruction within a specific instructional context.

Instruments

Two instruments were used in the study. The first instrument was a Number Sense Test, which served as both the pretest and posttest for the quantitative phase of the study. The test measured learners' competencies in number recognition, counting, comparison of quantities, pattern identification, and basic operations. The instrument consisted of objective items aligned with the Grade 1 Mathematics Curriculum Guide of DepEd.

The test was researcher-developed and subjected to expert validation to ensure content validity. The validators included three experts in mathematics education and elementary education who reviewed the test items for clarity, relevance, and alignment with curriculum competencies. Based on their recommendations, necessary revisions were made before the instrument was administered.

A pilot test was conducted among learners with similar characteristics to determine the reliability of the instrument. The reliability analysis yielded a Kuder–Richardson Formula 20 (KR-20) coefficient of 0.845, indicating good internal consistency.

The second instrument was an Observation Journal, which was used during classroom sessions to document learners' engagement, participation, cooperation, and use of manipulative-based activities. The journal served as a qualitative tool for recording classroom interactions and learning behaviors during the implementation of manipulative-based activities.

Data Collection

Data collection was conducted at Tucanon Elementary School in Aritao, Nueva Vizcaya, during the academic year 2025–2026.

Before the intervention, the Number Sense Test was administered as a pretest to determine the learners' baseline level of number sense. After the pretest administration, manipulative-based mathematics activities were implemented during regular mathematics lessons for approximately eight to ten weeks.

The intervention included activities using counters, blocks, number cards, base-ten blocks, number lines, and pattern materials designed to help pupils understand numerical relationships and basic operations.

After the intervention period, a similar Number Sense Test was administered as a posttest to measure improvements in learners' number sense.

During the intervention, classroom observations were conducted and recorded using the Observation Journal to document pupils' engagement, participation, and learning experiences while using manipulative-based materials.

Treatment of Data

Quantitative data obtained from the pretest and posttest were analyzed using descriptive and inferential statistics. The mean and standard deviation were computed to describe learners' level of number sense before and after the intervention.

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

To determine whether a significant difference existed between the pretest and posttest scores, a paired sample t-test was conducted at the 0.05 level of significance.

The interpretation of pupils' scores was based on the following scale:
Range | Level
17–20 | Excellent
13–16 | Very Satisfactory
9–12 | Satisfactory
5–8 | Fair
0–4 | Poor

Qualitative data obtained from classroom observations were analyzed using thematic analysis. The observation notes were reviewed, coded, and grouped into themes related to learners' engagement, participation, learning behaviors, and challenges encountered during the implementation of manipulative-based activities.

The qualitative findings were used to support and explain the quantitative results, providing a more comprehensive interpretation of the effectiveness of the instructional intervention.

Ethical Considerations

The study adhered to ethical standards in conducting educational research involving minors. Permission to conduct the study was obtained from the school administration and relevant educational authorities prior to data collection.

Informed consent was secured from the parents or guardians of the learners, while verbal assent was obtained from them before their participation in the study. Participation was voluntary, and learners were informed that they could withdraw from the study at any time without consequences.

The identities of the participants were kept confidential by using codes instead of names in all research records. All data collected was used solely for academic and research purposes.

The activities conducted during the intervention were developmentally appropriate and posed no harm to the participants. These measures ensured the protection of participants' rights and the ethical integrity of the research process.

Results and Discussion

This study examined the effect of manipulative-based activities on the number sense development of Grade 1 learners by analyzing pretest and posttest results, statistical comparisons, and classroom observations. The discussion integrated quantitative findings with qualitative insights and relevant literature to explain how and why the intervention influenced learning outcomes.

Pretest Results (Initial Level of Number Sense)

Before the intervention, the Grade 1 learners already demonstrated relatively strong number sense skills. The majority of learners (66.67%) achieved an excellent rating, while others fell under very satisfactory, satisfactory, and fair categories.

Score	Frequency	Percentage (%)	Qualitative Description
17-20	12	66.67	Excellent
13-16	1	5.56	Very Satisfactory
9-12	4	22.22	Satisfactory
5-8	1	5.56	Fair
0-4	0	0.00	Poor
Total	**18**	**100.00**	
Mean		**16.33**	**Very Satisfactory**
Standard Deviation		**4.765**	

Table 1. Frequency and Percentage Distribution of Respondents in Terms of Their Performance in the Pretest

The overall mean score of 16.33 (very satisfactory), with SD=4.765, indicated that learners had solid foundational skills in counting, number recognition, comparison, and simple operations. The absence of learners in the poor category suggested

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

that most of them were generally ready for enhancement-focused instruction rather than remediation. However, the presence of some learners in lower performance levels highlighted the need for differentiated instruction to address varying levels of readiness within the class.

These findings are consistent with recent research showing that children enter formal schooling with differing levels of number sense due to variations in early numeracy experiences at home and in preschool environments. Exposure to informal number-related activities such as counting games and everyday quantitative interactions contributes significantly to early numeracy development. Studies also indicate that early number sense skills—such as counting accuracy, magnitude comparison, and understanding number relationships—are strong predictors of later mathematics achievement (Soto-Calvo et al., 2021; Lin et al., 2022; Cahoon et al., 2025).

Furthermore, contemporary research suggests that differences in early learning opportunities naturally lead to varied numeracy abilities among learners within the same class. These findings emphasize the importance of early assessment and the use of differentiated activity-based instructional strategies to strengthen learners' number sense and support continued mathematical development.

Posttest Results (Level of Number Sense After Intervention)

After the implementation of manipulative-based activities, learners' number sense development improved markedly. Almost all learners (94.44%) reached the excellent level, and the mean score increased to 18.94, with SD=1.955, reflecting higher accuracy and consistency. Lower performance categories were virtually eliminated, indicating that the intervention benefited learners across ability levels.

Score	Frequency	Percentage (%)	Qualitative Description
17-20	17	94.44	Excellent
13-16	0	0.00	Very Satisfactory
9-12	1	5.56	Satisfactory
5-8	0	0.00	Fair
0-4	0	0.00	Poor
Total	**18**	**100.00**	
Mean		**18.94**	**Excellent**
Standard Deviation		**1.955**	

Table 2. Frequency and Percentage Distribution of Respondents in Terms of Their Performance in the Posttest

The results suggested that hands-on, concrete activities helped learners internalize abstract numerical concepts such as place value, number relationships, and basic operations. Recent research confirmed that manipulative-based activities enhance early mathematics learning by allowing learners to explore mathematical ideas through concrete representations before transitioning to symbolic forms. Studies indicate that when teachers provide structured guidance while using manipulative-based activities, learners demonstrate improved conceptual understanding and stronger problem-solving abilities (Fyfe et al., 2022).

Empirical findings also showed that manipulative-based activities increase engagement and support the development of deeper mathematical reasoning among young learners (Carbonneau et al., 2013). Classroom research further reported that learners exposed to systematic manipulative-based activities perform significantly better in numeracy assessments compared with those taught using purely abstract instruction (Tagalog & Oco, 2025). These results reinforced the importance of integrating hands-on learning materials in early mathematics instruction to strengthen number sense and improve learners' confidence and accuracy in performing numerical tasks.

Difference Between Pretest and Posttest Scores

Statistical analysis using a paired sample t-test revealed a significant difference between pretest and posttest scores, with $t(17) = -3.01$, $p = .008$. The mean gain of 2.61 points confirmed that the observed improvement was not due to chance, leading to the rejection of the null hypothesis. This result demonstrated that manipulative-based activities had a meaningful and positive effect on pupils' number sense development. The findings reinforced constructivist perspectives and prior research showing that developmentally appropriate, hands-on strategies enhance mathematical learning, especially when supported by scaffolding and teacher guidance.

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Test	Mean	Difference	t-value	p-value	Interpretation
Pretest	16.33	2.61	-3.01	0.008	Significant
Posttest	18.94				

Table 3. Analysis of the Difference between the Pretest and Posttest Scores of the Respondents

Recent studies support the effectiveness of manipulative-based activities in early mathematics learning. Research indicates that when manipulative-based activities are used together with teacher guidance and scaffolding, learners are better able to connect concrete representations with abstract mathematical concepts, resulting in improved conceptual understanding and problem-solving skills (Fyfe et al., 2022). Meta-analytic evidence also shows that structured use of manipulative-based activities significantly improves mathematical performance and conceptual learning among elementary learners (Carbonneau et al., 2013).

Recent classroom-based research further demonstrates that learners exposed to systematic manipulative-based activities show greater gains in numeracy skills compared with those taught through purely symbolic or traditional instruction (Tagalog & Oco, 2025). These findings reinforce the importance of integrating hands-on, guided learning strategies to strengthen learners' number sense and support meaningful mathematical learning.

Successes in Implementation

To complement the quantitative findings, classroom observations were analyzed to understand how learners responded to manipulative-based activities during the intervention.

Classroom observations revealed notable successes during the intervention. Learners showed heightened engagement, motivation, and enthusiasm when working with manipulative-based activities such as counters, blocks, number cards, and number lines. Learning became more interactive and student-centered, encouraging collaboration, discussion, and peer support. These activities fostered confidence, persistence, and positive attitudes toward mathematics. Pupils also demonstrated clear improvements in number sense skills, including counting, sequencing, comparison, and basic operations. The hands-on experiences helped bridge the gap between concrete and abstract thinking, promoting deeper understanding and long-term retention.

Studies further explain that hands-on materials help learners visualize mathematical relationships and support the transition from concrete experiences to abstract reasoning when accompanied by teacher guidance and scaffolding (Fyfe et al., 2022). As observed in the present study, learners demonstrated improvements in number sense skills such as counting, sequencing, comparison, and basic operations. These findings also align with Philippine-based research showing that activity-based and manipulative-supported instruction improves engagement and strengthens early numeracy skills among Filipino learners (Tagalog & Oco, 2025).

Similarly, recent local classroom studies report that contextualized manipulative-based activities help pupils better understand number relationships and develop positive attitudes toward mathematics (Dela Rosa & Angeles, 2022). These hands-on learning experiences, therefore, help bridge the gap between concrete and abstract thinking, resulting in deeper conceptual understanding and improved retention of mathematical concepts.

Challenges Encountered

Despite its effectiveness, the implementation of manipulative-based activities presented challenges. Time management was a primary concern, as hands-on activities required more instructional time than traditional methods. Limited resources also required careful planning, material sharing, and group rotations. Additionally, some learners initially experienced confusion and frustration, particularly when transitioning from concrete manipulation to abstract representations. These challenges underscore the importance of scaffolding, clear instructions, and the gradual progression of task complexity. Over time, consistent exposure and teacher support helped pupils overcome these difficulties and gain confidence.

The results demonstrated that manipulative-based activities significantly enhanced the number sense development of Grade 1 learners. While initial challenges existed, the successes—improved performance, engagement, confidence, and conceptual understanding—far outweighed the difficulties. The findings strongly support the integration of well-structured, guided manipulative-based activities in early grade mathematics to foster strong foundational numeracy skills. Some learners initially experienced confusion and frustration when transitioning from concrete manipulation to abstract representations. Scholars explain that this transition can be challenging for young learners unless teachers provide

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

scaffolding and gradually reduce reliance on physical materials (Fyfe et al., 2022). Over time, consistent exposure and guided practice help learners develop stronger conceptual understanding and confidence in mathematical reasoning.

Philippine studies report similar implementation issues but confirm the overall effectiveness of manipulative-based activities. Classroom research in local elementary schools found that while teachers faced constraints in time and resources, the use of contextualized manipulatives significantly improved learners' engagement, confidence, and numeracy performance (Dela Rosa & Angeles, 2022; Tagalog & Oco, 2025). Hence, the findings support integrating well-structured manipulative-based activities to strengthen foundational numeracy skills in early grade learners.

Conclusion and Recommendations

The study investigated the impact of manipulative-based activities on Grade 1 learners' number sense. Using a mixed-methods sequential explanatory design, 18 learners from Tucanon Elementary School participated in an 8–10-week intervention. Quantitative data from validated number sense tests were analyzed through descriptive statistics and paired t-tests, while classroom observations were examined using thematic analysis.

Findings showed learners initially had generally very satisfactory skills, though some needed support. After the intervention, most achieved excellent performance, with a statistically significant increase in mean scores. Hands-on activities improved understanding, accuracy, and problem-solving. Increased engagement and motivation were observed, though time management and initial confusion posed challenges. Overall, manipulative-based activities effectively strengthened conceptual understanding and early numeracy development.

Teachers may begin with diagnostic assessments to identify learners needing support and apply differentiated strategies. Manipulative-based activities may be regularly integrated into Grade 1 mathematics, aligned with curriculum goals, scaffolded, and supported through guided practice and exploration. Professional development on the use of effective manipulative-based activities is encouraged to improve instruction. Teachers may plan lessons carefully, provide adequate materials, allow time for hands-on learning, and use collaborative approaches to ease challenges and promote the shift from concrete to abstract thinking. Future research may examine long-term effects across grade levels, compare types of manipulative-based activities and teaching approaches, explore technology integration, support struggling learners, and assess teacher readiness and scalability in varied contexts.

Acknowledgement

The authors would like to thank the colleagues and institutions who provided guidance, feedback, and support throughout the conduct of this research and the preparation of this manuscript. Any remaining errors or omissions are the sole responsibility of the authors.

Funding

This research received no external funding from any public, commercial, or not-for-profit funding agency, and no organization provided financial support for the conduct of the study, authorship, or publication of this article.

Competing Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study; all data used were obtained from previously published sources as cited in the reference list.

References

Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press.

Cahoon, A., Simsek, E., Gilmore, C., & Simms, V. (2025). The cognitive and numerical predictors of early mathematical achievement: A latent growth curve analysis. *Journal of Cognition and Development, 26*(3), 443–463. https://doi.org/10.1080/15248372.2024.2434036

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Carbonneau, K. J., Marley, S. C., & Selig, J. P. (2013). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. *Journal of Educational Psychology, 105*(2), 380–400. https://doi.org/10.1037/a0031084

Dela Rosa, M. L., & Angeles, R. P. (2022). Activity-based mathematics instruction and numeracy development among Filipino primary learners. *Asia Pacific Journal of Multidisciplinary Research, 10*(3), 45–53. https://www.apjmr.com

Department of Education. (2016). *Mathematics curriculum guide – Grade 1*. https://www.deped.gov.ph/wp-content/uploads/MATATAG-Mathematics-CG-Grades1-4-and-7.pdf

Fyfe, E. R., McNeil, N. M., Son, J. Y., & Goldstone, R. L. (2022). Concreteness fading in mathematics and science instruction: A systematic review. *Educational Psychology Review, 26*(1), 9–25. https://doi.org/10.1007/s10648-014-9249-3

Lin, Y., Zhang, H., & Li, X. (2022). Number sense as a mediator between nonverbal intelligence and children's mathematical performance. *Psicologia: Reflexão e Crítica, 35*, Article 27. https://doi.org/10.1186/s41155-022-00231-1

Piaget, J. (1952). *The origins of intelligence in children*. International Universities Press.

Soto-Calvo, E., Simmons, F. R., & Adams, A.-M. (2021). Identifying the preschool home learning experiences that predict early number skills: Evidence from a longitudinal study. *Early Childhood Research Quarterly, 60*, 120–131. https://doi.org/10.1016/j.ecresq.2021.03.002

Tagalog, C. E., & Oco, R. M. (2025). Learning manipulatives and pupils' mathematical skills. *International Journal of Multidisciplinary Research and Analysis, 8*(5). https://www.ijmra.in/v8i5/8.php

Uttal, D. H., Scudder, K. V., & DeLoache, J. S. (2021). Manipulatives as symbols: A new perspective on the use of concrete objects to teach mathematics. *Journal of Applied Developmental Psychology*. https://doi.org/10.1016/j.appdev.2020.101164

Zhang, L., Wang, Y., & Chen, H. (2025). Stability of early number sense competencies for predicting mathematics difficulties. *Learning and Individual Differences, 118*, 102633. https://doi.org/10.1016/j.lindif.2025.102633

Appendices

No appendices are attached to this study.

© 2026 The International Review of Multidisciplinary Research. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.