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Manipulative-Based Mathematics Instruction and Number Sense Development Among Grade 3 Pupils

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ABSTRACT

This study explored how manipulative-based mathematics instruction shaped the number sense development of Grade 3 pupils at Dalena Elementary School in San Pablo, Isabela. Using a quantitative instructional association design, it determined the contribution of concrete material use, guided exploration, learner participation, and connection to mathematical symbols to pupils' place value understanding, number comparison, operation sense, estimation, and flexible problem solving. Data were gathered through a validated researcher-made instrument with a Cronbach's alpha coefficient of 0.91. Weighted mean, standard deviation, and Partial Least Squares Path Modeling were employed to analyze the data. Findings showed that manipulative-based mathematics instruction was generally high, with concrete material use emerging as the most evident classroom practice. Number sense development was likewise high, particularly in place value understanding and number comparison. However, estimation and flexible problem solving appeared as the weakest area, indicating that pupils still experienced difficulty in judging the reasonableness of answers and using varied solution strategies. Path modeling revealed that all dimensions of manipulative-based instruction significantly influenced number sense development, with connection to mathematical symbols identified as the strongest predictor. The study concluded that manipulatives became more effective when teachers intentionally linked concrete experiences to symbolic reasoning. It recommended strengthening guided questioning, pupil explanation, and problem-based manipulative activities to support deeper and more flexible mathematical understanding among Grade 3 learners.

Keywords: *manipulative-based instruction, mathematics learning, number sense, Grade 3 pupils, concrete materials, symbolic reasoning*

INTRODUCTION

Mathematics learning in the early grades serves as a foundation for later academic success because it develops children's ability to recognize patterns, compare quantities, reason with numbers, and solve everyday problems. In Grade 3, learners are expected to move beyond simple counting and begin demonstrating deeper number sense through understanding place value, composing and decomposing numbers, estimating, comparing, and applying operations meaningfully. The MATATAG Mathematics Curriculum emphasizes the importance of strong mathematical knowledge, conceptual understanding, and logically connected lessons so that learners can think flexibly and solve problems with confidence (Department of Education [DepEd], 2023). In the context of Dalena Elementary School in San Pablo, Isabela, strengthening number sense among Grade 3 pupils is therefore an important concern because

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learners at this stage need concrete and meaningful experiences before they can fully understand abstract mathematical ideas.

Number sense refers to a learner's flexible understanding of numbers, relationships, operations, and quantities. It is not limited to memorizing procedures or arriving at correct answers, but includes the ability to explain why a solution makes sense. Early number sense is strongly connected to later mathematics achievement because it supports mental computation, problem solving, estimation, and reasoning (National Council of Teachers of Mathematics [NCTM], 2020). However, many young learners experience difficulty in mathematics when instruction immediately focuses on symbols, rules, and written procedures without allowing them to first explore mathematical concepts through concrete experiences. This concern is especially relevant in elementary classrooms where pupils differ in readiness, attention span, language ability, and prior exposure to numeracy activities at home.

Manipulative-based mathematics instruction offers a practical response to this concern. Manipulatives are physical objects that learners can touch, move, group, count, compare, and arrange to represent mathematical ideas. These may include counters, sticks, base-ten blocks, number cards, beads, bottle caps, fraction pieces, or locally available materials. The Education Endowment Foundation explained that manipulatives help pupils connect concrete experiences with visual representations and abstract symbols, especially when teachers guide learners in discussing the mathematical meaning behind the objects (Education Endowment Foundation [EEF], 2017). Similarly, Clark et al. (2020) emphasized that manipulatives and representations should not be treated as mere classroom decorations or play materials, but as tools for reasoning, communication, and conceptual understanding.

Research has shown that manipulative use can improve pupils' mathematical performance when it is purposefully aligned with learning objectives. Larbi and Mavis (2016) found that the use of manipulatives in mathematics instruction supported better understanding of mathematical concepts because learners were able to see and handle representations of ideas that were otherwise abstract. More recent studies also suggest that hands-on materials help young learners participate more actively in mathematics lessons, especially when activities require them to explain, compare, model, and justify their thinking (Bognar et al., 2025). In Grade 3 classrooms, this may be seen when pupils use counters to understand multiplication as repeated addition, base-ten blocks to represent hundreds, tens, and ones, or number lines to compare and sequence numbers.

The need to improve foundational numeracy remains significant in the Philippine basic education setting. The country's PISA 2022 results showed that Filipino learners continued to perform below the OECD average in mathematics, which points to the need for stronger early-grade mathematical foundations (Organisation for Economic Co-operation and Development [OECD], 2023). Although PISA assesses 15-year-old learners, its results reflect the long-term effects of earlier learning experiences. This makes early interventions in number sense development highly important. DepEd's Basic Education Development Plan 2030 also recognizes the need to improve learning quality and strengthen foundational competencies among Filipino learners (DepEd, 2022). For schools such as Dalena Elementary School, this national concern may be addressed through classroom-level strategies that make mathematics more understandable, meaningful, and accessible to young pupils.

The study focused on a practical instructional approach that can be implemented even in resource-limited classrooms through teacher creativity and the use of available materials. By looking into manipulative-based instruction and number sense development, the study may provide useful insights for improving mathematics teaching practices, supporting pupils who struggle with abstract concepts, and strengthening early numeracy instruction in the school.

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Literature Review

Manipulative-Based Mathematics Instruction

Manipulative-based mathematics instruction refers to the use of concrete objects that pupils can touch, move, arrange, count, group, compare, and use to represent mathematical ideas. In elementary mathematics, manipulatives may include counters, base-ten blocks, number cards, sticks, beads, bottle caps, cubes, and other locally available materials. The Education Endowment Foundation explained that manipulatives help pupils connect mathematical ideas to visible and movable objects, especially when teachers guide learners in explaining what the materials represent (Education Endowment Foundation [EEF], 2017). This means that manipulatives are not simply used for play or decoration. They become meaningful when they support reasoning, discussion, and understanding.

Clark et al. (2020) emphasized that manipulatives and representations are most effective when they are used intentionally to develop mathematical language and conceptual understanding. athematical ideas, such as place value, regrouping, multiplication, division, and comparison of numbers, may remain abstract when taught only through symbols. Through manipulative-based instruction, pupils are given opportunities to see how numbers work before they are expected to solve written exercises independently.

Concrete, Representational, and Abstract Learning

Manipulative-based instruction is closely related to the concrete, representational, and abstract approach in mathematics learning. In this approach, pupils first handle actual objects, then move to drawings or visual models, and finally work with numbers and symbols. This progression helps children understand that mathematical symbols represent real quantities and relationships. EEF (2017) noted that teachers should not remove manipulatives based only on the age of pupils. Instead, the decision should depend on whether pupils already understand the concept well enough to work without the concrete support.

Pupils are still developing their ability to move from concrete experiences to abstract thinking. When a pupil uses base-ten blocks to show 243 as 2 hundreds, 4 tens, and 3 ones, the child begins to understand place value not merely as digits written on paper, but as a quantity that can be built, broken apart, and compared. This kind of learning supports deeper number sense.

Number Sense Development

Number sense refers to a child's flexible understanding of numbers, quantities, operations, relationships, and reasonableness of answers. It includes the ability to count meaningfully, compare numbers, estimate, recognize patterns, decompose and compose numbers, and explain numerical thinking. The National Council of Teachers of Mathematics stated that early mathematics education should promote reasoning, sense-making, problem solving, and meaningful engagement with numbers rather than simple memorization of procedures (National Council of Teachers of Mathematics [NCTM], 2020).

Number sense development serves as a bridge between basic counting skills and more complex mathematical operations. Learners who have strong number sense are more likely to understand why a solution works, detect unreasonable answers, and use more than one strategy in solving problems. In contrast, pupils with weak number sense may depend heavily on memorized steps without understanding the meaning of the operation. This can later affect their performance in multiplication, division, fractions, measurement, and problem solving.

Manipulatives and Conceptual Understanding in Mathematics

Studies have shown that manipulatives can help improve pupils' conceptual understanding in mathematics when they are properly integrated into instruction. Larbi and Mavis (2016) found that the use of manipulatives supported learners' understanding of mathematical concepts because pupils were able to interact physically with representations of abstract ideas. Similarly, Bungao-Abarquez (2020) reported that manipulative use in Grade 3 mathematics instruction improved learner performance compared with

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conventional methods, showing that concrete learning materials can support better mathematical understanding among young pupils.

However, the effectiveness of manipulatives depends on how teachers use them. EEF (2017) stressed that teachers must help pupils make connections between the objects, the diagrams, the mathematical language, and the numerical symbols. Without teacher guidance, pupils may focus only on the materials and fail to understand the concept behind the activity. Therefore, manipulative-based instruction should be planned carefully, with clear objectives, guided questioning, pupil explanation, and gradual movement toward independent problem solving.

Teacher Facilitation in Manipulative-Based Instruction

The role of the teacher is central in manipulative-based mathematics instruction. Teachers do not simply distribute materials and allow pupils to explore without direction. Instead, they guide learners in observing, comparing, explaining, and connecting their actions to mathematical concepts. Clark et al. (2020) highlighted that teachers should encourage discussion when using manipulatives so that pupils can describe what they notice, explain their reasoning, and connect concrete materials to mathematical representations.

In Grade 3 classrooms, teacher facilitation may include asking questions such as “How many tens did you make?”, “What happens if we exchange ten ones for one ten?”, “Why is this number greater?”, or “Can you show the same number in another way?” These questions encourage pupils to think beyond the activity itself. They also help learners develop mathematical vocabulary and confidence in explaining their ideas.

Manipulatives, Engagement, and Learner Participation

Manipulatives can also increase learner engagement because they make mathematics more active and visible. Young pupils often learn better when they are allowed to handle objects, test ideas, and work with classmates. Hands-on tasks can reduce fear of mathematics because pupils are not immediately pressured to produce written answers. Instead, they can first explore and reason through concrete materials. Abrahan (2025) found that the use of square tiles and counters helped improve Grade 3 learners’ multiplication skills, suggesting that manipulative-based activities can support both participation and performance. This is especially relevant to number sense development because number sense grows through repeated experiences with quantities and operations. When pupils are actively involved in forming groups, comparing sets, building numbers, and explaining strategies, they begin to see numbers as meaningful and flexible. Such experiences may be more effective than relying only on board work, drills, and textbook exercises.

Foundational Numeracy and the Philippine Context

The need to strengthen numeracy instruction is highly relevant in the Philippine education system. The OECD reported that only 16 percent of Filipino students reached at least Level 2 proficiency in mathematics in PISA 2022, which was far below the OECD average of 69 percent (Organisation for Economic Co-operation and Development [OECD], 2023). Although PISA assessed 15-year-old learners, the results suggest the importance of improving mathematical foundations in the earlier grades.

DepEd’s Basic Education Development Plan 2030 also recognized the need to improve learning quality and strengthen foundational competencies among Filipino learners (Department of Education [DepEd], 2022). In addition, the MATATAG Mathematics Curriculum emphasizes the development of mathematical understanding, problem solving, reasoning, and fluency in the early grades (DepEd, 2023). These national directions support the importance of investigating classroom strategies, such as manipulative-based mathematics instruction, that may help improve number sense development among Grade 3 pupils.

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METHODS

Research Design

The study used a quantitative instructional association design. This design was selected because the study examined how manipulative-based mathematics instruction was associated with the development of number sense among Grade 3 pupils. Unlike a purely descriptive design, this approach focused not only on describing classroom practices and learner outcomes, but also on determining how specific instructional features, such as concrete material use, guided exploration, learner manipulation, and concept connection, contributed to pupils' number sense development.

Research Locale

The study was conducted at Dalena Elementary School in San Pablo, Isabela. The school was considered an appropriate setting because it catered to elementary learners whose mathematical foundations were still developing. The Grade 3 level was specifically chosen because pupils at this stage were expected to strengthen their understanding of place value, operations, comparison of numbers, estimation, and basic problem-solving skills.

Participants and Sampling Technique

The participants of the study were Grade 3 pupils of Dalena Elementary School. The study used purposive cluster sampling, where intact Grade 3 classes were included based on their direct exposure to mathematics instruction involving concrete learning materials. This sampling technique was appropriate because the study focused on learners who had actual classroom experience with manipulative-based mathematics activities.

Research Instrument

The study used a researcher-made survey-checklist and a number sense assessment tool. The first part measured the extent of manipulative-based mathematics instruction in terms of concrete material use, guided exploration, learner participation, and connection of manipulatives to mathematical symbols. The second part assessed number sense development in terms of place value understanding, number comparison, operation sense, estimation, and flexible problem solving.

The instrument was validated by a panel of experts composed of mathematics teachers, a school head, and a research specialist. Their comments were used to refine the wording, alignment, clarity, and grade-level appropriateness of the items. A pilot test was also conducted among learners who were not part of the actual study. The reliability test produced a Cronbach's alpha coefficient of 0.91, which indicated that the instrument had excellent internal consistency.

Data Gathering

Permission to conduct the study was first secured from the proper school authority. After approval was granted, the researcher coordinated with the Grade 3 teacher regarding the schedule of data collection. The purpose of the study was explained in child-friendly language, and the pupils were guided properly during the administration of the instruments. The researcher ensured that the directions were clear and that the pupils answered independently. After completion, the responses were checked, encoded, and organized for statistical treatment.

Data Analysis

The study used Partial Least Squares Path Modeling as the main statistical treatment. This was chosen because it allowed the researcher to examine how the different dimensions of manipulative-based mathematics instruction contributed to number sense development. Weighted mean and standard deviation

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were used to describe the level of manipulative-based instruction and the level of number sense development. Path coefficients, effect size, and predictive relevance values were used to identify which instructional dimensions had the strongest influence on pupils' number sense. This treatment was considered appropriate because the study examined both the strength and practical contribution of instructional practices to learner development.

Ethical Consideration

The study observed ethical standards throughout the research process. Approval was obtained from the concerned school authority before data collection. Since the participants were young learners, parental consent and teacher assistance were secured. Participation was voluntary, and the pupils were assured that their answers would not affect their grades. The identities of the participants were kept confidential, and all gathered data were used only for academic research purposes. The researcher also ensured that the assessment activities were age-appropriate, non-threatening, and respectful of the learners' comfort and dignity.

RESULTS AND DISCUSSION

Table 1. Level of Manipulative-Based Mathematics Instruction in Terms of Concrete Material Use

Indicators	Mean	SD	Qualitative Description
The teacher used concrete objects such as counters, sticks, blocks, or locally available materials during Mathematics lessons.	4.18	0.61	High
The materials helped pupils see the meaning of numbers and quantities.	4.11	0.64	High
The teacher used manipulatives when introducing new number concepts.	4.04	0.68	High
Pupils were allowed to touch, move, group, and arrange the materials during activities.	4.22	0.59	Very High
The materials were appropriate to the lesson and the pupils' grade level.	4.09	0.66	High
Overall Mean	4.13	0.64	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

The result shows that concrete material use was generally high. This means that Grade 3 pupils were regularly exposed to physical objects that helped them understand number concepts in a visible and hands-on manner. The highest mean was obtained by allowing pupils to touch, move, group, and arrange materials, which indicates that instruction was not limited to teacher demonstration. However, the use of manipulatives when introducing new number concepts obtained a slightly lower mean, suggesting that concrete materials may not have been consistently used at the beginning of every lesson.

Table 2. Level of Manipulative-Based Mathematics Instruction in Terms of Guided Exploration

Indicators	Mean	SD	Qualitative Description
The teacher asked questions while pupils used the manipulatives.	3.94	0.72	High
Pupils were guided in explaining what the materials represented.	3.88	0.75	High
The teacher helped pupils connect the materials to numbers and symbols.	3.91	0.70	High
Pupils were encouraged to discover patterns and relationships using the materials.	3.76	0.79	High
The teacher corrected misconceptions during manipulative activities.	3.84	0.74	High
Overall Mean	3.87	0.74	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

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Guided exploration was also rated high, but it had a lower overall mean than concrete material use. This suggests that while manipulatives were present in the classroom, the depth of teacher questioning and guided reasoning still needed strengthening. The lowest mean was noted in encouraging pupils to discover patterns and relationships, which may imply that some activities were still focused on following directions rather than allowing pupils to reason, compare, and explain mathematical ideas independently.

Table 3. Level of Manipulative-Based Mathematics Instruction in Terms of Learner Participation

Indicators	Mean	SD	Qualitative Description
Pupils actively joined hands-on Mathematics activities.	4.20	0.58	High
Pupils worked with classmates while using manipulatives.	4.05	0.67	High
Pupils were given opportunities to show their solutions using materials.	4.02	0.69	High
Pupils explained their answers after using manipulatives.	3.71	0.81	High
Pupils showed interest and confidence during manipulative-based activities.	4.16	0.62	High
Overall Mean	4.03	0.67	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

The findings indicate that pupils were active during manipulative-based Mathematics instruction. They participated in hands-on tasks and showed interest in using learning materials. However, explaining answers after using manipulatives received the lowest mean. This reveals a realistic concern in the classroom. Pupils may be willing to manipulate objects and solve tasks, but they may still struggle to verbalize their reasoning. This implies the need to strengthen mathematical communication alongside hands-on learning.

Table 4. Level of Manipulative-Based Mathematics Instruction in Terms of Connection to Mathematical Symbols

Indicators	Mean	SD	Qualitative Description
The teacher connected concrete materials to number sentences.	3.86	0.76	High
Pupils were guided in moving from objects to drawings and symbols.	3.69	0.82	High
Manipulatives were used to explain place value and operations.	3.97	0.71	High
Pupils related the materials to written computations.	3.74	0.80	High
The teacher helped pupils solve without materials after guided practice.	3.62	0.84	High
Overall Mean	3.78	0.79	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

The result shows that the connection of manipulatives to mathematical symbols was high, but it obtained the lowest overall mean among the dimensions of manipulative-based instruction. This suggests that while concrete materials were used, the transition from concrete experience to abstract mathematical representation was not always smooth. Some pupils may have understood the activity while handling the materials but became less confident when asked to solve using only numbers, symbols, or written equations.

Table 5. Summary Level of Manipulative-Based Mathematics Instruction

Dimensions	Mean	SD	Qualitative Description
Concrete Material Use	4.13	0.64	High
Guided Exploration	3.87	0.74	High
Learner Participation	4.03	0.67	High
Connection to Mathematical Symbols	3.78	0.79	High
Overall Mean	3.95	0.71	High

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Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

Overall, manipulative-based Mathematics instruction was high. This implies that Grade 3 pupils at Dalena Elementary School were exposed to meaningful hands-on learning experiences in Mathematics. The strongest area was concrete material use, while the weakest area was the connection of manipulatives to mathematical symbols. This finding shows that the problem was not the absence of materials, but the need for a stronger bridge from concrete handling to abstract mathematical thinking.

Table 6. Level of Number Sense Development in Terms of Place Value Understanding

Indicators	Mean	SD	Qualitative Description
Pupils identified the value of digits in two-digit and three-digit numbers.	3.92	0.73	High
Pupils represented numbers using hundreds, tens, and ones.	3.88	0.76	High
Pupils composed and decomposed numbers correctly.	3.74	0.81	High
Pupils compared numbers based on place value.	3.81	0.78	High
Pupils explained how place value affected the size of numbers.	3.49	0.86	Moderate
Overall Mean	3.77	0.79	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

Place value understanding was high, showing that pupils generally understood the value of digits and could represent numbers using place value models. However, explaining how place value affected the size of numbers was only moderate. This suggests that pupils could perform place value tasks but still had difficulty expressing the reasoning behind their answers.

Table 7. Level of Number Sense Development in Terms of Number Comparison

Indicators	Mean	SD	Qualitative Description
Pupils compared two numbers correctly.	3.95	0.70	High
Pupils arranged numbers from least to greatest.	3.90	0.72	High
Pupils used greater than, less than, and equal signs correctly.	3.78	0.80	High
Pupils explained why one number was greater or smaller than another.	3.46	0.88	Moderate
Pupils used number lines or objects to support comparison.	3.83	0.77	High
Overall Mean	3.78	0.77	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

The level of number comparison was high. Pupils could compare and arrange numbers with reasonable accuracy. However, the ability to explain why one number was greater or smaller was only moderate. This points to a familiar classroom issue where learners can select the correct answer but may not yet fully articulate the mathematical logic behind it.

Table 8. Level of Number Sense Development in Terms of Operation Sense

Indicators	Mean	SD	Qualitative Description
Pupils understood addition as joining quantities.	3.96	0.69	High
Pupils understood subtraction as taking away or finding the difference.	3.82	0.75	High
Pupils showed multiplication as repeated addition.	3.64	0.84	High
Pupils selected the correct operation in simple word problems.	3.42	0.89	Moderate
Pupils explained their solution process using objects or drawings.	3.38	0.91	Moderate
Overall Mean	3.64	0.82	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

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Operation sense was high, but it showed clear areas for improvement. Pupils demonstrated better understanding of addition and subtraction than multiplication and word problem solving. The moderate rating in selecting operations in word problems suggests that some pupils still struggled to connect mathematical operations to real-life situations. This means that number sense development should include more guided problem contexts, not only computational practice.

Table 9. Level of Number Sense Development in Terms of Estimation and Flexible Problem Solving

Indicators	Mean	SD	Qualitative Description
Pupils estimated quantities using familiar objects.	3.56	0.86	High
Pupils checked whether their answers were reasonable.	3.31	0.93	Moderate
Pupils used more than one strategy to solve a number task.	3.28	0.95	Moderate
Pupils solved problems using drawings, objects, or mental strategies.	3.47	0.88	Moderate
Pupils adjusted their solutions when an answer did not make sense.	3.22	0.97	Moderate
Overall Mean	3.37	0.92	Moderate

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

Estimation and flexible problem solving obtained a moderate rating, making it the weakest area of number sense development. This finding shows that pupils were less confident when tasks required judgment, strategy selection, and checking the reasonableness of answers. This is a realistic concern because estimation and flexible thinking require deeper understanding than simply following learned procedures.

Table 10. Summary Level of Number Sense Development

Dimensions	Mean	SD	Qualitative Description
Place Value Understanding	3.77	0.79	High
Number Comparison	3.78	0.77	High
Operation Sense	3.64	0.82	High
Estimation and Flexible Problem Solving	3.37	0.92	Moderate
Overall Mean	3.64	0.83	High

Scale: 4.21 to 5.00, Very High; 3.41 to 4.20, High; 2.61 to 3.40, Moderate; 1.81 to 2.60, Low; 1.00 to 1.80, Very Low.

The overall level of number sense development was high. This indicates that Grade 3 pupils had generally developed important number sense skills, particularly in place value and number comparison. However, the moderate result in estimation and flexible problem solving reveals that pupils still needed support in using numbers with flexibility, checking answers, and applying different strategies. This finding shows that while pupils had gained foundational skills, higher-level number reasoning remained an area for improvement.

Table 11. Partial Least Squares Path Modeling Results on the Influence of Manipulative-Based Mathematics Instruction on Number Sense Development

Predictor Dimensions	Path Coefficient	t-value	p-value	Effect Size	Interpretation
Concrete Material Use	0.21	2.41	0.018	0.08	Significant, Small Effect
Guided Exploration	0.29	3.36	0.001	0.13	Significant, Moderate Effect
Learner Participation	0.18	2.06	0.043	0.06	Significant, Small Effect
Connection to Mathematical Symbols	0.34	4.12	0.001	0.17	Significant, Moderate Effect
Model R^2	0.58				Moderate Predictive Strength
Q^2 Predictive Relevance	0.41				Acceptable Predictive Relevance

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The Partial Least Squares Path Modeling results show that all dimensions of manipulative-based Mathematics instruction significantly influenced number sense development. The model explained 58 percent of the variance in pupils' number sense development, which indicates moderate predictive strength. This means that manipulative-based instruction made a meaningful contribution to how pupils developed number sense.

Among the predictors, connection to mathematical symbols had the strongest influence. This implies that pupils developed stronger number sense when teachers helped them move from concrete objects to drawings, number sentences, and written computations. Guided exploration also showed a moderate effect, which means that teacher questioning, explanation, and correction of misconceptions were important in helping pupils understand the mathematical meaning of the activities. Concrete material use and learner participation were also significant, but their effects were smaller. This suggests that simply using materials and allowing pupils to participate were helpful, but deeper learning occurred when pupils were guided to reason and connect their actions to mathematical symbols.

Table 12. *Overall Interpretation of the Model*

Model Indicator	Value	Interpretation
R^2 for Number Sense Development	0.58	Manipulative-based instruction explained a moderate portion of number sense development.
Q^2 Predictive Relevance	0.41	The model had acceptable ability to predict number sense outcomes.
Strongest Predictor	Connection to Mathematical Symbols	This dimension had the greatest contribution to pupils' number sense.
Weakest Instructional Dimension	Connection to Mathematical Symbols	It had the lowest mean but strongest predictive effect.
Weakest Number Sense Dimension	Estimation and Flexible Problem Solving	Pupils needed more support in flexible and strategic thinking.

The model suggests an important finding. The weakest instructional dimension, connection to mathematical symbols, was also the strongest predictor of number sense development. This means that improving this area may produce the greatest benefit for pupils. The result implies that teachers should not stop at allowing pupils to manipulate objects. They should consistently help learners translate concrete actions into mathematical language, drawings, number sentences, and independent solutions. This is especially important for Grade 3 pupils because they are gradually moving from concrete thinking to more abstract mathematical reasoning.

The results show that manipulative-based Mathematics instruction at Dalena Elementary School was generally effective, but some concerns remained. Pupils were active and interested during hands-on activities, yet they still needed stronger support in explaining their thinking, solving word problems, estimating, checking answers, and using flexible strategies. Therefore, the best instructional direction would be to strengthen guided discussion, symbolic connection, and problem-based use of manipulatives so that pupils can develop not only correct answers but also deeper number sense.

CONCLUSION

Manipulative-based mathematics instruction was meaningfully associated with the number sense development of Grade 3 pupils at Dalena Elementary School, San Pablo, Isabela, particularly when concrete

materials were supported by guided exploration, active learner participation, and clear connection to mathematical symbols. Although pupils showed high development in place value understanding, number comparison, and operation sense, they still needed improvement in estimation, flexible problem solving, explaining solutions, and checking the reasonableness of answers. Based on these findings, it is recommended that Grade 3 mathematics teachers continue using manipulatives, but with stronger emphasis on questioning, pupil explanation, and gradual movement from concrete objects to drawings, number sentences, and independent computation. Teachers should design more problem-based activities where pupils compare strategies, justify answers, and use manipulatives to solve real-life number tasks. School heads may also support teachers by providing simple, locally available mathematics materials and encouraging collaborative lesson planning focused on number sense development. Future researchers may conduct a similar study using intervention-based or classroom observation approaches to further examine how manipulative-based instruction improves pupils' mathematical reasoning over time.

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