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EXPLORING EARLY NUMERACY DEVELOPMENT THROUGH CONCRETE MANIPULATIVE PLAY: A QUALITATIVE STUDY OF 5–6 YEAR OLD CHILDREN IN AN INDONESIAN KINDERGARTEN

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Abstract: *This study explores early numeracy development through concrete manipulative play among children aged 5–6 years in an Indonesian kindergarten. The study addresses the challenge of developing numeracy skills in early childhood, particularly when learning experiences rely heavily on abstract instruction rather than direct interaction with meaningful materials. A descriptive qualitative approach was employed at TK Pembina Bantul, involving 24 children and two teachers. Data were collected through participatory observation, semi-structured interviews, and documentation and analyzed using the interactive model of Miles, Huberman, and Saldaña. The findings indicate that concrete manipulative play supports children's understanding of fundamental numeracy concepts through hands-on engagement with familiar objects from their immediate environment. Children demonstrated one-to-one correspondence by matching vegetable replicas to written numerals, arranging wooden blocks by size and dimension, classifying buttons by color, and applying comparison symbols to represent quantitative relationships. These activities enabled children to develop conceptual understanding of quantity, classification, seriation, and numerical symbols through meaningful and enjoyable learning experiences. The study highlights three factors that facilitated numeracy development: the* *use of familiar manipulatives, a playful learning environment, and adaptive teacher scaffolding that guided children from concrete manipulation to symbolic representation. The findings suggest that concrete manipulative play provides developmentally appropriate opportunities for constructing early mathematical understanding in kindergarten settings.*

Keywords: *Early Numeracy Development, Concrete Manipulative Play, Kindergarten Children, Scaffolding, Qualitative Study*

A. Introduction

Early Childhood Education (ECE) is a critical developmental stage that lays the foundation for a child's future trajectory. This educational phase is designed to provide stimulation for children from birth to age six, ensuring that all developmental domains—including religious and moral values, physical-motor skills, cognitive abilities, socio-emotional growth, and artistic expression—are nurtured in accordance with their developmental stage. (Meriem et al., 2020). Emphasizes that ECE programs must provide intellectual, social, and emotional stimulation that is developmentally appropriate (Trianingsih, 2023)**.** At this juncture, learning effectiveness is heavily dependent on hands-on experiences and engaging activities, with teachers playing a pivotal role in creating a safe, comfortable environment that encourages exploration and active learning. (Sari et al., 2024).

Recent studies have shown that early numeracy during the preschool years is a crucial foundation for mathematical readiness in later schooling. Number sense develops early, providing a basis for children to reason, relate quantities, and comprehend numerical relationships in a meaningful way. Play is widely recognized as the most effective way to stimulate various aspects of a child's development optimally. Regarding numeracy, children achieve better learning outcomes when engaged in manipulative, concrete play activities. Using tangible objects helps children grasp concepts of quantity, sequence, and numerical symbols incrementally.

A key area of cognitive development and one requiring specific attention is a child's ability to think and solve problems (Widi Nurwijayanti, 2025). This ability forms the basis for higher-order thinking skills, including numeracy. Numeracy comprises a set of basic mathematical competencies used to solve everyday problems, encompassing number, quantity, sequencing, and patterns (Ratnasari, 2020). This study focuses on the dimension of number sense, which serves as the fundamental building block for broader mathematical understanding. Number sense includes the capacity to count, categorize, and sort objects by quantity, align numerical symbols with quantities, and compare the sizes of two groups (Prayitno et al., 2023). These skills reflect cognitive processes that give meaning to numbers, which must be facilitated through the selection of appropriate learning media (Setyani et al., 2023). Consequently, strengthening numeracy in ECE settings requires shifting from rote memorization of numbers to concrete experiences that help children grasp the essence of mathematical concepts.

Jean Piaget's foundational work on cognitive development provides the primary theoretical lens for this study. In his seminal works, *The Psychology of Intelligence* (Piaget, 1972) and *The Origins of Intelligence in Children* (Piaget, 1952). Piaget proposed that children's cognitive development progresses through four sequential stages: sensorimotor, preoperational, concrete operational, and formal operational. Children aged 5–6 years fall within the preoperational stage (approximately ages 2–7), characterized by the emergence of symbolic thinking, language development, and intuitive reasoning.

However, at this stage, children's thinking remains largely egocentric and perception-bound, meaning they are not yet capable of logical operations or abstract reasoning without tangible, physical stimuli. Piaget emphasized that knowledge is not passively received but actively constructed through the child's direct interaction with their environment, a process he termed "constructivism". Therefore, for numeracy learning to be meaningful at this stage, it must be grounded in concrete, manipulative experiences rather than abstract symbolic instruction.

Building upon this, Piaget (1952) further argued that the process of assimilation and accommodation, whereby children integrate new experiences into existing cognitive schemas or adjust those schemas in response to new information, is most effectively triggered through hands-on engagement with real objects. When children manipulate wooden blocks, sort buttons by color, or arrange miniature objects in sequence, they are actively constructing their understanding of quantity, order, and numerical relationships. This theoretical foundation underscores the critical importance of concrete play as a pedagogically sound vehicle for early numeracy development, particularly for children in the 5–6 age range who are at the transitional boundary between concrete experience and the emergence of early symbolic understanding.

Aligned with Jean Piaget's theory of cognitive development, young children are in the preoperational stage and require concrete tools or media to bridge the gap toward abstract thinking. (Made & Devi, 2020). Using concrete media is a natural way for children to construct number sense through direct interaction with their environment. (Agustina et al., 2025). By manipulating real objects, children can connect sensorimotor experiences with the cognitive concepts they are developing. Research by (Way & Cartwright, 2025) supports this, demonstrating that physical activity and concrete representations of numbers can significantly strengthen memory and numerical understanding. Concrete play allows children to touch, move, categorize, and compare objects based on physical attributes, which enhances retention and stimulates logical thinking.

These concrete objects function as a "bridge" between sensory experience and symbolic understanding. (Chen, 2024). However, Piaget's theory should be approached critically, as a child's numerical development is determined not only by cognitive stage but also by the quality of teacher scaffolding, the learning environment, and the design of classroom activities. International research indicates that the quality of teacher interaction during play significantly impacts the depth of mathematical understanding children build; thus, numeracy instruction should be viewed as a socio-pedagogical process rather than a purely individual development.

A review of recent empirical studies further situates the novelty of the present research. In their meta-analysis of 41 experimental studies, they demonstrated that early numeracy interventions yield significant positive effects on young children's mathematical competencies, confirming that numeracy development is both feasible and impactful when initiated in early childhood (Hidayah & Retnawati, 2024). Their findings provide a strong empirical basis for prioritizing structured numeracy programs in ECE settings. Complementing this, Fitriya et al. (2025) demonstrated that contextual problem-based numeracy learning—incorporating concrete media, games, and developmentally appropriate active activities—is effective in early childhood settings, reinforcing the centrality of hands-on approaches to numeracy instruction.

From a different angle (Alkouri & Wardat, 2025) examined the efficacy of a structured curriculum integrating digital tools in preschool mathematics, finding that conceptual sequencing and scaffolded support are critical determinants of mathematical learning outcomes in young children. Together, these studies affirm the importance of concrete, structured, and scaffolded approaches to early numeracy. However, a notable gap remains: none of these studies specifically investigates concrete play using everyday environmental objects within the qualitative, naturalistic context of Indonesian kindergartens for children aged 5–6 years—precisely the focus of the present study.

Despite this, Indonesia's current numeracy levels are concerning. PISA 2023 data indicate that 82% of students remain below the minimum proficiency standard in mathematics—a figure that correlates with the low indicators of literacy and numeracy in the Early Childhood Development Index (ECDI) (Yuda & Rosmilawati, 2024). BPS data (2020) confirms that this dimension records the lowest achievement (64.6%) compared to physical and socio-emotional dimensions, suggesting that disparities in numerical understanding begin as early as the preschool years. While PISA technically measures literacy and numeracy among adolescents, Indonesia's low scores reflect a *"foundational crisis"* that likely originates in early childhood. Weak number sense at the primary school level suggests that children have not successfully bridged the gap between concrete concepts and symbolic numeracy during their preschool years.

This gap is evident in field settings, such as at TK Pembina Bantul, Yogyakarta, where numeracy stimulation remains dominated by conventional methods and rote counting without a genuine understanding of quantity. Children continue to struggle to connect numerical symbols to real-world quantities and to compare groups of objects accurately. The dissonance between the *Kurikulum Merdeka* mandate—which prioritizes contextual learning—and classroom practices that lean toward the abstract is the primary driver of this study. Therefore, there is an urgent need for innovative, structured concrete play strategies to help children transition from the sensorimotor stage to mature symbolic understanding (Kemendikbudristek, 2023). While research on manipulative media and numeracy is abundant, studies specifically addressing concrete play and early numeracy development among children aged 5–6 in the Indonesian kindergarten context remain limited. This study seeks to address three core research questions: (a) How do concrete play activities stimulate children's numeracy skills? (b) What is the role of teachers in facilitating this learning? (c) What challenges arise in its implementation within ECE classrooms?

B. Method

This study adopts a descriptive qualitative approach to provide an in-depth exploration of how children develop numeracy skills through concrete play activities. This approach is particularly well-suited for investigating early childhood numeracy in its natural setting, as it allows for the discovery of nuanced learning patterns that quantitative metrics might overlook (Adi Cahya & Muntazhimah, 2024).

The research was conducted at TK Pembina Bantul, involving 24 children from Group B and two educators. To ensure a comprehensive understanding, the principle of theoretical saturation guided the sample size; data collection concluded once no new instructional patterns or variations in children's mathematical responses were observed, indicating that the data were sufficiently rich to address the research objectives. (Salamah et al., 2025).

We adhered to rigorous ethical standards throughout the study. Before commencing data collection, informed consent was obtained from the school administration and the children's parents, while child-appropriate assent was ensured. To protect participant privacy, we utilized pseudonyms for both teachers and children. Furthermore, all digital data was stored on encrypted, password-protected devices to maintain strict confidentiality.

To ensure the trustworthiness of the findings, this study employed two triangulation techniques alongside additional credibility measures. First, source triangulation was applied by comparing data obtained from three distinct sources: the children, the teachers, and the children's work documentation. This ensured that findings were not solely reflective of a single perspective but were confirmed across multiple viewpoints. Second, triangulation of techniques was conducted by cross-checking data collected through three methods—participatory observation, semi-structured interviews, and documentation—to verify the consistency of information from the same source. For instance, teachers' statements gathered during interviews were confirmed against direct classroom observations and further corroborated by children's work samples. Both triangulation techniques were applied simultaneously to strengthen the study's internal validity (Sugiyono, 2019; Noble & Heale, 2019). In addition, member checking was conducted by reconfirming interview transcripts with the participating teachers, and peer debriefing was carried out with academic colleagues to minimize researcher bias and strengthen the credibility of interpretations (Ahmed, 2024).

Data analysis followed the revised interactive model developed by Miles et al. (2014), comprising three stages. First, data condensation involved selecting, focusing on, and simplifying raw data from observations, interviews, and documentation to ensure relevance to the research objectives. At this stage, data unrelated to children's numeracy development were filtered and excluded from further analysis. Second, data display involved organizing the condensed information into descriptive narratives, tables, and direct quotations to facilitate conclusion drawing. Third, conclusion drawing and verification involved inductively deriving conclusions based on emerging patterns in the data, which were subsequently verified through triangulation and member checking to ensure that interpretations accurately reflected field realities (Miles et al., 2014). The analysis employed thematic coding to identify emerging instructional patterns. For instance, raw data—such as a teacher's specific questioning technique or a child's physical act of aligning blocks to compare quantities—were systematically coded as “concrete mathematical interaction”. These codes were then iteratively aggregated into broader, more meaningful themes, such as “the transition from concrete manipulation to abstract representation” and “the teacher’s role as a facilitator”.

C. Result and Discussion

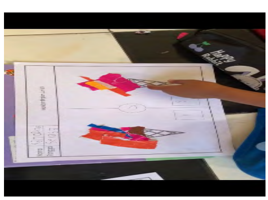
The Development of Children’s Numeracy Skills through Concrete Play

The research results indicate that the success of learning interventions in stimulating children’s numeracy depends heavily on the teacher’s active role as a facilitator. As evidenced in the researcher’s field notes: *“Children showed higher levels of enthusiasm and focus when manipulating physical objects like wooden blocks compared to working on static worksheets; they spontaneously discussed the quantities as they built their structures”* (Researcher’s Field Notes, 25 Februari 2025). This approach enables children to engage in play-based activities while simultaneously grasping the underlying learning objectives.

Instruction is facilitated through concrete media, such as colored buttons, seeds, wooden blocks, and vegetable replicas. This was further supported by the teacher’s perspective during the interview: *“By using these concrete objects, I do not need to force them to memorize numbers. They discover the concept of quantity naturally because they can touch and group the items themselves”* (Teacher Interview B1, 25 Februari 2025).

As detailed in Table 1, various play activities have been designed to stimulate specific numeracy aspects, ranging from number recognition to logical comparison.

Table 1. Types of Concrete Play Activities and Stimulated Numeracy Aspects

Type of Activity	Picture	Concrete Media Used	Stimulated Numeracy Aspect
Counting and categorizing objects		Buttons and blocks	Number sense, counting
Sequencing objects from largest to smallest		Blocks	Seriation, size comparison
Arranging number symbols according to quantity		Vegetable replicas	One-to-one correspondence, symbol recognition
Comparing the quantity of two groups		Children's worksheets (LKA)	Concept of more / less

Source: Researcher Documentation (2025)

Table 1 shows that playing with concrete objects helps children naturally understand numerical concepts. This is confirmed by the student documentation (LKA), which shows that 90% of the children successfully demonstrated correct one-to-one correspondence when interacting with the vegetable replicas (Student Documentation, February 25, 2025). Field observations reveal that children can estimate the number of objects without counting them one by one, indicating the development of *number sense*—a child's intuitive understanding of quantity. These findings align with (Vogt et al., 2018), who assert that play-based exploration with concrete objects is effective in fostering numeracy skills.

However, these findings must also be discussed within the context of Piagetian theory. Although active engagement with physical objects facilitates the formation of more robust cognitive schemas, recent research by (Baroody et al., 2019) suggests that effectiveness depends not only on the "tangibility" of the media, but also on how teachers facilitate repeated interactions between the child and these objects. In other words, concrete media alone are insufficient; the teacher's role in providing probing questions is crucial in determining whether a child is merely "playing" or truly engaging in "mathematical abstraction". Consequently, the synergy between instructional media and pedagogical facilitation is critical for establishing stable logical understanding in children.

Counting and Grouping Activities through Concrete Objects

The first activity focuses on fostering early numeracy skills through counting and grouping tasks. The implementation begins with the teacher instructing the children to count objects randomly, aimed at stimulating their sensitivity to quantity. Furthermore, this activity allows the teacher to assess the children's *one-to-one correspondence* skills—the capacity to match spoken numbers with the physical action of touching each object. (Shih, 2026).

As outlined in Table 1 under the grouping category, children utilize buttons to practice counting precision. The process of grouping buttons by color and recounting the total within each category gradually enhances their understanding of classification. Teacher B1 emphasized that the use of colored buttons is particularly beneficial because:

"Children practice grouping not only through verbalization but also through the integration of visual and motor skills". (Teacher B1 Interview, February 25, 2025). This suggests that a firm grasp of classification requires an in-depth recognition of an object's physical properties before a child can perform mathematical generalizations. These findings are consistent with those who assert that concrete experiences help children bridge numerical symbols with real-world quantities, thereby significantly deepening conceptual understanding.

Once basic counting skills are stimulated, the teacher increases the challenge by asking the children to classify objects based on specific characteristics. This activity trains cognitive abilities in recognizing similarities and differences, which serves as the foundation for logical thinking. This strategy aligns with an exploratory learning approach, in which children no longer learn mathematics mechanically but rather through the construction of logical categories.

To reinforce understanding of number symbols (1–20), the teacher integrates blocks with a floor-writing activity (Figure 2). The illustration in Figure 2 demonstrates how children arrange a set number of blocks according to instructions and then write the corresponding numerical symbol on the floor.

Figure 2. Integration of blocks with number symbols

Furthermore, the floor-writing activity (Figure 2) provides a multidimensional learning experience, enabling children to bridge the enactive stage (object manipulation) with the symbolic stage (numeral representation). While some frameworks argue that sensorimotor activity alone is sufficient for learning, these findings corroborate. (Zeng, 2025), who emphasize that verbal *scaffolding*—particularly through probing questions—is the determining factor in ensuring children do not merely engage in 'rote symbol mimicry', but rather develop a genuine grasp of the quantity underlying the digits.

It is also noteworthy that while concrete experiences are vital, the success of these interventions is deeply rooted in the qualitative context. As noted by Iz et al. (2025), interventions utilizing manipulative aids in kindergartens are successful specifically when the teacher facilitates a seamless transition from concrete manipulation to abstract representation, ensuring the activity remains a cognitive bridge rather than a disconnected play task. This approach aligns with the principles of the Merdeka Curriculum, which promote meaningful learning, deep learning, and Higher Order Thinking Skills (HOTS), guiding children not merely to memorize number symbols but to classify, reason, and construct genuine mathematical understanding through structured, experience-based exploration.

Stimulating Seriation Skills through Block-Ordering Activities

The second activity in this numeracy stimulation series focuses on reinforcing seriation skills, which are a child's ability to arrange objects based on size. As illustrated in the "Sorting Objects from Largest to Smallest" category in Table 1, children were observed arranging wooden blocks in the correct dimensional sequence. This activity demands visual acuity and fine motor coordination, requiring children to perform iterative comparisons between blocks to determine their accurate sequential positions. Figure 3 illustrates how the children sort the objects from largest to smallest.

Figure 3. Block-Ordering Activity

As illustrated in the image above, the block-ordering process involved significant trial-and-error, which initially caused the children to hesitate in arranging the blocks correctly. Observing this, the teacher provided *scaffolding* through probing questions: 'Try aligning the bottom edges on the floor, then feel them—which one is heavier, and which one looks longer?' (Researcher Field Notes, February 25, 2025). This approach appeared effective as it incorporated tactile experiences. Teacher B1 emphasized that for young children, size ordering is much more intuitive when they hold the objects directly to perceive mass differences, rather than relying solely on visual perception (Teacher B1 Interview, February 25, 2025). These observations are consistent with recent research documenting that physical interaction with objects correlates positively with cognitive processing and developmental outcomes (Halimah & Chamidah, 2025)**.** Furthermore, engaging in simultaneous comparison tasks—comparing multiple objects at once—strengthens children's seriation skills, providing a robust foundation for logical-mathematical reasoning in later schooling (Torres-Peña et al., 2025). In line with *Merdeka Curriculum*, these activities foster critical reasoning, as children are not simply arranging objects but actively observing, comparing, and drawing logical conclusions from tactile and visual evidence.

Theoretically, this activity facilitates the development of a child's analytical logic. However, an interesting discourse surrounds this approach. While classical Piagetian research emphasizes that children are only capable of seriation after achieving logical conservation, the findings of this study, supported by research from (Baroody et al., 2019), demonstrate that repeated physical comparison can gradually refine a child's ordinal reasoning without requiring full logical conservation. Nonetheless, an alternative perspective must be acknowledged: longitudinal research suggests that kindergarten seriation skills significantly predict arithmetic achievement in later grades, particularly when coupled with counting knowledge. This implies that while block-ordering is a valuable activity, its long-term benefit may depend on whether teachers explicitly verbalize the relational logic behind each arrangement. This practice is central to cultivating critical reasoning as envisioned in the Merdeka Curriculum, wherein children are guided to evaluate evidence, revise their thinking, and construct reasoned conclusions rather than merely completing procedural tasks.

Internalizing One-to-One Correspondence

The third activity focuses on strengthening the concept of *one-to-one correspondence* and the contextual recognition of numerical symbols. Unlike the previous activities that prioritized grouping, this stage requires children to actively connect the quantity of concrete objects with their symbolic representations. The use of vegetable and fruit replicas was selected to foster emotional engagement while facilitating the children's cognitive assimilation process.

As illustrated in Figure 4, *One-to-One Correspondence and Number Recognition Activities*, the children collect vegetable replicas and write the corresponding number on the floor, matching the quantity of the items collected.

Figure 4. One-to-One Correspondence and Number Recognition Activities

As illustrated in the image above, the children are engaged in writing numerals corresponding to the quantities they have collected. Their ability to utilize symbols is evident as they record these values based on the vegetable replicas. Learning is most effective when children can directly touch and compare objects through concrete media.

This is documented in the researcher's field notes as follows: 'After observing and counting the collected fruit and vegetable replicas (consisting of pineapples, papayas, and mustard greens), a male student wrote the number "5" on the floor. Meanwhile, a female student counted block replicas and wrote the number "2" on the floor (Researcher's Field Notes, February 25, 2025).

Consistent with the interview conducted with the teacher of Group B1, writing on the floor reduces academic pressure: This was confirmed by Teacher B1 during an in-depth interview: 'Typically, children feel burdened and tense when asked to write numbers in a grid notebook, fearing that their lines might be crooked or their penmanship untidy. However, when they are asked to write large numbers on the floor, right next to the collection of fruits they prepared themselves, they are highly enthusiastic. Writing numbers is no longer merely a task of copying from the chalkboard, but rather an opportunity to demonstrate that they understand the quantity of fruits that they possess (Teacher B1 interview, February 25, 2025).

This observation is supported by (Dierkx et al., 2025) highlight that one-to-one correspondence develops in the context of informal learning environments rather than in formal, worksheet-based instruction. Observations from this study suggest that when children arrange their own collections before recording the corresponding numeral, they appear to engage more meaningfully with the quantity-symbol relationship—moving beyond rote mimicry toward emergent conceptual understanding.

This dynamic learning environment reflects the application of *joyful learning* within the framework of *deep learning* as conceptualized in the *Merdeka Curriculum*. Rather than treating numeracy as a mechanical drill, integrating playful media — vegetable and fruit replicas, floor writing, and self-directed collection — creates conditions in which children experience genuine intellectual joy while engaging in cognitively demanding tasks. In the *Merdeka Curriculum*, *deep learning* is not defined by the complexity of content alone, but by the depth of meaning children construct through the learning process. When a child writes the numeral '5' on the floor, not because they were told to copy it, but because they counted five pineapples that they collected themselves, that act of symbol-writing becomes an expression of understanding rather than imitation — precisely the kind of meaningful, joyful, and deeply internalized learning that the *Merdeka Curriculum* envisions as its pedagogical foundation.

However, this transition warrants a nuanced perspective. While the enactive-to-symbolic transition observed aligns with traditional representational theory, a contrasting viewpoint exists. Experimental research suggests that children trained with symbolic aids—such as verbal counting—can sometimes make larger gains in arithmetic transformation than those relying solely on non-symbolic comparisons (Hyde et al., 2021). This implies that delaying the introduction of symbols until children have 'mastered' concrete manipulation may not always be optimal; instead, a parallel introduction of concrete objects and symbols may accelerate conceptual bridging more effectively.

Stimulating Comparative Logic (Comparing Quantities of Two Groups)

The fourth activity, which culminates this numeracy stimulation series, focuses on strengthening comparative reasoning. Unlike the previous activities involving three-dimensional objects (loose parts), this stage measures the extent to which children can transfer their conceptual understanding of quantity into a two-dimensional medium through Student Worksheets.

As illustrated in Figure 5, *Activities for Comparing Two Groups*, the children utilize origami paper cutouts (collages) on their worksheets to compare the quantities of two distinct groups.

Figure 5. Activities for Comparing Two Groups

After attaching the collages, the children are asked to count the paper cutouts on each side, write the corresponding numerals, and place the appropriate comparison symbol (>, <) in the central circle. Field notes document a moment of success: a child confidently wrote the numbers '8' and '1', then drew the "greater than" symbol (>) with the "mouth" opening towards the 8.

This success is consistent with the *Kemdikbudristek* (2022) guidelines, which emphasize that two-dimensional media are best comprehended by children when preceded by rich, concrete experiences. Teacher B1 confirms that this achievement is the "harvest" of previous sensorimotor experiences: "Because they have been accustomed to handling real objects like buttons and blocks from the beginning, they are no longer confused when facing symbols on paper" (Teacher B1 Interview, February 25, 2025). This statement is supported by research from (Outhwaite et al., 2024), which asserts that the ability to compare quantities is one of the most reliable indicators of *number sense* and can be identified as early as the preschool level as a predictor of a child's mathematical readiness.

Academically, success in comparative logic serves as an indicator of adequate cognitive maturity. The children no longer perceive symbols (>) as foreign markings, but rather as mathematical tools for communication that express that one group has a greater magnitude than the other. This aligns with the perspective of Khakima et al. (2024) regarding the importance of experience-based activities in introducing concepts of numbers and comparisons. The ability to compare two sets accurately is an important foundation for early arithmetic development, including addition and subtraction (Tavakoli, 2016). Thus, integrating concrete object play with structured evaluation is proven effective in facilitating the comprehensive development of *number sense* in early childhood.

The Role of the Teacher as a Facilitator

The success of numeracy exploration at TK Pembina Bantul relies heavily on transforming the teacher's role from a mere provider of information to an adaptive facilitator. In this capacity, the teacher is responsible not only for providing instructional media but also for designing a play environment that naturally stimulates a child's curiosity. Figure 6 illustrates the dynamics of participatory interaction, wherein the teacher facilitates children's exploration directly on the floor, creating a learning atmosphere rich in discovery.

Figure 6. The Teacher's Role as a Facilitator

As illustrated in the image above, the teacher is guiding the children by providing an explanation of the activities to be undertaken. In doing so, the teacher implements *scaffolding* techniques by offering probing questions to the children. This was further evidenced during the interview with the Group B1 teacher: 'When a child asks why an object feels heavier, I do not answer immediately; instead, I invite them to feel the comparison themselves so that they discover the answer through their own physical experience' (Teacher B1 interview, February 25, 2025).

This dialogic approach reflects the multi-faceted role of early childhood educators—acting simultaneously as motivators, facilitators, and material creators—where experience-based approaches serve as key elements in enhancing children's engagement (Setiani Nurul & Wakinah, 2025). These observations suggest that at TK Pembina Bantul, responsive teacher facilitation appears to be a meaningful factor in bridging play experiences into conceptual understanding, although the extent to which this can be replicated across diverse classroom profiles remains an open question.

Implementation in the field, however, faces systemic tensions. The challenge of facilitating 24 children with varying developmental tempos reflects a broader structural issue in early childhood education. Research indicates that while teacher effectiveness is central, it is significantly constrained by class size, preparation time, and the adequacy of available resources (Wildam et al., 2025). Shifting from formal, direct instruction to a facilitative role requires a transformation in classroom practice that demands not only pedagogical knowledge but also sustained professional development and institutional support (Louw & Claassens, 2024). Despite these operational constraints, the creative use of *loose parts* underscores that teachers remain the primary catalyst in transforming play into meaningful mathematical discovery. This explanation aligns with Hurlock's view that adult guidance is the most crucial external factor in helping children achieve optimal cognitive maturity (Hurlock, 1978). Hurlock further asserts that children's developmental progress is significantly shaped by the quality of adult interaction they receive during their formative years, making the teacher's facilitative presence an indispensable element in early numeracy development.

D. Conclusion

This research demonstrates that concrete, play-based activities using manipulatives from the immediate environment have successfully stimulated early numeracy competencies in early childhood. The indicators of this success are evident across four domains: children demonstrated accurate one-to-one correspondence when matching vegetable replicas with written numerals, correctly arranged wooden blocks in dimensional sequence reflecting seriation skills, classified buttons by color with increasing precision, and confidently applied comparison symbols (>,<) on two-dimensional worksheets. These achievements indicate that children have moved beyond rote imitation toward genuine conceptual understanding of quantity, classification, seriation, and numerical symbol recognition. This success can be attributed to three interrelated factors: the use of contextually familiar concrete media that activate children's prior sensory experience, the integration of joyful and meaningful learning environments that reduce academic pressure, and the presence of adaptive teacher facilitation that employs scaffolding and probing questions to guide children from enactive manipulation toward symbolic representation — principles that are fundamentally aligned with the pedagogical vision of the *Merdeka Curriculum*.

Nevertheless, this study is not without limitations. The findings are drawn from a single institution — TK Pembina Bantul — and a single class group, which limits the generalizability of the results across diverse early childhood settings with varying resource availability, class sizes, and teacher competency profiles. Furthermore, the cross-sectional nature of this study does not allow for conclusions regarding the long-term impact of concrete play stimulation on children's mathematical readiness as they transition into primary education. Future researchers are therefore encouraged to conduct longitudinal studies involving multiple institutions across different socioeconomic and geographic contexts, and to examine whether the numeracy gains observed in this study are sustained and predictive of arithmetic achievement in later grades.

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