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Improving Children's Cognitive Development Through Problem-Based Learning and Direct Instruction Assisted by Number Plate Media in Group B at Kenanga Kindergarten Banjarmasin

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ABSTRACT

This study aimed to improve children's cognitive ability to match quantities with numerical symbols through the implementation of Problem-Based Learning (PBL) and Direct Instruction (DI) supported by Number Plate media. The study employed classroom action research based on the Kemmis and McTaggart model, conducted over four meetings from April 13 to 16, 2026. The participants were 12 children in Group B at Kenanga Kindergarten Banjarmasin, consisting of eight boys and four girls. Data were collected through observation, documentation, interviews, and cognitive development assessments and analyzed using qualitative and quantitative descriptive methods. PBL encouraged children to solve simple numerical problems, while DI provided structured guidance and demonstrations supported by concrete learning media. The findings revealed improvements in teacher activity from 61% to

98%, children's activity from 59% to 83%, and cognitive development achievement from 33% to 92%. By the fourth meeting, children's activity and cognitive development had exceeded the predetermined classical success criterion of 80%. These findings suggest that integrating PBL and DI with Number Plate media can support children's cognitive development, particularly their ability to associate quantities with numerical symbols.

Introduction

Early numeracy is an essential aspect of cognitive development in early childhood, particularly in understanding the relationship between quantities and numerical symbols. Children need meaningful learning experiences that connect concrete objects with numerical representations rather than merely memorizing numbers. Matilla and Orrantia et al., (2024) emphasized that associating numerical symbols with quantities is fundamental to developing number understanding in preschool children. Similarly, the National Association for the Education of Young Children and the National Council of Teachers of Mathematics (2002) highlighted the importance of meaningful mathematical experiences involving concrete objects and everyday situations. Therefore, early numeracy instruction should encourage children to explore, count, compare, and match quantities with numerical symbols through developmentally appropriate activities.

Preliminary observations at Kenanga Kindergarten Banjarmasin

revealed that children's ability to match quantities with numerical symbols remained below the expected level. Of the 12 children in Group B, six (50%) were categorized as Developing as Expected (Berkembang Sesuai Harapan, BSH), two as Beginning to Develop (Mulai Berkembang, MB), and four as Not Yet Developing (Belum Berkembang, BB). These results had not met the predetermined success criterion of at least 80% of children achieving the Very Well Developed (Berkembang Sangat Baik, BSB) category. Classroom observations also indicated limited engagement, predominantly teacher-centered instruction, and insufficient use of concrete learning media. These conditions demonstrated the need for more interactive and structured instructional strategies to strengthen children's early numeracy skills.

Integrating Problem-Based Learning (PBL) and Direct Instruction (DI) offers a potential approach to addressing these challenges. PBL encourages children to explore simple problems, develop reasoning skills, and actively participate in learning activities. Wulandari et al. (2018) reported that PBL could stimulate children's understanding of numerical concepts. Meanwhile, DI provides explicit explanations, demonstrations, and structured guidance to support children's understanding of mathematical relationships. Combining these approaches allows children to explore numerical problems while receiving appropriate instructional assistance. Concrete learning media can further strengthen this process by connecting abstract numerical

symbols with observable quantities. Fadhilah et al. (2022) demonstrated that Paper Plate media improved counting abilities among children aged 5–6 years, suggesting the potential value of similar manipulatives in early numeracy instruction.

Previous studies have investigated PBL for developing numerical concepts (Wulandari et al., 2018), Paper Plate media for improving counting skills (Fadhilah et al., 2022), and the integration of PBL, DI, Montessori methods, and puzzle media for enhancing number–numeral matching abilities (Amariza & Faqihatuddiniyah, 2026). Although these studies demonstrate the relevance of problem-solving approaches, structured instruction, and concrete materials, they employed different instructional combinations and learning media. The present study therefore examines the integration of PBL and DI supported by Number Plate media in the specific classroom context of Kenanga Kindergarten Banjarmasin. Its contextual contribution lies in examining improvements in teacher activities, children's engagement, and cognitive development through this instructional combination.

Accordingly, this classroom action research aims to improve children's cognitive ability to match quantities with numerical symbols through PBL and DI assisted by Number Plate media. Specifically, the study investigates changes in teacher activities, children's learning participation, and cognitive development across four instructional meetings. The findings are expected to provide practical insights into

integrating problem-solving activities, structured guidance, and concrete learning materials to support early childhood numeracy development.

Methods

This study employed Classroom Action Research (CAR) based on the Kemmis and McTaggart model to improve children's cognitive ability to match quantities with numerical symbols through Problem-Based Learning (PBL) and Direct Instruction (DI) supported by Number Plate media. The research was conducted in Group B at Kenanga Kindergarten Banjarmasin during the 2025/2026 academic year, involving four meetings held from April 13 to 16, 2026. The research procedure consisted of four interconnected stages: planning, action, observation, and reflection. These stages guided the implementation, evaluation, and refinement of instructional activities throughout the intervention.

The participants comprised 12 children, including eight boys and four girls. Nurul Aidilla Fitri served as the observer, while Norsehan acted as the research collaborator. Data were collected through observation, documentation, interviews, and cognitive development assessments. Observations focused on teacher activities and children's participation during learning, while documentation and interviews provided supplementary information about instructional implementation. Cognitive assessments measured children's ability to

match quantities with corresponding numerical symbols.

Data were analyzed using qualitative and quantitative descriptive approaches. Qualitative analysis described instructional processes, teacher and child activities, and reflections on each meeting. Quantitative analysis converted observation and assessment scores into percentages to identify changes across the four meetings. Percentages were calculated by dividing the obtained score by the maximum possible score and multiplying the result by 100%.

The success criteria were established before implementing the intervention. Teacher activities were categorized as excellent when achieving scores of 29–36, while children's individual activities were considered highly active at scores of 17–20. Cognitive development was classified as Very Well Developed (Berkembang Sangat Baik, BSB) when children obtained scores of 9–12. Classical success was achieved when at least 80% of children met the established criteria for learning participation and cognitive development. Data credibility was supported by comparing information obtained through observations, documentation, and interviews, alongside discussions with the research collaborator to examine the consistency of findings.

Result and Discussions

This classroom action research involved 12 children in Group B at Kenanga Kindergarten Banjarmasin during the 2025/2026 academic year. The study examined improvements in teacher activities, children's

learning engagement, and cognitive development through the implementation of Problem-Based Learning (PBL) and Direct Instruction (DI) supported by Number Plate media across four meetings.

Table 1. Teacher Activity Observation Results

Meeting	Score	Percentage	Category
1	22	61%	Fair
2	27	75%	Good
3	29	81%	Excellent
4	35	98%	Excellent

Table 1 demonstrates a consistent improvement in teacher activities, increasing from 61% in the first meeting to 98% in the fourth meeting. Teacher performance reached the excellent category by the third meeting (81%) and continued improving in the final meeting. These findings indicate increasingly effective instructional implementation throughout the intervention.

Table 2. Children's Learning Activity Observation Results

Meeting	Percentage	Category
1	59%	Moderately Active
2	61%	Moderately Active
3	64%	Active
4	83%	Highly Active

As presented in Table 2, children's learning activities increased

from 59% to 83% across the four meetings. The most substantial improvement occurred between the third and fourth meetings, with a 19-percentage-point increase. By the final meeting, children's engagement had reached the highly active category and exceeded the predetermined classical success criterion of 80%.

Table 3. Children's Cognitive Development Achievement

Meeting	Percentage	Category
1	33%	Not Yet Developed (BB)
2	58%	Beginning to Develop (MB)
3	75%	Developing as Expected (BSH)
4	92%	Very Well Developed (BSB)

Table 3 shows a progressive improvement in children's cognitive development, increasing from 33% in the first meeting to 58%, 75%, and 92% in subsequent meetings. By the fourth meeting, the reported achievement had reached the Very Well Developed (BSB) category and surpassed the 80% success criterion. These findings indicate improved performance in matching quantities with corresponding numerical symbols throughout the intervention.

Discussion

The findings revealed consistent improvements in teacher activities, children's engagement, and cognitive development throughout the implementation of PBL and DI supported by Number Plate media. Teacher activities increased from 61% to 98%, children's

engagement from 59% to 83%, and cognitive achievement from 33% to 92%. These improvements suggest that integrating problem-solving activities, structured instruction, and concrete learning materials may support early numeracy development. However, the observed changes should be interpreted within the classroom action research context rather than as definitive evidence of causal relationships.

The integration of PBL and DI provided complementary instructional functions. PBL encouraged children to explore simple numerical problems, identify quantities, and associate them with appropriate symbols, while DI facilitated understanding through explicit demonstrations, structured explanations, and guided practice. Number Plate media further supported these activities by providing concrete representations of numerical concepts. Together, these instructional components offered opportunities for active participation, observation, and hands-on learning. Nevertheless, their individual contributions could not be determined because they were implemented simultaneously.

These findings are consistent with Amelia et al. (2025), who investigated the integration of PBL, Explicit Instruction, and Magic Box media to support children's cognitive development. Although both studies employed combined instructional approaches, they differed in learning media and research settings. Similarly, Fadhilah et al. (2022) reported an increase in children's average counting scores from 58.00 to

79.31 following the implementation of Paper Plate media. Their findings support the potential value of concrete manipulatives in early numeracy learning. However, differences in instructional design, learning indicators, and research procedures prevent direct comparisons of effectiveness between the studies.

From a classroom action research perspective, the progressive improvements across four meetings highlight the importance of continuous observation and instructional reflection. Teacher activities increased from 61% to 75%, 81%, and 98%, while children's engagement and cognitive achievement demonstrated similar upward trends. These patterns suggest that instructional implementation and children's learning outcomes improved concurrently. Nevertheless, detailed reflection records would be necessary to identify the specific instructional adjustments contributing to improvements between meetings.

The present study contributes practical evidence regarding the application of PBL and DI supported by Number Plate media in early childhood numeracy instruction. Its contribution primarily concerns the contextual implementation of these approaches and the observed improvements in teacher performance, children's participation, and number–numeral matching skills. Rather than establishing the superiority of a particular instructional model, the findings illustrate how structured guidance and concrete problem-solving activities can be

integrated into kindergarten learning experiences.

Despite these positive findings, several limitations should be acknowledged. The study involved only 12 children from a single kindergarten, limiting the generalizability of its results. Furthermore, the simultaneous implementation of PBL, DI, and Number Plate media prevented the identification of their individual effects. More detailed documentation of children's developmental categories, assessment procedures, percentage calculations, and instructional reflections would strengthen the interpretation of the findings. Future research could involve larger and more diverse samples, extended observation periods, and comparative instructional designs to examine the effectiveness of similar approaches.

Conclusion

This study demonstrated improvements in teacher activities, children's learning engagement, and cognitive development through the implementation of Problem-Based Learning (PBL) and Direct Instruction (DI) supported by Number Plate media in Group B at Kenanga Kindergarten Banjarmasin. By the fourth meeting, teacher activities reached 98%, children's engagement increased to 83%, and cognitive development achievement reached 92%, exceeding the predetermined classical success criterion of 80% for children's engagement and cognitive development. These findings suggest that integrating problem-solving activities, structured instruction, and

concrete learning media can support early numeracy development, particularly children's ability to match quantities with numerical symbols.

Based on these findings, teachers are encouraged to incorporate Number Plate media through demonstrations, guided practice, and independent exploration according to children's developmental needs. Schools should support the availability of safe, developmentally appropriate learning materials. Future research should involve larger and more diverse samples, extend the intervention period, and investigate the individual contributions of instructional models and learning media to children's cognitive development.

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