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Number puzzle-based learning to develop logical thinking skills in 5–6 year old children

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Abstract

Observation results early in PAUD SPS TP Tugu Mandiri II shows that ability think logical child age 5–6 years Still low. This study aims to improve the logical thinking skills of children aged 5–6 years through number puzzle media. The study used the Classroom Action Research (CAR) method of the Kemmis and McTaggart model which was carried out in two cycles with 20 children as research subjects consisting of 10 boys and 10 girls. Data collection techniques included observation, documentation, and field notes, while data analysis used quantitative and qualitative descriptive analysis. The results showed that number puzzle media effectively improved children's logical thinking skills. The percentage of achievement of logical thinking skills increased from 28% in the pre-action stage to 52% in Cycle I and reached 79% in Cycle II. Improvements were seen in the ability to classify, sort, match, and recognize patterns.

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INTRODUCTION

Early Childhood Education (PAUD) plays a crucial role in laying the foundation for children's growth and development (Duncan et al., 2022; Fadillah & Solihin, 2025). Early childhood is an important period for providing appropriate, targeted, and continuous stimulation to support the development of essential skills (Attanasio et al., 2022; Marzola et al., 2023). Learning activities at this stage should be designed according to children's developmental characteristics and provide opportunities for active participation, exploration, and meaningful experiences. Research on guided play indicates that play-based learning, when supported by appropriate teacher guidance, can facilitate children's learning and development, including early mathematical understanding (Skene et al., 2022; Svane et al., 2023). Therefore, early childhood learning should be designed through active, enjoyable, and child-centered activities that support children's development across multiple domains.

One important aspect of development in early childhood education is cognitive development (Alotaibi, 2024; Jeong et al., 2021; Peng & Kievit, 2020). This aspect relates to children's ability to acquire and process information, recognize relationships, understand their surroundings, and solve simple problems encountered in everyday life. According to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 137 of 2014 concerning National Standards for Early Childhood Education, cognitive development for children aged 5–6 years includes learning and problem-solving skills, logical thinking, and symbolic thinking (Peraturan Menteri Pendidikan Dan Kebudayaan Republik Indonesia Nomor 137 Tahun 2014 Tentang Standar Nasional Pendidikan Anak Usia Dini, 2014). Logical thinking involves skills such as classifying objects, arranging objects in sequence, matching quantities with number symbols, and recognizing patterns. These abilities are related to the development of early numeracy, including children's understanding of the relationship between numerical symbols and quantities (LeFevre et al., 2022; Tobia et al., 2021). Research on preschool children's patterning skills also highlights the importance of recognizing and continuing patterns as part of early mathematical learning (Larkin et al., 2024; Zhang et al., 2025; Zippert et al., 2021).

Children aged 5–6 years need learning experiences that help them connect the concepts they encounter with objects and situations they can observe directly. Activities involving numbers, quantities, sequences, and patterns can provide opportunities for children to compare, organize, and interpret information. Research on early numerical competencies has shown that structured games involving numbers can support counting skills and children's ability to recognize numerical structures (Gasteiger & Moeller, 2021), learning activities for young children should provide concrete and engaging experiences that allow them to explore concepts through play rather than relying solely on verbal explanations (Vidal Carulla et al., 2021).

Logical thinking skills do not develop optimally without appropriate stimulation (Hariani et al., 2022). Teachers play an important role in designing learning experiences that encourage children to observe, compare, classify, arrange, match, and identify patterns. Learning activities should provide opportunities for children to participate actively, try different strategies, and learn from their experiences. When learning activities are designed around clear developmental objectives, educational games can serve as a means of connecting children's play experiences with the concepts they are expected to understand.

One educational medium that can be used to support logical thinking is the number puzzle. Number puzzles provide opportunities for children to arrange, match, sort, and pair puzzle pieces according to numerical symbols, quantities, or sequences. These activities can help children recognize number symbols and practice observing, comparing, grouping, and identifying relationships between objects. Research by Anggoro and Netra reported an effect of number-puzzle games on the cognitive development of preschool children aged 5–6 years (Tyas Anggoro & Netra, 2022). Nazilah examined educational puzzle games in relation to the cognitive abilities

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of children in the same age range, while Sidiq and Fadlillah discussed the use of puzzle games to support cognitive development in children aged 5–6 years (Nazilah et al., 2022; Sidiq & Fadlillah, 2023). These studies provide a basis for considering number puzzles as a learning medium, although their findings do not by themselves establish the effectiveness of every puzzle-based activity for every logical-thinking indicator.

Initial observations at PAUD SPS TP Tugu Mandiri II showed that the logical thinking skills of children aged 5–6 years had not yet developed optimally. Some children experienced difficulty classifying objects according to particular characteristics, arranging number symbols in the correct order, matching quantities of objects with their corresponding number symbols, and recognizing simple patterns. Some children also confused number symbols with similar visual forms, which affected their ability to arrange numbers sequentially. These observations indicate a need for learning activities that provide more direct and structured opportunities to practice logical thinking.

Observations of classroom learning also indicated that activities were still dominated by textbooks and worksheets, while educational games had not been utilized optimally. This situation limited opportunities for children to explore objects, experiment with different arrangements, and discover relationships independently. Some children appeared less enthusiastic about participating in learning activities and had not consistently demonstrated logical-thinking skills corresponding to the developmental indicators for children aged 5–6 years. A more engaging learning approach was therefore needed to provide concrete experiences through which children could practice classifying, sorting, matching, and recognizing patterns. Number-puzzle activities were selected as a potential alternative to address these classroom learning needs.

Previous studies have examined the use of puzzle media to support cognitive development in early childhood. Lestari investigated the use of number-puzzle media to improve children's cognitive abilities in number recognition (Lestari et al., 2021). Natari and Suryana examined educational puzzle games as a means of supporting cognitive development, including the recognition of number symbols (Natari & Suryana, 2021). Meanwhile, Masrifah examined a creative puzzle medium to support children's cognitive development (Masrifah et al., 2022). Together, these studies indicate that puzzle-based activities have been explored in various early childhood learning contexts, although the learning objectives and puzzle formats differ across studies.

Other studies have investigated related outcomes, including problem-solving skills and the development of puzzle-based learning media. Ratna and Imamah (2023) examined young children's problem-solving abilities through puzzle play, while Hasibuan et al. (2022) investigated puzzle games and their contribution to the cognitive development of children aged 5–6 years (Ratna & Imamah, 2023; Utami et al., 2022). Asmawati (2023) developed puzzle games for early childhood based on Banten local culture, illustrating how puzzle media can also be designed in ways that reflect children's cultural contexts (Asmawati, 2023). These studies contribute to the discussion of puzzle-based learning, but they address different outcomes, designs, or learning contexts from the present study.

The synthesis of previous research indicates that puzzle media has been investigated in relation to number recognition, general cognitive development, problem-solving skills, and the design of educational games. However, the present study focuses specifically on the development of logical thinking through number-puzzle activities assessed using four indicators: classifying, sorting, matching, and recognizing patterns. It also examines the use of number puzzles to improve classroom learning through a Classroom Action Research approach at PAUD SPS TP Tugu Mandiri II. This combination of specific indicators, learning media, and classroom context constitutes the practical focus of the present study.

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Based on this rationale, this study aims to improve the logical thinking skills of children aged 5–6 years through number-puzzle media at PAUD SPS TP Tugu Mandiri II. Using a Classroom Action Research approach, the study examines the implementation of number-puzzle activities and changes in children's performance across the action cycles. The findings are expected to contribute to research on game-based learning for early childhood logical thinking and provide practical guidance for PAUD teachers in designing active, engaging, and developmentally appropriate learning activities.

METHOD

This study employed Classroom Action Research (CAR) using the Kemmis and McTaggart model, which consists of four stages: planning, action implementation, observation, and reflection (Siregar, 2025; Wijayati, 2022). The research was conducted at PAUD SPS TP Tugu Mandiri II during the 2025/2026 academic year. The research subjects were 20 children aged 5–6 years, consisting of 10 boys and 10 girls. The participants were selected based on preliminary observations indicating that their logical thinking skills needed improvement, particularly in classifying, sorting, matching, and recognizing patterns.

The research was conducted in two cycles, with each cycle comprising four sessions lasting 60 minutes per session. Each cycle followed four stages: planning, action implementation, observation, and reflection. During the planning stage, the researcher developed a teaching module, prepared number puzzle media, observation instruments, and the necessary learning tools. The action implementation stage involved learning activities using number puzzle media to stimulate children's logical thinking skills. During the learning sessions, the researcher and collaborating teachers observed teacher activities and children's logical thinking skills using a prepared observation sheet. The observation results were analyzed during the reflection stage as a basis for improving actions in the subsequent cycle.

Data collection techniques included observation, documentation, and field notes (Busetto et al., 2020; Cypress, 2018). Observation was used to obtain data on the development of children's logical thinking skills during the learning process. Documentation was used to supplement the research data with activity photographs, attendance lists, and other supporting documents. Field notes were used to record findings that emerged during the implementation of the actions and served as material for reflection at each stage.

The research instrument consisted of observation sheets designed to assess children's logical thinking skills based on four indicators: classifying, sorting, matching, and recognizing patterns. Teacher activity observation sheets and documentation were also used as supporting instruments to obtain more comprehensive data. Each indicator was assessed using a four-point rating scale, with scores ranging from 1 to 4. Therefore, the maximum possible score for each child was 16, calculated by multiplying the four indicators by the maximum score of 4 for each indicator ($4 \times 4 = 16$). With 20 children participating in the study, the maximum total score was 320 (20 children × 4 indicators × 4 points = 320).

The data were analyzed using quantitative and qualitative descriptive analysis techniques (Creswell & Creswell, 2022; Donkoh, 2023; Dunwoodie et al., 2023). Quantitative analysis involved calculating the percentage of children's logical thinking achievement in the pre-action stage, Cycle I, and Cycle II. The achievement percentage was calculated by dividing the total score obtained by the maximum possible score of 320 and multiplying the result by 100%. Qualitative analysis involved data reduction, data presentation, and conclusion drawing based on observations and field notes. The research was considered successful when children's logical thinking achievement reached at least 75%, with children attaining the Developing According to Expectations (BSH) or Very Well Developed (BSB) categories.

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RESULTS AND DISCUSSION

Results

Pre-action Results

Stage pre-action implemented For get description beginning about ability think logical child age 5–6 years before given action through Use of number puzzle media . Observation done against 20 children at PAUD SPS TP Tugu Independent II Year Academic Year 2025/2026 with refers to four indicator ability think logical , namely classify , sort , match , and recognize pattern . Observation results show that ability think logical child Still relatively low so that required effort repair through application of more learning media interesting and appropriate with characteristics Study child age early .

Based on results observation , some big child Not yet capable control indicator ability think logical optimally . Children are still experience difficulty in grouping object based on characteristics certain , sorting number in a way correct , matching symbol number with amount objects , and recognize pattern simple . Condition the show that the learning process is taking place before action Not yet capable give optimal stimulation of development ability think logical child .

Table 1. Results of Children's Logical Thinking Abilities at the Pre-action Stage

Category	Number of children	Percentage
BSB	0	0%
BSH	0	0%
MB	4	20%
BB	16	80%

Based on Table 1, the majority of children are in the Not Yet Developing (BB) category, namely 16 children (80%), while 4 children (20%) are in the Starting to Develop (MB) category. No children have yet reached the Developing According to Expectations (BSH) or Very Well Developing (BSB) categories. Overall, the score obtained in the pre-action stage was 90 out of a maximum score of 320, with an achievement percentage of 28%. These results indicate that children's logical thinking abilities are still below the research success indicators, so learning actions are needed through the use of number puzzle media.

Figure 1. Development of Children's Logical Thinking Skills in the Pre-action Stage

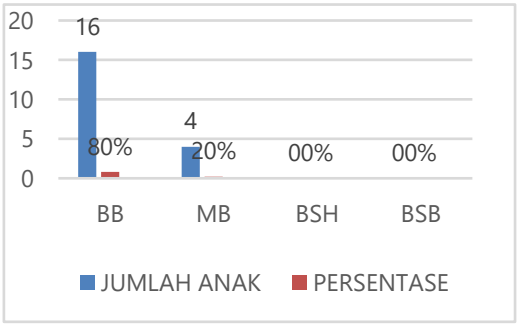


Figure 1 illustrates that children's logical thinking skills were still dominated by the BB category. The absence of children in the BSH and BSB categories indicated that their abilities in classifying, sorting, matching, and recognizing patterns required further stimulation. The pre-

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action findings therefore served as the basis for designing learning activities using number puzzles in Cycle I.

Results of Cycle I

The implementation of actions in Cycle I was carried out through the application of number puzzle media in learning to improve the logical thinking skills of children aged 5–6 years at PAUD SPS TP Tugu Mandiri II in the 2025/2026 Academic Year. Learning activities were designed based on the results of reflections at the pre-action stage by providing more concrete learning experiences through activities of sequencing numbers, matching number symbols with the number of objects, grouping objects, and recognizing simple patterns. The use of number puzzle media aims to increase children's involvement in the learning process so that logical thinking skills can develop optimally.

Observations showed an improvement in logical thinking skills compared to the pre-treatment period. Children began to demonstrate the ability to sequence numbers, match number symbols to the number of objects, and group objects based on specific characteristics. However, some children still required teacher guidance when completing activities related to patterns and simple problem-solving.

Qualitative observations provided further insight into how children's ability to match number symbols with object quantities developed throughout the intervention. During Cycle I, some children still experienced difficulty connecting written numerals with the corresponding number of objects. For example, a child attempting to complete a number puzzle required teacher guidance to count the objects individually before selecting the corresponding number symbol. This observation indicated that the child was still developing an understanding of the relationship between numerical symbols and quantities.

A second observation during Cycle I showed progress through guided practice. When children were encouraged to count the objects one by one and compare the total with the available number pieces, some began to correct their initial choices. The teacher's prompts helped direct children's attention to the actual quantity of objects rather than relying solely on their initial guesses. These observations were consistent with the quantitative findings in Cycle I, when the achievement percentage increased to 52%, although some children still required support during learning activities.

Table 2. Results of Children's Logical Thinking Abilities in Cycle I

Category	Number of children	Percentage
BSB	0	0%
BSH	5	25%
MB	15	75%
BB	0	0%

Based on Table 2, 15 children (75%) were in the Beginning to Develop (MB) category and 5 children (25%) had reached the Developing as Expected (BSH) category. There were no more children in the Not Yet Developing (BB) or Very Well Developing (BSB) categories. Overall, the total score obtained in Cycle I reached 167 out of a maximum score of 320, with an achievement percentage of 52%. These results indicate a 24% increase compared to the pre-action stage, but this achievement is still below the established research success indicator, which is 75%.

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Figure 2. Development of Children's Logical Thinking Skills in Cycle I

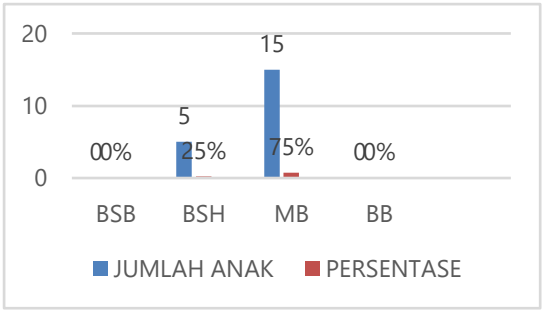


Figure 2 shows a change in the distribution of children's developmental categories compared with the pre-action stage. The BB category was no longer represented, and some children had reached the BSH category. Nevertheless, most children remained in the MB category, indicating that their logical thinking skills had not yet developed optimally. These findings provided a basis for improving the learning strategies implemented in Cycle II.

Results of Cycle II

The implementation of actions in Cycle II is a refinement of the actions in Cycle I based on the results of the reflection that has been carried out. Learning improvements are focused on increasing child engagement through the use of more varied number puzzle media, providing stimulation in the form of trigger questions, and more intensive mentoring during learning activities. Activities are carried out in four meetings with the theme "Preserving the Environment Around Me" and the subtheme "Fruit Plants". Through this theme, children are invited to learn the concept of numbers through activities of sequencing numbers, matching number symbols with the number of fruits, grouping fruits based on certain characteristics, and recognizing simple patterns.

Observation results show that ability think logical child experience further improvement Good compared to with Cycle I. Children are seen more active follow activity learning, able putting together a number puzzle in a way independent, and more believe self when answer teacher's questions. In addition, some big child has capable connect symbol number with amount object in a way right, sort number with true, and recognize pattern simple through activity play using number puzzle media.

Further progress was observed in Cycle II, when number-puzzle activities were integrated with the theme of fruit plants. Children were asked to count fruit illustrations and match them with the corresponding number symbols. Compared with the previous cycle, children demonstrated greater independence in counting objects, selecting number pieces, and checking whether the symbols matched the quantities. This change suggested that repeated practice, concrete materials, and more focused teacher guidance helped children develop a stronger connection between number symbols and object quantities. These qualitative findings complemented the quantitative result in Cycle II, when achievement reached 79% and all children were classified in the Developing According to Expectations (BSH) or Very Well Developed (BSB) categories.

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Table 3. Results of Children's Logical Thinking Abilities in Cycle II

Category	Number of children	Percentage
BSB	9	45%
BSH	11	55%
MB	0	0%
BB	0	0%

Based on Table 3, all children have achieved the expected developmental categories. Nine children (45%) are in the Very Well Developed (VS) category, and 11 children (55%) are in the Developing According to Expectations (BSH) category. There are no more children in the Beginning to Develop (MB) or Not Yet Developed (BB) categories. The total score obtained in Cycle II reached 252 out of a maximum score of 320, with an achievement percentage of 79%. These results have exceeded the research success indicator set at 75%, so the action was declared successful.

Figure 3. Development of Children's Logical Thinking Skills in Cycle II

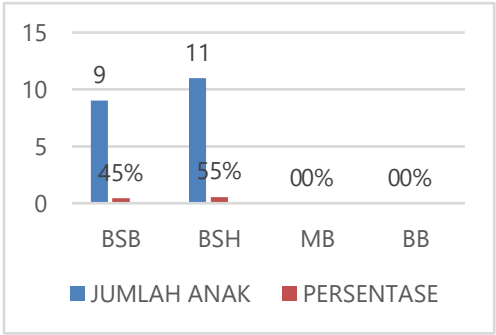


Figure 3 illustrates the improvement in children's logical thinking skills following the implementation of number puzzle media in Cycle II. The distribution of children across the BSH and BSB categories indicates progress in the assessed skills. The learning activities provided opportunities for children to engage directly with numerical concepts, sequence numbers, match object quantities with number symbols, and recognize simple patterns.

Comparison of Results Between Cycles

Comparison of results between cycles was conducted to determine the effectiveness of using number puzzles in improving the logical thinking skills of children aged 5–6 years. The analysis was conducted by comparing the results from the pre-action stage, Cycle I, and Cycle II based on developmental categories and the percentage of logical thinking achievement.

Table 4. Comparison of Children's Logical Thinking Abilities Between Cycles

Stage Study	Total Score	Percentage
Pre-action	90	28%
Cycle I	167	52%
Cycle II	252	79%

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Based on Table 4, children's logical thinking skills showed improvement at each stage of the study. In the pre-action phase, the percentage of logical thinking achievement only reached 28%, with the majority of children in the Not Yet Developing (BB) category. After the implementation of the number puzzle media in Cycle I, the percentage increased to 52%, indicated by the absence of any children in the Not Yet Developing category, although the majority remained in the Beginning to Develop (MB) category.

A more significant improvement occurred in Cycle II, with a 79% achievement percentage, exceeding the research success indicator of 75%. All children achieved the Developing According to Expectations (BSH) and Developing Very Well (BSB) categories. Overall, there was a 51% increase from the pre-action stage to Cycle II. These results indicate that the use of number puzzles is effective in improving the logical thinking skills of children aged 5–6 years at SPS TP Tugu Mandiri II PAUD.

Figure 4. Comparison of Children's Logical Thinking Abilities Between Cycles

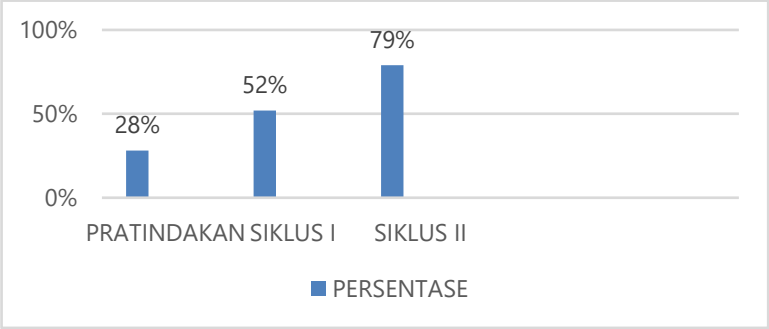


Figure 4 presents the upward trend in children's logical thinking achievement throughout the intervention. The percentage increased by 51 percentage points from the pre-action stage to Cycle II. This improvement was consistent with the observed development in children's abilities to classify, sort, match, and recognize patterns. Taken together, the quantitative results and classroom observations indicate that children's logical thinking skills improved following the implementation of number puzzle-based learning activities.

Discussion

The results showed that number-puzzle media improved the logical thinking skills of children aged 5–6 years at PAUD SPS TP Tugu Mandiri II. Achievement increased from 28% in the pre-action stage to 52% in Cycle I and 79% in Cycle II, exceeding the study's success criterion of 75%. This upward pattern suggests that number-puzzle activities provided repeated, concrete opportunities to classify, sort, match, and recognize patterns. This interpretation is consistent with research indicating that guided play can support children's learning and development in educational contexts (Skene et al., 2022) and with a review of mathematics interventions across educational settings (Svane et al., 2023). The findings should, however, be interpreted as improvement observed in this classroom action research rather than as proof that the same effect will occur in every setting.

The learning activities required children to manipulate number pieces, count objects, compare quantities, sequence symbols, and examine arrangements. These activities are relevant to early numeracy research emphasizing the relationship between numerical symbols and quantities (LeFevre et al., 2022; Tobia et al., 2021). The use of structured number games is also

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consistent with research on developing early numerical competencies through board games (Gasteiger & Moeller, 2021). In addition, the observed progress in recognizing simple patterns relates to research identifying preschool patterning as an important early mathematical skill (Larkin et al., 2024; Zhang et al., 2025; Zippert et al., 2021). Taken together, these studies provide a relevant basis for interpreting why direct manipulation, repeated practice, and attention to numerical relationships may have supported children's performance in the present study.

Improvement was also evident in children's observed learning behaviour. During the pre-action stage, many children had difficulty sequencing numbers, grouping objects by characteristics, matching number symbols with quantities, and recognizing simple patterns. During Cycle I, some children still needed teacher prompts to count objects individually before selecting a number symbol. In Cycle II, children showed greater independence in counting, selecting number pieces, checking matches, and completing activities. These observations complement the increase in the overall achievement score, although the present data do not isolate the contribution of each teaching strategy to the observed change.

The findings are broadly consistent with previous studies of puzzle-based learning in early childhood. Anggoro and Netra examined number-puzzle games in relation to the cognitive development of preschool children aged 5–6 years, while Nazilah investigated educational puzzle games and children's cognitive abilities (Nazilah et al., 2022; Tyas Anggoro & Netra, 2022). Sidiq and Fadlillah likewise examined puzzle games as a means of supporting cognitive development among children aged 5–6 years (Sidiq & Fadlillah, 2023). Other studies have explored number-puzzle media and educational puzzle formats in different early childhood learning contexts (Masrifah et al., 2022; Natari & Suryana, 2021; Nurani et al., 2024). The present study adds classroom-based evidence by following children's achievement across two action cycles and assessing four specific indicators of logical thinking.

The findings also relate to studies addressing specific learning outcomes and puzzle-media design. Ratna and Imamah examined young children's problem-solving abilities through puzzle play (Ratna & Imamah, 2023). Utami investigated the development of a puzzle game to support cognitive development in early childhood, while Asmawati developed a puzzle game based on Banten local culture (Asmawati, 2023; Nabila et al., 2023). These studies differ from the present research in their outcomes, media design, or learning context. The distinctive contribution of this study is its focus on classifying, sorting, matching, and recognizing patterns, examined through a Classroom Action Research process at PAUD SPS TP Tugu Mandiri II. The increase from 28% to 79% across the action stages provides context-specific evidence of improvement in these indicators following the implementation and refinement of number-puzzle activities.

Pedagogically, number puzzles can serve as an alternative medium for giving children structured opportunities to handle objects, compare quantities, organize sequences, and solve simple problems. The activities are most useful when teachers provide guidance and prompts that help children explain or check their choices, rather than focusing only on completing a puzzle. This emphasis on guided participation is consistent with research on guided play and play-based learning (Skene et al., 2022; Vidal Carulla et al., 2021). In practice, teachers can ask children to count objects, explain why a number symbol matches a quantity, group objects by a stated characteristic, or continue a simple pattern. Because this study involved 20 children at one PAUD site and used two action cycles, the findings provide evidence for this classroom context; further studies in other settings are needed before generalizing the results more broadly.

CONCLUSION

Application of number puzzle media proven effective in increase ability think logical child 5–6 years old at PAUD SPS TP Tugu Independent II Year Academic Year 2025/2026. Use of the media capable create more learning active , fun , and meaningful so that child get experience

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Study in a way concrete in classify , sort , match , and recognize pattern . Research results show existence improvement ability think logical child in a way gradually from stage pre-action until Cycle II, with achievements end as much as 79% which has been beyond indicator success study by 75%. Findings This show that the number puzzle media No only support achievement aspect cognitive , in particular ability think logical , but also improves activity , concentration , and confidence self child during the learning process . Therefore that , number puzzle media can recommended as one of the innovative learning media alternatives For develop ability think logical child age early . Research furthermore recommended develop use of number puzzle media in aspects other developments or apply it to different levels and contexts differentiated learning so that obtained more findings comprehensive.

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