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Enhancing Higher-Order Thinking Skills in Early Childhood Through APE Puzzle Hopscotch: A Quasi-Experimental Study

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Abstract
This study examines the influence of APE puzzle hopscotch on higher-order thinking skills (HOTS) in children aged 4-6 years at PAUD IT ADAR Kalasan DIY. Employing a quasi-experimental design, the research included an experimental group receiving the APE puzzle hopscotch intervention and a control group without any intervention. Over four months, pretest and posttest assessments were conducted to evaluate HOTS in both groups. The research instruments measured indicators across analysis (C4), evaluation (C5), and creation (C6). Results revealed significant enhancements in the experimental group's HOTS, with N-Gain scores showing moderate effectiveness. Statistical tests confirmed the intervention's impact, demonstrating significant differences in post-test scores between the experimental and control groups ($p < 0.05$). The findings suggest that APE puzzle hopscotch effectively stimulates cognitive development in early childhood. Despite limitations such as a small sample size and short study duration, the study underscores the potential of interactive educational tools in enhancing critical thinking and problem-solving skills. Implications for educational practice include the integration of engaging tools into curricula to foster HOTS. Future research should address the current study's limitations, validate the findings across different settings, and explore the effects on other developmental areas. Additionally, longitudinal studies could provide deeper insights into the long-term benefits of such educational tools. This research contributes to the ongoing discourse on the importance of innovative teaching strategies in early childhood education, emphasizing the role of interactive play in cognitive growth.

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Introduction

The cultivation of higher-order thinking skills (HOTS) in early childhood is pivotal in preparing future generations to thrive in a rapidly evolving world. As technological advancements reshape societal dynamics, the ability to think critically, solve complex problems, and innovate becomes increasingly essential (Munar, 2022; Ahmad, 2023). Early childhood, often referred to as the golden age of development, presents a critical window for stimulating cognitive, social, and emotional growth (Rahman, 2009). Therefore, innovative educational strategies that foster these skills are paramount to ensuring children can meet future challenges effectively. Recognizing this, educators and policymakers are increasingly focusing on early interventions that enhance HOTS, ensuring that children develop the cognitive flexibility and problem-solving abilities required in the 21st century (Jaenudin et al., 2020).

Previous research underscores the significance of early cognitive stimulation in developing HOTS. Bloom's Taxonomy provides a foundational framework, categorizing thinking skills into lower-order (LOTS) and higher-order (HOTS) domains, with the latter including analyzing, evaluating, and creating (Endrayanto, 2021; Ahmad, 2023). Implementing educational approaches that align with these cognitive stages is essential for fostering comprehensive development in children (Jaenudin et al., 2020). Studies indicate that activities encouraging critical thinking from a young age can significantly enhance cognitive functions, problem-solving abilities, and overall academic performance (Sutama et al., 2019; Greiff et al., 2015). These findings are supported by research highlighting that early childhood is a period of rapid brain development, where appropriate stimulation can lead to long-term benefits in cognitive and social capabilities (Ghent & Kanira, 2012).

In the realm of early childhood education, educational game tools (APE) have emerged as effective mediums for promoting developmental milestones. These tools are designed to provide engaging, interactive learning experiences that cater to children's innate curiosity and learning potential (Badru & Eliyawati, 2010; Khasanah, 2021). Research demonstrates that APE can stimulate various developmental aspects, including cognitive, motor, and social-emotional growth, by incorporating playful elements into the learning process (Aristian, 2021; Mentari & Andriyani, 2021). This approach aligns with pedagogical theories advocating for play-based learning as a means to enhance educational outcomes. The effectiveness of APE in facilitating learning is further evidenced by studies showing improvements in children's attention spans, creativity, and social skills through the use of educational games (Baharun et al., 2020; Widayati et al., 2020).

Specific studies on the use of puzzles and traditional games like hopscotch reveal their efficacy in promoting cognitive and motor development in children. Puzzles, for instance, require children to engage in problem-solving and critical thinking, thus stimulating their cognitive faculties (Akbar et al., 2022). Similarly, hopscotch enhances physical coordination and social skills, demonstrating the interconnection between physical and cognitive development (Hasanah et al., 2022). The integration of such games into educational settings has been shown to increase children's engagement, learning concentration, and overall academic success (Suci Ramadhani et al., 2016; Fitri, 2014). Additionally, these games provide opportunities for children to develop fine motor skills, patience, and perseverance, essential components for their overall growth (Apino & Retnawati, 2017; Mustika, 2021).

The combined use of puzzle and hopscotch games, termed Puzzle Hopscotch, presents a novel educational tool aimed at stimulating HOTS in early childhood. This hybrid game leverages the cognitive challenges of puzzles and the physical engagement of hopscotch to provide a holistic developmental experience (Khasanah, 2021). Prior research highlights the potential of such innovative educational tools to foster multiple intelligences, including verbal, logical-mathematical, spatial-visual, and kinesthetic skills (Herdayanti & Watini, 2021). This multidimensional approach not only enhances cognitive abilities but also supports comprehensive developmental growth. Studies suggest that engaging children in these multifaceted activities can significantly enhance their problem-solving abilities, social interactions, and emotional regulation (Puspitasari et al., 2022; Hasanah et al., 2022).

Despite the promising evidence, existing studies on the use of educational game tools often lack comprehensive assessments of their impact on HOTS specifically. Many studies focus broadly on cognitive and motor development without isolating higher-order thinking skills as a distinct outcome (Fahmi, 2023; Munar, 2022). Moreover, there is a scarcity of research evaluating the combined effects of multiple game types, such as Puzzle Hopscotch, on early childhood development. Addressing these gaps is crucial to understanding the full potential and limitations of these educational tools in fostering advanced cognitive skills in young learners. Furthermore, there is a need to explore the long-term impacts of such educational interventions to determine their effectiveness over sustained periods (Sutama et al., 2019; Nachiappan et al., 2018).

This study aims to investigate the effect of learning using APE Puzzle Hopscotch on higher-order thinking skills in children aged 4-6 years at PAUD IT ADAR Kalasan DIY. By focusing on the combined cognitive and physical engagement offered by Puzzle Hopscotch, this research seeks to provide empirical evidence on its efficacy in enhancing HOTS. The findings are expected to contribute to the development of innovative educational strategies and tools that can be implemented in early childhood education to foster critical thinking, problem-solving, and creativity, thereby preparing children for future academic and life challenges. This study will fill existing gaps in the literature by offering a nuanced understanding of how specific educational tools can impact higher-order cognitive functions in early childhood, thus informing future educational practices and policies (Greiff et al., 2015; W. T. A. Putri & Umah, 2020).

Methods

This study employs a quantitative research method with an experimental research design, specifically a quasi-experimental design involving an experimental group receiving the APE puzzle hopscotch intervention and a control group without any intervention. The quasi-experimental approach, as illustrated in Figure 1, aims to assess the impact of the APE puzzle hopscotch on higher-order thinking skills in early childhood. The research was conducted over four months at PAUD IT ADAR Kalasan DIY, starting from preliminary observations to data collection. Initially, a pretest was administered to both groups to assess their baseline higher-order thinking skills. Subsequently, the experimental group underwent the APE puzzle hopscotch intervention, while the control group continued with their regular activities. After the intervention, a posttest was conducted to evaluate changes in higher-order thinking skills, following the procedure flow detailed in Chart 1.

O_1	X	O_2
O_3		O_4

Figure 1. Pretest Posttest Control Group Design

The primary tools used in this study included the APE puzzle hopscotch, observation sheets, interview guidelines, and documentation methods. Observations were recorded openly using structured sheets to measure specific aspects of higher-order thinking skills, detailed in Table 1. Interviews, guided by predefined questions, were conducted using cellphones to capture visual data, reinforcing observational data. Documentation included drawings, photos, and children's work to supplement and validate the findings. Data analysis employed descriptive statistical methods, normality and homogeneity tests, hypothesis testing using independent tests, and N-Gain Score analysis to determine the intervention's efficacy.

Table 1. Higher Order Thinking Skills Research Instrument

Variable Higher Order Thinking Skills		
No	**Indicator**	**Sub-indicator**
1	C4 Analysis	1. Children can solve problems encountered during the learning process 2. Children can differentiate each command in the form of figures, writing, shapes, and colours 3. Children can use and group objects according to shape, colour, and size 4. Children can answer the questions given 5. Children provide feedback (questions/answers) to criticize the game being played
2	C5 Evaluation	1. Children can evaluate themselves in activities (if they or their friends make mistakes or errors in the game) 2. Children can ask and answer questions about the activities carried out
3	C6 Create	1. Children can produce different works from their friends 2. Children can provide ideas for activities to be carried out 3. Children can create activities with their imagination

To ensure the reliability and validity of the research instruments, a thorough validation process was conducted before the field tests. The research instrument for assessing higher-order thinking skills measured specific indicators across three categories: Analysis (C4), Evaluation (C5), and Creation (C6). Each category included sub-indicators such as problem-solving, differentiation of commands, grouping objects, self-evaluation, and idea generation. Validity and reliability tests were conducted according to established procedures (Sugiyono, 2021, 2015, 2022). The comprehensive approach ensured the study's robustness and accuracy in measuring the targeted outcomes.

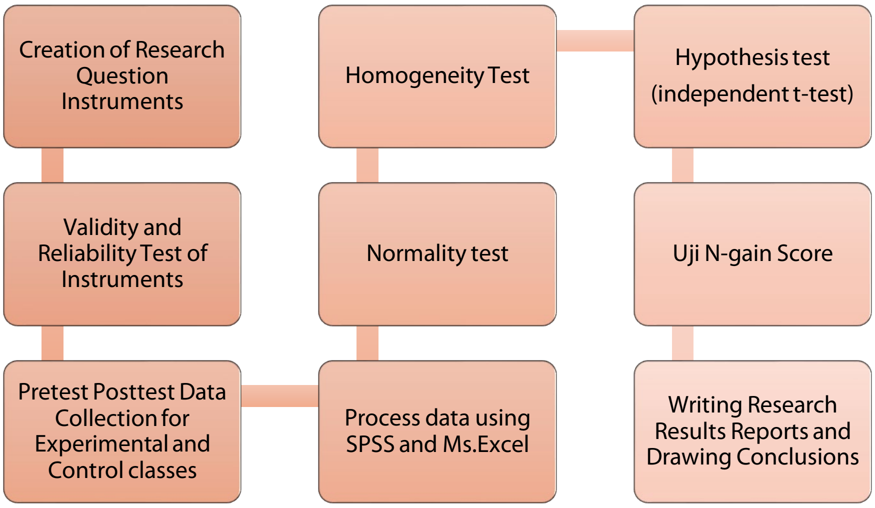

Figure 2. Research Flow

This research was conducted for approximately 4 months, starting from pre-research with observation to the data collection stage. Research location at PAUD IT ADAR Kalasan DIY.

Result

The research results can be seen based on the following description of the research data:

3.1. Data Description Pr*etest-Posttest* Control and Experimental Classes on Higher Order Thinking Skills (HOTS) in Children Aged 4-6 Years

The control class is the class before being given treatment and the experimental class is the class after being given treatment. In the initial stage of observation in the control class when collecting data, children carried out learning as usual without being treated or treated, but still with the same lesson plans and play activities from the beginning to the end of learning. Next, in the observation stage in the experimental class when collecting data, children carried out learning as usual which is then given treatment or treatment, namely using APE media puzzle hopscotch, learning is still carried out with the same lesson plans and play activities as the control class from start to finish. These two things aim to measure whether there is an influence on children's higher-order thinking skills (HOTS), both before and after being given treatment using APE learning media. puzzle hopscotch. Based on the results pretest-posttest can be seen in the following table:

Table 2. Data Analysis Results in Pretest-Posttest HOTS Control and Experiment Class

No	Interval Score (%)	Criteria/Categories	Control Class		Experiment Class	
			Pretest	Posttest	Pretest	Posttest
1	0 – 25	BB	0	0	0	0
2	26 – 50	MB	6	0	6	0
3	51 – 75	BSH	15	14	15	10
4	76 – 100	BSB	0	7	0	11
	Total		21	21	21	21

Based on Table 2, the pretest data for higher order thinking skills (HOTS) in the control class showed 6 children, in the beginning, to develop (MB) category with a score range of 26-50%, and 15 children developing as expected (BSH) with a score range of 51-75%. Posttest data indicated 14 children in the BSH category and 7 children in the very well-developing (BSB) category with score ranges of 51-75% and 76-100% respectively. This demonstrates a significant improvement from pretest to posttest, with children advancing from MB to BSH and an increase in the BSB category. In the experimental class pretest, 6 children were in the MB category (26-50%), and 15 children were in the BSH category (51-75%). Posttest results showed 10 children in the BSH category and 11 in the BSB category (76-100%). This indicates a notable improvement in the experimental class, with children moving from MB to BSH and BSB categories after treatment with APE puzzle hopscotch.

3.2. Validity and Reliability Test Results

A validity test determines whether an item is valid and whether the instrument used is correct, influencing the accuracy of results if it has high validity (Muidatul Faziyah, 2021). Meanwhile, reliability assesses whether a questionnaire provides consistent answers over time (Sugiyono, 2015). Conducting both tests is crucial because invalid and unreliable instruments will lead to invalid and unreliable research results, making these tests essential. For a sample size of N=21 at a 5% significance level, the r_{table} value is 0.433.

Table 3. Value of Validity Test Results

No	r_{xy} (r_{count})	r_{table}	information
1	0,593	0,433	Valid
2	0,674	0,433	Valid
3	0,552	0,433	Valid
4	0,600	0,433	Valid
5	0,794	0,433	Valid
6	0,797	0,433	Valid
7	0,632	0,433	Valid
8	0,605	0,433	Valid
9	0,831	0,433	Valid
10	0,642	0,433	Valid
11	0,637	0,433	Valid
12	0,633	0,433	Valid
13	0,549	0,433	Valid
14	0,564	0,433	Valid
15	0,611	0,433	Valid
16	0,457	0,433	Valid

Based on Table 3, the validity test results indicate that each item was declared valid after being tested using SPSS. With the rtable value at 0.433 and rcount values greater than rtable, the data is declared valid for all items.

Table 4. Value of Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N of Items
.924	16

Based on the data in Table 4, Cronbach's alpha is 0.924, indicating that the data is reliable or accepted. Since a value greater than 0.70 is considered the threshold for reliability, it can be concluded that the data is reliable.

3.3. Normality Test Results

The normality test is a prerequisite test using SPSS to test and find out whether the data used is normally distributed or not. (Imam, 2016)

Table 5. Normality Test Results

	Shapiro-Wilk			
Class	**Statistic**	**df**	**Sig.**	**information**
Pretest Control	0.961	21	0,534	Normal
Posttest Control	0,943	21	0,250	Normal

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Pretest Experiment	0,939	21	0,207	Normal
Posttest Experiment	0,933	21	0,161	Normal

Based on Table 5, the normality data was assessed using the Shapiro-Wilk test for the pretest and posttest results. If the value is greater than 0.05, it indicates that the data is normally distributed. This conclusion is based on the test criterion where if the probability value (sig) is greater than α, H0 is accepted. Conversely, if the probability value (sig) is less than or equal to α, H0 is rejected.

3.4. Homogeneity Test Results

The homogeneity test is used to find out whether the object under study has the same variant. If the object to be studied does not have the same variant, then this test cannot be applied. (Siregar, 2014).

Table 6. Homogeneity Test Results

Test of Homogeneity of Variance				
	Levene Statistic	**df1**	**df2**	**Sig.**
Pretest	0,147	1	40	0,900
Postest	0,033	1	40	0,857

Based on Table 6, the values obtained for the pretest and posttest are 0.900 and 0.857, respectively, indicating that the data is homogeneous since the significance value is greater than 0.05. Therefore, it can be concluded that the pretest and posttest data for children's higher-order thinking skills have homogeneous variance.

3.5. Hypothesis Test (Independent T-Test)

Using the SPSS program to test the hypothesis on the pretest and posttest values with a 5% significance level, the hypotheses tested are Ha: Learning using APEpuzzle hopscotch influences children's higher-order thinking skills in PAUD IT ADAR and H0: Learning using APEpuzzle hopscotch does not affect children's higher-order thinking skills in PAUD IT ADAR. Based on probability, Ha is accepted if significant < 0.05 and H0 is rejected if significant > 0.05.

The formulation of research hypotheses is as follows: Ha: There is a difference in the average student learning outcomes between the control group and the experimental group, and H0: There is no difference in the average student learning outcomes between the control group and the experimental group. The criteria for accepting and rejecting the hypothesis are as follows: if the sig. (2-tailed) value > 0.05, H0 is accepted and Ha is rejected, meaning there is no difference in the average student learning outcomes between the control group and the experimental group; if the sig. (2-tailed) value < 0.05, H0 is rejected and Ha is accepted, meaning there is a difference in the average student learning outcomes between the control group and the experimental group. The independent sample t-test aims to compare or determine whether there are differences in pretest and posttest scores in the control group and the experimental group (Kariadinata, 2012).

Table 7. Test T-test Independent

Data	Group	df	Significance Value	Decision
Pretest	Control and Experiment	40	0,206	H_a accepted
Posttest	Control and Experiment	40	0,002	H_0 rejected

The T_{table} value is based on degrees of freedom (df) = N - 2, which for 21-2 equals 19, resulting in a T_{table} value of 1.729. This value is used to determine whether H0 is rejected and Ha is accepted. Based on Table 7, the results of the independent tests show that for the pretest, H0 is accepted, indicating no significant difference between the control group and the experimental group, as the significance value is 0.206 (greater than 0.05). However, for the posttest, H0 is rejected because the significance value is 0.002 (less than 0.05). Therefore, it can be concluded that there are differences in higher-order thinking skills between those learning with APE Puzzle hopscotch and those learning without it.

3.6. N-Gain Score Test Results

Normalized gain or N-gain score the aim is to determine the comparison, and difference. or difference in scores and measure the effectiveness of the extent of improvement in learning outcomes from the beginning before being given treatment until after being given treatment, namely in the control and experimental classes. (Hake, 1999)

Table 8. Test Calculation Results N-Gain

N	Control Group	Experiment Group
	N-Gain Score (%)	N-Gain Score (%)
1	33,33	50,00
2	27,78	35,29
3	26,67	35,71
4	26,67	50,00
5	23,53	46,67
6	36,36	61,54
7	40,00	75,00
8	54,55	100,00
9	42,86	61,54
10	42,86	45,45
11	40,00	66,67
12	44,44	100,00
13	37,50	50,00
14	50,00	85,71
15	21,05	43,75
16	13,33	28,57
17	29,41	53,33
18	33,33	57,14
19	50,00	61,54
20	15,38	40,00
21	28,57	50,00
MEAN	34,17	57,04
MAX	54,55	100,00
MIN	13,33	28,57

Based on Table 8, the N-gain score test data in per cent form shows that the average N-gain score for the control group, which did not receive any treatment, is 34.17%, placing it in the ineffective category, with a minimum N-gain score of 13.33% and a maximum of 54.55%. In contrast, the experimental group, which received the APE Puzzle hopscotch treatment, has an average N-gain score of 57.04%, categorizing it as quite effective, with a minimum N-gain score of 28.57% and a maximum of 100%. Thus, it can be concluded that the use of APE Puzzle hopscotch is quite effective in improving higher-order thinking skills in children aged 4-6 years.

Based on the explanations above, it is evident that children have been able to reach the stage of higher-order thinking skills, as observed during experiments. Learning can be effectively packaged to stimulate their development using APE puzzle hopscotch. Consequently, it can be concluded that there is an influence between the variables X (APE puzzle hopscotch) and Y (higher-order thinking skills/HOTS). The results indicate that X has a significant impact on Y, demonstrated by the significant value of the independent T-test being 0.002, which is less than 0.05. This signifies differences between the control group and the experimental group. The substantial influence of X on Y is further evidenced by the categorization of

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assessments of higher-order thinking skills in children aged 4-6 years, as depicted in the following table and graph.

Table 9. The Big Influence of X on Y

No	Category	Number of Children	%
1	BB	0	0
2	MB	0	0
3	BSH	10	48
4	BSB	11	52
	Total	**21**	**100**

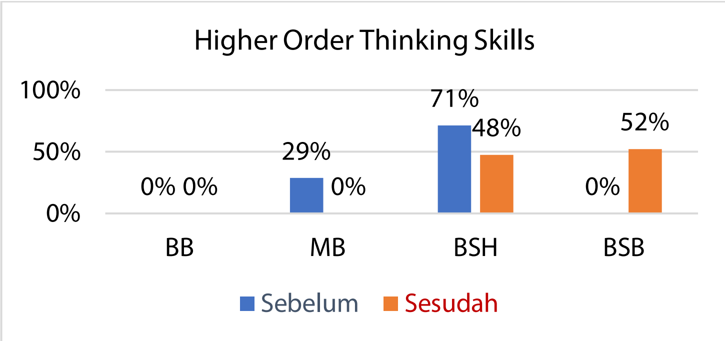

Figure 3. Higher Order Thinking Skills Graph

Based on Table 9, it is explained that no children fell into the BB and MB categories after receiving treatment. However, 10 children are in the BSH category, and 11 children are in the BSB category, totalling 21 children from the experimental class post-experiment. Figure 6 presents a graph displaying the pre and post-class results in the experimental class, with the pre-experimental class marked in blue and the post-experimental class in red. The graph shows no children in the BB category in both pre and post-experimental classes. In the MB category, 29% of children were from the pre-experimental class, but this changed to 0% in the post-experimental class. In the BSH category, 71% of children were in the pre-experimental class, which decreased to 48% in the post-experimental class. In the BSB category, there were 0% of children in the pre-experimental class, which increased to 52% in the post-experimental class.

3.7. Implementation of APE puzzle hopscotch on the higher-order thinking skills (HOTS)

This statement is supported by field conditions based on observations of the assessment indicators for measuring HOTS, namely C4, C5, and C6.

3.7.1. C4 Analyze

Figure 4. Children's Learning Activities Show Analyze

The figure shows an activity where the child at point C4 appears to be analyzing and trying to solve each challenge given in the learning process using APE puzzle hopscotch. Besides the activities depicted, children can also differentiate commands, group objects, and use colours effectively. They can provide feedback by answering questions and can critique by asking questions during activities. For example, a child demonstrated confidence by coming forward to express an opinion. Based on the observation sheet, the analysis at point C4 received a classification score of 83%, indicating that the child has been able to perform C4 analysis and implement it during the activity.

3.7.2. C5 evaluating

Figure 5. Children's Activities Show Evaluating

The figure above illustrates point C5, where a child is seen giving directions to a friend to play correctly according to the instructions (evaluating) and correcting their friend's worksheet. At this stage, children can also evaluate their abilities during activities, ask and answer questions about the activities, and evaluate themselves and their peers by correcting friends when they make mistakes in games. Based on the observation sheet, the child's score classification was 87%, indicating that the child was able to carry out evaluations effectively.

3.7.3. C6 Creating

Figure 6. Children's Activities Show Creating

it shows that the child is at point C6, where the child's imagination has been well implemented in creating and producing a beautiful work. At the creation stage, children can produce works distinct from their peers, utilizing their ideas and imaginations to create unique and creative outputs characteristic of early childhood. They express their creative ideas through different figures and colours. On the creating point, the child has demonstrated the ability to create works with their imagination, achieving a score of 84%.

Based on the explanation above, it can also be seen the magnitude of the influence of each indicator on children's higher-order thinking skills, namely as in the following diagram:

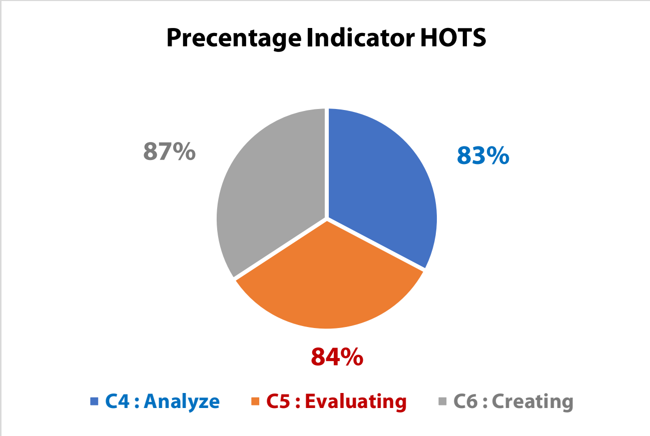

Figure 6. HOTS Child Percentage Diagram

The percentage diagram above shows that the highest score is at point C6 (Creating) with 87%. Observations in the field indicate that older children can create works by combining their thinking abilities with their imagination, producing outputs that even the teacher had not anticipated. This demonstrates that children's cognitive and imaginative capabilities are effectively connected, leading to unique and interesting work. The second highest score is at point C5 (Evaluating) with 84%, where children can evaluate both themselves and their peers. However, children still require more guidance to develop greater independence, self-confidence, and the ability to evaluate their own and others' mistakes. The lowest score is at point C4 (Analyzing) with 83%. At this stage, children exercise their ability to analyze, complete activities, express opinions, distinguish colours and shapes, and solve puzzles. This shows that while many children can perform analytical tasks well, there are still several who struggle with shyness, doubt, and lack of confidence when faced with challenges, often giving up or seeking the teacher's help instead of attempting to analyze the problem.

Discussion

This study investigates the effect of APE puzzle hopscotch on higher-order thinking skills (HOTS) in children aged 4-6 years at PAUD IT ADAR Kalasan DIY. Previous research highlights the necessity of appropriate stimuli to enhance children's critical thinking and cognitive development (Fahmi, 2023; Rahman, 2009). Higher-order thinking, encompassing analysis, evaluation, and creation, is essential in modern education to foster competitive and innovative human resources (Munar, 2022; Endrayanto, 2021). Implementing creative and interactive educational tools like APE puzzle hopscotch aligns with the need to stimulate young learners' cognitive and motor skills, ensuring a comprehensive development approach (Akbar et al., 2022; Hasanah et al., 2022). This study explores whether APE puzzle hopscotch can significantly impact children's HOTS, contributing to the growing body of literature on early childhood education and cognitive development.

The study's findings indicate a significant improvement in the experimental group's HOTS, as evidenced by pretest and posttest scores. In the control group, posttest data showed 14 children in the developing as expected (BSH) category and 7 in the very well developing (BSB) category. Conversely, the experimental group demonstrated notable progress, with 10 children in the BSH category and 11 in the BSB category post-treatment. These results underscore the effectiveness of APE puzzle hopscotch in enhancing children's cognitive abilities, validating the hypothesis that interactive learning media positively impact HOTS (Muidatul Faziyah, 2021; Sugiyono, 2015). The observed improvements suggest that integrating such tools in early childhood education can lead to substantial gains in cognitive development, particularly in areas requiring higher-order thinking.

Comparing these results with previous studies reveals consistent findings regarding the benefits of interactive educational tools. Research indicates that educational game tools can significantly enhance children's cognitive and motor skills, supporting our results (Aristian, 2021; Mentari & Andriyani, 2021). Additionally, the integration of traditional games like hopscotch into educational media aligns with findings that such activities improve physical coordination and cognitive function (Utari et al., 2022; M. A. Putri et al., 2021). This study further corroborates the importance of innovative learning approaches in early childhood education (Siregar, 2014; Imam, 2016). These findings suggest that combining traditional games with modern educational techniques can yield significant benefits in developing critical cognitive and motor skills in young children, supporting a holistic approach to early childhood education.

Contrarily, some studies emphasize the challenges of implementing interactive tools in diverse educational settings. While our findings show significant improvement, it is essential to consider contextual factors such as teacher preparedness and resource availability (Badru & Eliyawati, 2010; Khasanah, 2021). The successful application of APE puzzle hopscotch requires thorough teacher training and a supportive learning environment. This study's controlled setting may have facilitated better outcomes, highlighting the need for adaptable strategies in broader educational contexts (Poetry, 2019; Setyaningsih et al., 2022). These considerations underscore the importance of providing adequate support and resources to educators to maximize the benefits of innovative educational tools like APE puzzle hopscotch across various settings.

The results can be explained by the stimulating nature of APE puzzle hopscotch, which engages multiple cognitive and motor skills simultaneously. The integration of puzzles and physical activity promotes both analytical and creative thinking, fostering comprehensive cognitive development (Pendidikan et al., 2022; Munar, 2022). The significant improvement in post-test scores reflects the tool's effectiveness in providing a balanced, engaging learning experience. However, the influence of individual differences in cognitive development should be acknowledged, as children may respond variably to the same stimuli (Apino & Retnawati, 2017; Ghent & Kanira, 2012). This variability highlights the need for personalized approaches in early childhood education to cater to each child's unique developmental trajectory.

The significance of these findings lies in their potential implications for early childhood education. By incorporating interactive and stimulating educational tools like APE puzzle hopscotch, educators can enhance cognitive development and prepare children for future learning challenges. However, cautious interpretation is necessary, considering potential limitations such as sample size and the specific educational setting. Further research is recommended to explore the tool's effectiveness across diverse demographics and educational environments (Greiff et al., 2015; W. T. A. Putri & Umah, 2020). These steps will help ensure that the benefits observed in this study can be generalized and applied broadly, enhancing early childhood education practices.

These findings imply that integrating innovative educational tools into early childhood curricula can significantly enhance cognitive development. The positive impact of APE puzzle hopscotch on HOTS suggests that similar interactive media could be beneficial in other educational contexts. This study underscores the importance of creativity and innovation in educational strategies, advocating for the broader implementation of such tools to foster comprehensive cognitive and motor skills development in young children (Jaenudin et al., 2020; Sutama et al., 2019). The broader application of these findings could lead to significant advancements in early childhood education, promoting a more engaging and effective learning environment. This study demonstrates the potential of APE puzzle hopscotch as an effective tool for enhancing higher-order thinking skills in early childhood education.

The significant improvements observed in the experimental group highlight the tool's capacity to stimulate cognitive development comprehensively. The implications for educational practice include the need for incorporating interactive, engaging tools into curricula to foster critical thinking and problem-solving skills. Future research should aim to validate these findings across different educational settings, ensuring that such innovative approaches can be universally applied to benefit children's cognitive development (Nachiappan et al., 2018;

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Herdayanti & Watini, 2021). This research contributes to the ongoing discourse on the importance of early childhood education and the need for innovative teaching tools to support holistic development.

Conclusion

This study aimed to investigate the impact of using APE puzzle hopscotch on the higher-order thinking skills (HOTS) of children aged 4-6 years in PAUD IT ADAR Kalasan DIY. Findings indicate significant enhancement in HOTS among children using APE puzzle hopscotch, evidenced by improved posttest scores. These results suggest that integrating innovative educational tools into early childhood curricula can substantially enhance cognitive development, advocating for creativity and innovation in educational strategies. Despite limitations such as a small sample size and short study duration, the research underscores the potential benefits of such tools in fostering comprehensive cognitive and motor skills development. Future research should address these limitations, explore the effects on other developmental areas, and investigate implementation challenges to provide valuable insights for educators and policymakers. In conclusion, APE puzzle hopscotch significantly enhances children's HOTS, supporting the broader implementation of interactive educational tools to advance early childhood education.

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