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The Application of the Arithmetic Bowling Method on Children's Cognitive Abilities

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Abstract

The cognitive abilities of early childhood, particularly in recognizing numbers, counting, and performing simple addition, are still not optimally developed when conventional methods dominate learning and meaningful play activities are lacking. Therefore, this study aims to determine the effectiveness of applying the Arithmetic Bowling play method in developing the cognitive abilities of 5-6 year-old children at TKIT Baitusshalihin Banda Aceh. This study used a quantitative approach with a one–group pretest–posttest design involving 20 children as research subjects. The instrument used was a cognitive ability observation sheet that included indicators of number recognition, color pattern arrangement, counting objects, and simple addition. The data were analyzed using descriptive statistics and an inferential test, a Paired Sample t-Test. The results showed a significant increase in children's cognitive abilities after applying the Arithmetic Bowling method, as indicated by a pretest total score of 241, which increased to 313 on the posttest, yielding an average increase of 3.6 points. The t-test yielded a p-value of 0.000 (<0.05), indicating that the Arithmetic Bowling method had a significant effect on the development of children's cognitive abilities. These findings imply that integrating interactive, concrete, and contextual educational games can be an effective learning strategy for early childhood educators to support children's cognitive development in line with the Merdeka Curriculum.

Keywords: Arithmetic Bowling; Cognitive Abilities; Early Childhood; Play-Based Learning; Pre-Mathematics

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INTRODUCTION

Early childhood education (ECE) aims to provide high-quality educational guidance and stimulation so that children can grow into intelligent individuals who are useful to society and the country. Early childhood education (ECE) can be delivered through formal, non-formal, and informal channels. According to Permendikbud No. 37 of 2014, early childhood education is a form of education that aims to encourage and optimize various aspects of child development. There are six aspects of development that educators in Early Childhood Education need to improve (Fauziddin & Mufarizuddin, 2018).

One aspect that needs improvement in young children is their cognitive abilities. One important cognitive element to develop is the ability to understand the concept of comparison, which is the basis for children to understand the relationship between objects and quantities, such as "many," "few," "more," "less," "equal," and "different" (Indriyani & Setyadi, 2025) .

Based on initial observations at TKIT Baitusshalihin on July 14, 2025, it was found that children's cognitive abilities in recognizing and counting numbers were not yet optimally developed. The learning process was not yet fully aligned with the *Standar Tingkat Pencapaian Perkembangan Anak* (STPPA) because it was still dominated by conversation-based methods and the use of notebooks and paper, lacking interactive play activities. This condition causes children to be less active, easily bored, and unable to gain meaningful learning experiences. Therefore, there is a need for innovative learning methods appropriate to the characteristics of early childhood, one of which is the application of the Arithmetic Bowling method as a concrete and fun means of learning to count.

Pre-mathematics learning in early childhood is still often dominated by conventional methods that do not actively involve children, so that the development of cognitive abilities such as recognizing numbers, counting, and simple addition has not developed optimally. In fact, the Merdeka Curriculum emphasizes contextual, child-centered, play-based learning. Although play-based learning has been widely studied, empirical research on the effectiveness of Arithmetic Bowling as a pre-mathematics learning medium for children aged 5–6 years remains limited. Therefore, this study is important for providing empirical evidence and practical guidance for early childhood educators in implementing interactive, play-based learning aligned with the Merdeka Curriculum.

The application of Arithmetic Bowling as a structured learning method for introducing numbers and simple arithmetic operations (through the activities of throwing, counting pins, and then adding the results of two throws) (Tumbel, 2021). Arithmetic Bowling is a combination of bowling activities and arithmetic concepts. Bowling is a sport that involves knocking down ten pins located at the end of a lane using a ball. In general, bowlers use one hand to hold the ball. Arithmetic Bowling provides this experience through activities such as rolling the ball, counting the number of pins knocked down, adding up the results of two throws, arranging numbers, and recognizing color patterns. This activity directly stimulates logical thinking, number-symbol recognition, and simple calculation skills, in line with indicators of child development (Rahayu & Alim, 2020) . Puspa & Jaya (2023) states that bowling is a sport activity in which a ball is rolled or thrown with the hands. The ball is launched toward pins arranged in a specific pattern, known as a strike.

Based on the results of previous studies, there have been many studies that use bowling as a medium to develop the counting skills of early childhood, such as the study conducted by (Aisya & Suryana, 2023) with the title The Effect of Fruit Bowling on the Counting Skills of 5-6 Year Old Children at the Aisyiyah 14 Padang Kindergarten-Kanak Aisyiyah 14 Padang, showed that the Fruit Bowling game has an effective influence in improving children's number recognition skills. However, this study is still limited to number recognition, without integrating addition concepts.

Furthermore, research by (Mahdalena et al., 2023) entitled The Effect of Modified Bowling Games on the Counting Ability of 4-5 Year Old Children, regarding Modified Bowling, focuses more

on the development of gross motor skills and counting ability, but does not specifically relate it to cognitive indicators according to STPPA. Thus, the findings of this study are not only consistent with previous studies but also make new contributions by integrating formal arithmetic elements (addition, number symbol recognition, color patterns) with comprehensive cognitive development indicators.

The novelty of the study, entitled "The Application of the Arithmetic Bowling Method on the Cognitive Abilities of Children at Baitusshalihin Islamic Kindergarten," lies in the development of innovative learning media and a more comprehensive focus on the cognitive abilities of young children. Previous studies generally focused only on modified bowling games to train children's counting or number skills, such as fruit bowling. Meanwhile, this study introduces Arithmetic Bowling as a learning medium that not only hones counting skills but also trains logical thinking, understanding number symbols, recognizing color patterns, and performing simple addition in a contextual context through play activities. Through the design of this medium, children's gross motor skills are also developed, as the activities of rolling the ball and knocking down pins are carried out simultaneously with thinking and counting. Thus, this game combines physical and cognitive stimulation in an integrated manner.

Theoretically, this research contributes to the development of early childhood learning studies, particularly from a play-based learning perspective, by reinforcing the understanding that educational games can serve as a structured learning method grounded in pedagogical principles to develop children's cognitive abilities (Amanda & Wahyuningsih, 2025). This study expands the discourse on integrating motor activities and cognitive processes. It provides empirical evidence on the effectiveness of the Arithmetic Bowling play method in stimulating logical thinking, number-symbol recognition, and simple addition skills in early childhood.

Practically, this research contributes to educators and early childhood education practitioners by offering an alternative, innovative, enjoyable, and contextually relevant learning strategy through the application of the Arithmetic Bowling game method. The findings of this study can serve as a reference for designing learning activities aligned with the characteristics of early childhood development, as well as STPPA and the Merdeka Curriculum. This research can also be utilized by educational institutions as a basis for developing more varied game-based learning media, so that the cognitive learning process does not only focus on conventional methods but emphasizes active, creative, and meaningful learning experiences.

Based on these issues, this study positions itself to examine more closely the effectiveness of applying the Arithmetic Bowling method to improve cognitive abilities in early childhood comprehensively. It emphasizes the urgency of developing cognitive abilities through the Arithmetic Bowling method. This study is expected to contribute theoretically to strengthening research on game-oriented learning and to provide practical benefits for early childhood educators in designing creative, interactive learning processes aligned with the Merdeka Curriculum. Thus, the objective of this study

is to analyze and prove the effectiveness of the Arithmetic Bowling game method in developing the cognitive abilities of 5–6 year-old children at TKIT Baitusshalihin Banda Aceh.

METHODS

The method applied in this study was a quantitative approach with a pre-experimental design. The research design applied in this study is a "One-Group Pretest-Posttest Design" (Arliana et al., 2022), in which, before receiving treatment, the subjects, consisting of 20 students aged 5-6 years, participated in arithmetic bowling games for approximately 1 week. The research first administered a pretest, followed by a posttest after implementing the Arithmetic Bowling method.

The use of a pre-experimental design (one group pretest–posttest design) in this study was based on contextual considerations and research objectives. This design was chosen because the research was conducted in a real ECE classroom setting with a limited number of subjects, making it impossible to divide the subjects into control groups without disrupting the regular learning process.

Table 1

One Group Pretest-Posttest Research Design

0_1	X	0_2
Pretest	*Treatment*	*Posttest*

Description:

X : Treatment (Application of arithmetic *bowling*)

0_1 : Initial test (*pre-test*) before learning

0_2 : Post-test after learning (Triastuti et al., 2024)

This study was conducted at TKIT Baitusshalihin, located in Gampong Ceurih, Ulee Kareng District, Banda Aceh City, an early childhood education institution that focuses on character development and students' basic skills.

This study used two main methods to collect data: observation and document recording (Andini & Rahmawati, 2025). Observation was used to directly observe the development of children's cognitive abilities during the implementation of the Arithmetic Bowling game. Observations were conducted based on cognitive development achievement indicators compiled in accordance with the Foundation Phase Learning Outcomes of the Ministry of Education, Culture, Research, and Technology. Documentation was used to obtain supporting data, including school profiles, photos of activities, and evidence of children's learning activities during the research period (Agung et al., 2023).

The cognitive ability indicators in this study were selected because they represent essential pre-mathematical aspects of children aged 5–6 years, as outlined in the STPPA and Foundation Phase Learning Outcomes. These indicators include number recognition, counting objects, simple addition, and color pattern arrangement, which reflect children's understanding of numbers, quantities, and

logical thinking skills. These four indicators are interrelated and relevant to be stimulated through Arithmetic Bowling activities, thereby providing a comprehensive description of children's cognitive development.

This research was conducted for approximately one week, after obtaining official permission from the school and related institutions. The stages taken in this study included: (1) preparation of measurement tools, (2) preliminary testing, (3) implementation of treatments related to the arithmetic bowling game, and (4) final testing. The intervention was carried out in stages to support the children in adjusting to the rules of the game and to provide researchers with opportunities to observe the children's cognitive progress. All activities were carried out in a fun atmosphere, supported by researchers and classroom teachers, so that the children felt safe and enthusiastic about participating (Yulan et al., 2025).

This study used a pre-experimental design without a control group, limiting its internal validity. In addition, the short duration of the intervention and the use of observation as a measurement tool introduced subjectivity into the assessment. Hence, the study's results need to be interpreted contextually. However, the limitations of this research method lie in the short duration of the intervention, which means the results describe more of an initial effect and do not yet reflect the long-term impact of applying arithmetic bowling games on children's cognitive development. In addition, this study did not use longitudinal observation, which would have allowed for continuous monitoring of children's development.

Table 2

Child Development Achievement Rubric

Learning Outcomes	***Learning Objectives***	***Context***	***Child Development Indicators***			
			Emerging (1)	***Developing (2)***	***Proficient (3)***	***Advanced (4)***
Children recognize and use pre-mathematical concepts to solve problems in everyday life	The child can count numbers in sequence (rote counting)	Observe whether the child can correctly name and sequence the numbers 1–6 and count the number of pins that fall after each throw				
		The child throws the ball at the pins and counts the number of pins that fall.				
		The child demonstrates				

Learning Outcomes	***Learning Objectives***	***Context***	***Child Development Indicators***			
			Emerging (1)	***Developing (2)***	***Proficient (3)***	***Advanced (4)***
		the ability to add up the pins that fall in two rounds of play				
		Children can arrange six color patterns (sage, dark orange, green, red, purple)				

Source: Explanatory Book on the Scope of Learning Outcomes for the Foundation Phase (Ministry of Education and Culture, 2022)

Data analysis was conducted using descriptive and inferential approaches. Descriptive analysis was used to describe the distribution of children's achievements across the categories of Newly Developing, Competent, Adequate, and Proficient, both before and after treatment. On the other hand, inferential analysis was conducted using normality tests and paired-samples t-tests in SPSS version 26 to examine differences between pretest and posttest results. The significance level was set at 5% ($p < 0.05$). If the significance value was less than 0.05, then the use of arithmetic bowling was considered to have a significant effect on the cognitive abilities of children at TKIT Baitusshalihin.

RESULTS AND DISCUSSION

RESULTS

Based on the descriptive analysis of the 20 students who participated in the arithmetic bowling game learning activity, it was found that the children's cognitive abilities improved after the treatment. The pretest results showed that most children were in the newly developing to adequate category, with simple addition, number sequencing, and color recognition. This improvement was evident from the increase in the overall average score of the children, which was marked by an increase in the children's ability to recognize number symbols, count objects, recognize colors accurately, and perform simple addition more independently (Agung et al., 2024).

Table 3

Research Data Analysis Results

No	Name	*Pretest* (number)	Average	*Posttest* (number)	Average	Delta (Δ)
1.	MA	11	2.75	15	3.75	4
2	FMA	13	3.25	16	4	3
3.	HA	13	3.25	16	4	3
4.	RA	10	2.5	15	3.75	5
5.	PMA	14	3.5	16	4	2
6.	MAA	14	3.5	16	4	2
7.	FM	11	2.75	15	3.75	4
8.	HA	13	3.25	16	4	3
9.	MA	13	3.25	16	4	3
10.	AA	12	3	16	4	4
11.	MN	10	2.5	15	3.75	5
12.	PLI	12	3	16	4	4
13.	MS	13	3.25	15	3.75	2
14.	AK	12	3	16	4	4
15.	FAK	12	3	16	4	4
16.	TMZA	11	2.75	15	3.75	4
17.	MAM	13	3.25	16	4	3
18.	MFM	10	2.5	16	4	6
19.	AAR	12	3	15	3.75	3
20	LR	12	3	16	4	4
Total		**241**	**60.25**	**313**	**78.25**	**72**
Total		12.05	3.0125	15.65	3.9125	3.6

From the results of the pretest and posttest data analysis of 20 children who participated in learning activities using the Arithmetic Bowling method. The table shows that the total pretest score was 241, while the total posttest score increased to 313, resulting in a cumulative increase of 59 points. On average, the children's pretest score was 12.05, which then increased to 15.65 on the posttest. Thus, the average increase (Δ) was 3.6 points (Juliasari & Esita, 2025) .

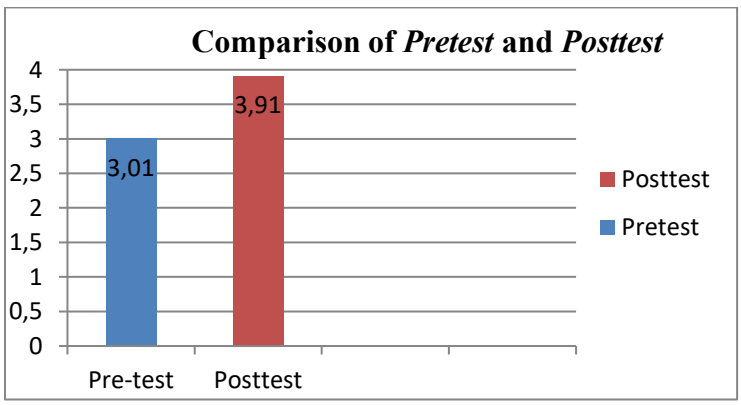

Figure 1. Comparison of Pretest and Posttest

The bar chart compares the pretest and posttest results of the children's cognitive abilities after implementing the Arithmetic Bowling game method at TKIT Baitusshalihin. At the pretest stage, the average score for the children was 3.01, reflecting their initial abilities in recognizing numbers, counting objects, and performing simple addition before treatment. After participating in learning using the Arithmetic Bowling game, the average posttest score increased to 3.91. This increase indicates that learning media that rely on games can provide a more efficient boost to children's cognitive development, especially in logical thinking and pre-mathematics.

Normality Test

The normality test is used to determine whether a sample from the population follows a normal distribution or is close to normal. In this study, the researcher applied the Shapiro-Wilk test in SPSS Version 26. The Shapiro-Wilk test was applied to data samples of less than 50, with the following conditions for determining normality: .

Significance of the test ($\propto$) = 0.05

If the p-value is less than 0.05, then the null hypothesis (Ho) is rejected, meaning the data is not normally distributed; otherwise, the sample comes from a population with a normal distribution.

If Sig. >0.05, then $H_a$is accepted, or the data is normally distributed.

Table 2

Normality Test

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistics	df	Sig.	Statistic	df	Sig.
Pretest	.184	20	.075	.913	20	.073
Posttest	.186	20	.068	.954	20	.424

The normality test results indicate that the pretest and posttest data meet the assumption of normality. Based on the Shapiro–Wilk test, which is more appropriate for samples with fewer than 50 respondents, the significance value for the pretest data is 0.073, while for the posttest data it is 0.424. Both values are greater than 0.05, indicating that the pretest and posttest data are normally distributed. Therefore, the data from this study meet the criteria for parametric statistical analysis, such as the Paired Sample t-Test.

Hypothesis Testing (T-Test)

The t-test was conducted to evaluate the research hypothesis regarding the effect of each independent variable on the dependent variable (Azhari et al., 2023). The t-test was used to determine whether the independent variables had separate effects on the dependent variable.

Table 3

T-test

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pre-test - Post-test	3.013	.325	.073	2,860	3,165	41,455	19	.000

According to the Paired Samples Test table, the (2-tailed) p-value is 0.000, which is below the significance level of 0.05. This indicates a significant difference between the pretest and posttest results. In this study, the decision-making guidelines state that if the (2-tailed) value is < 0, based on the information obtained, it can be concluded that there is a significant difference between the two data groups. Conversely, if the Sig. value is greater than 0.05, then there is no significant difference, so it can be stated that the hypothesis is:

Ha: Arithmetic Bowling Media can develop the cognitive abilities of 5-6 year old children at TKIT Baitusshalihin.

Ho : Arithmetic Bowling Media cannot develop the cognitive abilities of 5-6 year old children at TKIT Baitusshalihin.

After obtaining a t-value of 41.455, the next step is to compare this value with the t-table to determine whether there is a significant difference between the pretest and posttest results. (Rahmani et al., 2025) The hypothesis criteria are as follows:

Ha is accepted and Ho is rejected if t-calculated > t-table

Ho is accepted and Ha is rejected if t-calculated < t-table

The t-table value is determined based on a significance level of 0.05 using the formula (df = n – 1). Thus, the formula for determining the t-table value can be written as follows: (Teni, 2021)

If df = n-1, then df = 20-1= 19 (1.729)

Based on the analysis results in the table, df = 19, and the significance value is 1.729, indicating that the t-count (41.455) has a greater absolute value than the t-table value at the significance level. If the significance value is less than 0.05, then the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted. Thus, it can be concluded that the use of arithmetic bowling media

significantly improves cognitive abilities in children aged 5 to 6 years at TKIT Baitusshalihin.

DISCUSSION

The study results indicate that implementing the arithmetic bowling method has a significant impact on the development of thinking skills among children aged 5 to 6 years at TKIT Baitusshalihin. This finding is supported by the results of the paired-samples t-test, where the t-value (41.455) is greater in absolute value than the t-table value (1.729), and the significance value is 0.000 (< 0.05). These results provide empirical evidence of a significant difference between pretest and posttest scores, thereby accepting the research hypothesis (Ha), namely that the Arithmetic Bowling media can develop children's cognitive abilities.

The findings of this study align with the basic concept of cognitive development in early childhood, which emphasizes the importance of learning through concrete activities and direct experiences. According to Piaget, children aged 5 to 6 years are in the preoperational stage, where they learn through direct interaction with real objects (Marinda, 2020).

According to Kurniati's research, bowling games benefit the gross motor development of children aged 5 to 6 years. This is because in bowling games, children engage in many activities that involve their large muscles. For example, they run, jump, and swing their arms when throwing the ball. In addition, this game helps develop coordination between children's eyes, hands, and feet to knock down the placed pins (Siregar et al., 2025).

Arithmetic Bowling provides this experience through activities such as rolling the ball, counting the number of pins that fall, adding up the results of two throws, arranging numbers, and recognizing color patterns. These activities directly stimulate logical thinking, number-symbol recognition, and basic counting skills, in line with children's developmental milestones.

Cognitive refers to all cognitive activities related to perception, thinking, memory, and information processing that enable individuals to master information, overcome challenges, and plan for the future. According to Piaget, cognitive theory proposes that a person's thinking develops and becomes more complex as neurological maturity advances and is influenced by the environment. According to Piaget's theory, cognitive development is understood through the perspectives of structuralism and constructivism. The structuralist approach is seen from its perspective on intelligence, which develops through a series of growth phases influenced by the characteristics of cognitive structures.

The results of this study are also supported by previous research. Research conducted by Aisya & Suryana (2023) entitled "The Effect of Fruit Bowling Games on the Ability to Count in Children Aged 5-6 Years at Aisyiyah 14 Padang Kindergarten," shows that fruit bowling games effectively improve children's ability to recognize numbers. However, this study is still limited to number

recognition without integrating the concept of addition. Furthermore, research by Mahdalena et al. (2023) entitled The Effect of Modified Bowling Games on the Counting Ability of 4-5 Year Old Children, regarding Modified Bowling, focuses more on the development of gross motor skills and counting ability, but does not specifically relate it to cognitive indicators according to STPPA.

Based on this comparison, this study does not contradict previous research findings but rather reinforces the evidence that bowling is an effective learning medium for developing young children's cognitive abilities. The advantage of this study lies in the use of Arithmetic Bowling media, which is more systematic, structured, and in line with the learning outcomes of the Merdeka Curriculum. Thus, this game not only improves counting skills but also contributes to the development of broader cognitive skills, such as problem-solving, decision-making, and logical thinking, in children.

One factor that influences the success of learning in early childhood is the type of media used as a learning tool for preschoolers, such as educational games that can stimulate various aspects of development. One important way to hone children's counting skills is to introduce numbers early. To introduce numbers to children at an early age in a fun and interesting way, it is important to use appropriate media, such as arithmetic bowling games (Rahman, 2024).

Play has distinctive characteristics, namely: (1) There is an intrinsic motivation from the child; (2) Play activities do not always focus on the result; (3) student participation is very active; (4) it is flexible; (5) it evokes positive feelings; (6) it is done voluntarily; (7) it is fun; and (8) it can teach certain knowledge and skills in line with the objectives of the game (Andriansyah, 2024).

By bowling, children can understand the concept of calculation, carefully estimate the force needed to knock down the bowling ball, and practice coordinating their eyes and hands. After playing this game, children will gain a lot of knowledge about number recognition. In addition, when they are asked to arrange bowling pins in the correct order, children will also learn about sequences and grouping of numbers. Thus, bowling can improve number recognition skills, which are part of cognitive development. This cognitive development lays the foundation for children's thinking.

Counting skills are a part of every child's mathematical skills. Activities related to counting in children involve sequencing numbers and counting, as well as understanding quantities, to develop skills that are very important in everyday life.

The theory of counting ability was proposed by Gelman and Gallistel, who stated that five principles are applied when performing counting activities. The first three principles relate to calculation methods. Children need to understand the three basic principles before performing calculations thoroughly. a) The foundation principle in the calculation process, where each object is counted once and no more than that. There are two main skills applied in this principle: matching numbers to objects and separating counted objects from uncounted ones. A common mistake is failing to pay attention to an object and counting it twice. b) The principle of ordinality requires the use of a

consistent sequence of numbers to ensure accuracy in counting. Maintaining sequence consistency is one of the basic principles of counting that children understand. Children need to understand number sequences well to count. c). The principle of cardinality refers to the understanding that the total number of objects in a group corresponds to the last number obtained when counting. d). The principle of abstraction determines that every object can be measured or counted. e). The principle of unrelated order reveals that objects can be counted in any order (Widowati et al., 2022).

The following are several stages of mastering counting in mathematics: a) Mastering concepts or understanding of something can be done by utilizing real objects and events, such as recognizing colors, shapes, and counting objects or numbers. b) The transition period is a thinking process that is a step from understanding real things to understanding unreal symbols. Here, real objects still exist, but their symbolic forms are introduced. c) Signs or symbols are visual representations of various ideas. For example, the symbol seven represents the concept of the number seven, red represents the concept of color, large represents the concept of space, and so on.

This study provides a conceptual contribution to strengthening play-based learning in early childhood education, particularly in the development of cognitive abilities. The main contribution of this study lies in the development of the concept of Arithmetic Bowling as a structured educational play method that is aligned with the cognitive development indicators of children aged 5–6 years. Conceptually, this study expands the use of bowling games, which previously focused more on counting skills, into a comprehensive pre-mathematics learning medium that introduces number symbols, counts objects, performs simple addition, and arranges color patterns in accordance with STPPA. These findings confirm that integrating motor activities and cognitive processes through concrete games optimally supports children's logical thinking development and aligns with the principles of the Merdeka Curriculum.

This study also has several limitations that need to be critically considered. The use of a pre-experimental design without a control group limits the generalizability of the findings, as the improvement in children's cognitive abilities cannot be fully compared with other learning conditions. In addition, the relatively small number of subjects and the short duration of the intervention may influence the study's results. The observation instruments also have the potential to cause subjectivity in assessment. Therefore, further research is recommended to use a stronger experimental design, involve a broader sample, and a longer intervention duration to obtain more comprehensive and in-depth findings.

CONCLUSION

Based on the study's results, the application of the Arithmetic Bowling method plays an important role in supporting the development of cognitive abilities in early childhood through structured, contextual, and meaningful play-based learning. This method helps children build a concrete

understanding of pre-mathematics while strengthening the concept of play-based learning, aligned with child development indicators and the principles of the Merdeka Curriculum. These findings have practical implications for early childhood educators, suggesting that they utilize Arithmetic Bowling as an alternative method of pre-mathematics learning that is enjoyable, active, and participatory. Further research is recommended using a stronger design with control groups, a larger number of subjects, and a longer intervention duration, as well as developing game variations to examine their influence on other aspects of child development, such as social-emotional and motor skills.

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REFERENCES

Agung, A., Bayu, N., Saptiari, N. M., Hindu, U., Gusti, N. I., & Sugriwa, B. (2023). Hubungan Perkembangan Kognitif Peserta Didik Dengan Proses Belajar. *Metta : Jurnal Ilmu Multidisiplin*, *3*(4), 504–515. https://doi.org/10.37329/metta.v3i4.3401

Agung, A., Vira, A., Putri, W., Widiana, I. W., & Rini, M. G. (2024). Media Augmented Reality Belajar Membaca untuk Menumbuhkan Kemampuan Kognitif dan Literasi Membaca Awal Anak Usia Dini. *Journal of Education Action Research*, *8*(3), 504–512. https://doi.org/10.23887/jear.v8i3.83973

Aisya, H. S., & Suryana, D. (2023). Pengaruh Permainan Bowling Buah Terhadap Kemampuan Berhitung Anak Usia 5-6 Tahun di Taman Kanak-kanak Aisyiyah 14 Padang. *Jurnal Pendidikan Tambusai*, *7*(2), 18592–18601. https://doi.org/10.31004/jptam.v7i2.9327

Amanda, D., & Wahyuningsih, T. (2025). Penerapan Pendekatan Play-based learning dalam Mengembangkan Sosial Emosional Anak Usia 5-6 Tahun. *Aulad: Journal on Early Childhood*, *8*(2), 791–799. https://doi.org/10.31004/aulad.v8i2.1113

Andini, Y. S., & Rahmawati, I. Y. (2025). Application of the Show and Tell Method to Improve the Speaking Skills of Children Aged 4-5 Years. *PAUDIA:Jurnal Penelitian dalam Bidang Pendidikan Anak Usia Dini, 14*(4), 828–839. https://doi.org/10.26877/paudia.v14i4.2115

Arliana, B. ., Putri, R. D., & Sari, S. P. (2022). Peningkatan Self-disclosure melalui bimbingan kelompok pada siswa kelas X di SMA Negeri 1 Rambang Niru. *Jurnal Pendidikan Dan Konseling (JPDK)*, *4*(4), 1120–1123. https://doi.org/10.31004/jpdk.v4i4.5409

Azhari, E., Saleh, L. M., & Marantika, M. (2023). Analisis Faktor Penyebab Keterlambatan Proyek Pembangunan Gedung Laboratorium Terpadu dan Perpustakaan MAN 1 Maluku Tengah. *Journal Agregate*, *2*(2), 262–270. https://doi.org/10.31959/ja.v2i2.1906

Fauziddin, M., & Mufarizuddin, M. (2018). Useful of Clap Hand Games for Optimalize Cogtivite Aspects in Early Childhood Education. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *2*(2), 162. https://doi.org/10.31004/obsesi.v2i2.76

Indriyani, R., & Setyadi, D. (2025). Development of Interactive Picture Books on Comparing Numbers for Early Childhood Education. *PAUDIA:Jurnal Penelitian dalam Bidang Pendidikan Anak Usia Dini, 14*(4), 757–774. https://doi.org/10.26877/paudia.v14i4.2338

Juliasari, N., Rohmiati, R., & Esita, Z. (2025). The Application of Augmented Reality Media to Improve Cognitive Abilities in Early Childhood. *Edunesia : Jurnal Ilmiah Pendidikan*, *6*(3), 1888–1899. https://doi.org/10.51276/edu.v6i3.1260

Kemendikbud. (2022). Capaian Pembelajaran Fase Fondasi. *Kemendibudristek*, 1–38. https://kurikulum.kemdikbud.go.id/file/1678157827_capaian.pdf

Lisa. (2021). Prinsip Dan Konsep Permainan Matematika Bagi Anak Usia Dini. *Bunayya*, *3*(1), 93–107. https://doi.org/10.22373/bunayya.v3i1.2047

Mahdalena, Aulia, Afifah, S. N., & Susari, H. D. (2023). Pengaruh Permainan Bowling Modifikasi Terhadap Kemampuan Membilang Anak Usia 4-5 Tahun. *Prosiding SNBK (Seminar Nasional Bimbingan Dan Konseling)*, *7*(1), 128–135. https://prosiding.unipma.ac.id/index.php/SNBK/article/view/4686

Marinda, L. . (2020). Teori Perkembangan Kognitif Jean Piaget dan Problematikanya Pada Anak Usia Sekolah Dasar. *An-Nisa' Journal of Gender Studies* , *13*(1), 116-152. https://doi.org/10.35719/annisa.v13i1.26

Puspa, & Jaya, M. P. sari. (2023). Pengaruh Metode Bermain Bowling Aritmatika untuk Mengembangkan Kemampuan Kognitif Pada Anak Usia 4-5 Tahun di PAUD AL-Ishlah Rambutan/Banyuasin. *Jurnal Lentera Pedagogi*, *6*(2), 94–98. https://doi.org/10.54895/lentera.v6i2.1727

Rahayu, P., & Alim, M. L. (2020). Meningkatkan Perkembangan Kognitif Anak Melalui Bermain Bowling Aritmatika Pada Anak Usia 4-5 Tahun Kelompok A TK An- Nur Ujung Padang Kampar Utara. *JOTE (Journal On Teacher Education)* *2*(1), 256–261. https://doi.org/10.31004/jote.v2i1.1227

Rahman. (2024). Upaya Peningkatan Kemampuan Kognitif Berhitung Anak Dengan Permainan Balok. *EDUKIDS : Jurnal Inovasi Pendidikan Anak Usia Dini*, *4*(1), 14-20. https://doi.org/10.51878/edukids.v4i1.3710

Rahmani, D. A., Risnawati , R., & Hamdani , M. F. (2025). Uji T-Student Dua Sampel Saling Berpasangan/Dependend (Paired Sample t –Test). *Jurnal Penelitian Ilmu Pendidikan Indonesia*, *4*(2), 568–576. https://doi.org/10.31004/jpion.v4i2.420

Rokhiyatul Amania, R. H. (2020). Pengaruh Pembelajaran Project Based Learning Terhadap Karakter Sosial Anak Usia 5-6 Tahun Di TK Tanjungsari Surabaya. *Jurnal PAUD Teratai* 1–6.

Siregar, S., Daulay, A. M., & Oktarina, H., (2025). Penggunaan Permainan Bowling dalam Pengenalan Angka Terhadap Anak Usia Dini di RA Tadika Adnani. *Khirani: Jurnal Pendidikan Anak Usia Dini*, *3*(1), 172–185. https://doi.org/10.47861/khirani.v3i1.1579

Teni, A. Y. (2021). Pengaruh Motivasi Belajar Terhadap Hasil Belajar Siswa Kelas VII SMP Negeri 2 Kedokan Bunder Kabupaten Indramayu. *Jurnal Pendidikan Indonesia*, *2*(01), 105–117. https://doi.org/10.59141/japendi.v2i01.73

Triastuti, A., Arafat, Y., & Murjainah. (2024). Pengaruh Penggunaan Media Papan Sumber Daya Alam Terhadap Minat Belajar Siswa Pada Pembelajaran IPAS Kelas IV SD. *Jurnal Pendidikan Dasar Dan Keguruan*, *9*(02), 44-50. https://doi.org/10.47435/jpdk.v9i02.3180

Tumbel, M. E. (2021). *Penerapan Metode Bermain Bowling Aritmatika Untuk Meningkatkan Kemampuan Kognitif Melalui Mengenal Angka 1-20 Pada Anak Kelompok B di TK Kristen Lembon Samala Moronge Selatan 1*. *7*(7), 439–443. https://doi.org/https://doi.org/10.5281/zenodo.7571219

Widowati, P. N. ., Efriyana, T. ., Pratiwi, Y. D. ., & Lukas, S. . (2022). Mengukur Kemampuan Berhitung melalui Metode Fun Game Wordwall pada Siswa Kelas 1 Sekolah Dasar Strada Kampung Sawah. *Jurnal Pendidikan Dan Konseling (JPDK)*, *4*(6), 2957–2964. https://doi.org/10.31004/jpdk.v4i6.8670

Yulan, D., Awalunnisa, S., & Zuama, S. N. (2025). The Effect of Snakes and Ladders on Children's Gross Motor Skills. *PAUDIA:Jurnal Penelitian dalam Bidang Pendidikan Anak Usia Dini, 14*(4), 885–900. https://doi.org/10.26877/paudia.v14i4.2402

Ziaurrahman, Z., ZA, T., & Andriansyah, A. (2024). Pengembangan E-Book Interaktif untuk Menunjang Pembelajaran Diferensiasi pada Mata Pelajaran Pendidikan Agama Islam di Sekolah Dasar. *Jurnal Didaktika Pendidikan Dasar*, *8*(1), 165-184. https://doi.org/10.26811/didaktika.v8i1.1333