



The Effect of the Traditional “*Bola Boy*” Game Using Numbered Cans on Improving Number Symbol Recognition Skills in Students with Mild Intellectual Disabilities

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Abstract: This study aims to determine the effect of modifying the traditional “*bola boy*” game with numbered cans on the ability of students with mild intellectual disabilities to recognize number symbols. Despite previous interventions using picture cards and videos, these students continue to face difficulties in distinguishing number symbols. A quantitative pre-experimental design with a one-group pre-test post-test approach was employed, involving six fourth-grade students from the Bhakti Luhur Baumata Special Education School selected through total sampling. Data were collected using written tests assessing counting, matching, sequencing, and number completion skills, and analyzed using a Paired Samples t-test with SPSS version 25.0. The results revealed a significant improvement in number symbol recognition, with mean scores rising from 58.67 (SD = 15.01) in the pre-test to 81.83 (SD = 12.95) in the post-test, representing an average gain of 23.16 points. Learning mastery increased from 33.3 percent to 100 percent. The paired samples t-test produced a t-value of -16.269 with $p < 0.001$, indicating a statistically significant difference. The effectiveness of this medium is attributed to its alignment with the concrete operational learning characteristics of these students, its integration of motor and cognitive activities providing multisensory experiences, and its facilitation of learning stages based on Dienes' Theory. The modified “*bola boy*” game with numbered cans is therefore proven to be an effective and valuable tool for teaching basic number symbol recognition in special education settings.

Keywords: *traditional games, bola boy, membered cans, number symbols, students with mild intellectual disabilities*

I. Introduction

Children with intellectual disabilities are individuals who have very low intelligence accompanied by an inability to adapt their behavior, which manifests during their developmental years. Many children with mild intellectual disabilities speak fluently but have a limited vocabulary; they experience difficulty with abstract thinking but are still able to keep up with academic lessons both in special education schools and in mainstream schools. In line with the characteristics described above, play can enhance children's cognitive abilities as well as their motor, communication, and language skills. Delays in intellectual development depend on the severity of the child's disabilities and the level of support provided by their environment. Children with mild intellectual disabilities are a subgroup of children with special needs who experience mental retardation; this is caused by incomplete brain development and neurological function. The general characteristics of individuals with intellectual disabilities include, first, intellectual limitations; second, social limitations; and third, limitations in other mental functions. Consequently, the education and instruction provided require specialized programs (Widiastuti & Winaya, 2019).

Mathematical skills encompass learning activities such as addition, subtraction, multiplication, and division; geometric structures; measurement; financial transactions; and time management. Mathematical skills are crucial for enhancing logical thinking abilities (Laurens et al., 2017; Sella et al., 2021). Numeracy skills for children with intellectual disabilities are beneficial for daily activities, such as when buying groceries or supplies, managing finances in simple ways, purchasing medications, and using public transportation. Additionally, numeracy skills form the foundation for the readiness of children with intellectual disabilities to participate in education (Ardiyanto, 2014). Another perspective highlights the benefits of numeracy skills for children with intellectual disabilities as a tool for problem-solving in daily life (Susilawati, 2022). Furthermore, they can enhance reasoning skills and critical thinking skills (Sadidah & Wijaya, 2016).

Teaching math to children with intellectual disabilities is indeed challenging. To bridge their limitations in abstract thinking, educators must use a multisensory approach through physical activities and the manipulation of real objects to transform abstract concepts into concrete forms (Darma & Harsiwi, 2025). Numeracy skills in children with intellectual disabilities need to be developed through engaging learning activities (Wita Harahap & Surya, 2017). Learning materials for children with intellectual disabilities include tools for motor skill development, such as form boards and puzzles; sensory development exercises, such as tactile and olfactory exercises; tools for self-care practice, such as buttoning and zipping exercises; and concentration-building tools, such as balance boards, as well as materials for reading and numeracy practice, among others. (Hestyaningsih & Pratisti, 2021) emphasize that engaging learning media for improving the counting skills of children with intellectual disabilities are best achieved through games. One promising approach is the use of traditional games, which are not only entertaining but also rich in educational values and can be adapted into contextual learning tools.

In this study, games specifically traditional games are used as a learning medium to improve the numeracy skills of children with intellectual disabilities. Traditional games are entertaining activities that use simple tools or no tools at all. Every traditional folk game actually contains values that can be utilized as educational tools for children. “*bola boy*” is one of the traditional games found in Indonesia. Different regions use different terms to refer to “*bola boyan*.” In Kupang itself, the traditional “*bola boy*” game is called “*bola boy*.” East Nusa Tenggara is known for its rich diversity of local wisdom, so there should be traditional games that can serve as a medium for developing the abilities of children with special needs, as indicated by the findings of (Liunokas et al., 2024) which has already applied a musical piol game to develop the gross motor skills of visually impaired children; similarly, a “*bola boy*” marked with numbers could serve as an alternative to help children with mild intellectual disabilities develop their ability to recognize numbers.

Preliminary observations at the Bhakti Luhur Baumata Special Education School indicate that some students with mild intellectual disabilities face difficulties in recognizing numbers. Teachers had previously attempted to address these difficulties by modifying teaching materials such as picture cards and videos but these efforts have not yet yielded significant improvement. This failure stems from the fundamental limitations of both media for the learning characteristics of children with mild intellectual disabilities. Picture cards are static and two-dimensional, making them too abstract for children with mild intellectual disabilities who are still in the concrete operational stage. The cards do not provide a manipulative experience; children only see images of numbers without being able to feel, touch, or physically interact with the objects representing those numbers. Video media tends to make children passive because they only watch without direct interaction, thus failing to provide the kinesthetic feedback that children with mild intellectual disabilities desperately need. As a result, students with mild intellectual disabilities merely memorize the numbers 1-10 but still struggle to meaningfully recall and distinguish the written numeral symbols. As indicated by the interview results above, at the Bhakti Luhur Baumata Special Education (SPED), all mathematics learning activities focused on number recognition rely solely on flashcards and never incorporate traditional games related to number recognition; furthermore, instruction always takes place inside the classroom, which sometimes leads to boredom among the children. This aligns with the findings of Hestyaningsih and Pratisti, who state that engaging learning media for improving the numeracy skills of children with intellectual disabilities are best achieved through games (Hestyaningsih & Pratisti, 2021). One approach to stimulating children’s development by leveraging play activities is through traditional games (Gunawan & Swandi, 2025).

While many previous studies have developed traditional games for children with intellectual disabilities, the novelty of this study lies in the modification of the traditional “*bola boy*” game by replacing roof tile or ceramic shards which were used as targets with used tin cans labeled with the numbers 1-10, which are then arranged in a pyramid in numerical order from 1 to 10. The traditional “*boi-boian*” or “*bola boy*” game essentially uses roof tile fragments arranged in a pyramid and a tennis ball as game equipment (Rahayu & Ismet, 2021; Astuti, E., 2018).

II. Method

This study employs a quantitative approach. According to Creswell & Creswell (2023), a quantitative research approach is a type of research that utilizes structured data collection methods,

numerical data analysis using statistical techniques, and makes statistical estimates or generalizations. This study aims to determine the effect of modifying the “bola boy” game with numbered cans on the ability to recognize number symbols among students with mild intellectual disabilities. The study employs a pre-experimental design with a one-group pre-test-post-test design. (Sugiyono, 2019) explains that this design consists of a single group that takes a pretest (O_1) before the intervention, then receives the intervention (X), and concludes with a posttest (O_2); thus, the effects of the intervention can be determined more accurately by comparing the conditions before and after the intervention.

The population in this study consisted of all 6 fourth-grade students with mild intellectual disabilities at Bhakti Luhur Baumata Special Education School . Total sampling was used due to the limited population size. The use of a sample of 6 students in this pre-experimental design was based on the characteristics of the population of students with intellectual disabilities, whose numbers are limited. As stated in the SAGE Encyclopedia of Research Design, a pre-experimental design with a one-group pre-test post-test can be applied under conditions of limited participants (a small, atypical sample), provided that the interpretation and generalization of results are conducted with caution (Zulkipli et al., 2024).

Research variables are studied to obtain information about the construct under investigation and to draw relevant conclusions (Sugiyono, 2019). The independent variable (X) is the “bola boy” game with numbered cans a modification of the traditional “bola boy” game in which roof tiles or tile fragments are replaced as targets with used cans labeled with the numbers 1-10, which are then arranged in a pyramid shape. In this game, students are asked to throw a ball at the pyramid of cans, pick up the cans that fall, and rearrange them in numerical order from 1 to 10. The dependent variable (Y) is the ability of students with mild intellectual disabilities to recognize number symbols a foundational competency in number recognition that includes the ability to read number symbols, (b) point to number symbols as instructed, and (c) write number symbols as instructed, which was measured through written tests during the pre-test and post-test covering the ability to name, match, and sequence the number symbols 1–10. The instrument used was a test of number symbol recognition administered during the pre-test and post-test. The test instrument used in this study covered three indicators: (1) counting numbers, (2) matching numbers, and (3) ordering numbers.

Data collection involved the use of tests to measure the ability of students with mild intellectual disabilities to recognize number symbols before and after receiving treatment. In addition, observations were conducted during the game to assess the students’ engagement and responses to the “bola boy” game with numbered cans.

The data analysis technique used in this study was the Paired Samples t-test. The Paired Samples t-test was chosen because the data came from the same subjects (pre-test and post-test), and the sample size ($n=6$) allowed for the use of a parametric test, provided that the assumption of normality was met. This test was used to examine the difference in means between the pre-test and post-test scores (Sugiyono, 2019; Field, 2018). Data processing was conducted using SPSS version 25.0 to obtain more accurate analysis results.

This study was conducted through the following stages. The first stage was a preliminary study aimed at identifying and examining various indicators of the ability to recognize number symbols. The second stage was the administration of a pre-test to measure the students' initial abilities. The third stage was the implementation of the intervention, namely the "bola boy" game with numbered cans. The fourth stage was the administration of a post-test to measure the students' final abilities after the intervention. The fifth stage was data analysis to examine the difference between the pre-test and post-test scores.

III. Results and Discussion

A. Results

This study was conducted at Bhakti Luhur Baumata Special Education School over the course of six sessions, consisting of one pretest, four treatment sessions, and one posttest. The following is a presentation of the pretest and posttest results, as well as the outcomes regarding changes in number recognition skills in mathematics instruction through the use of numbered “*bola boy*” media for students with mild intellectual disabilities at Bhakti Luhur Baumata Special Education School.

Table 1. Pre-test and post-test scores of fourth-grade students with mild intellectual disabilities at Bhakti Luhur Baumata Special Education School in mathematics learning using numbered bola boy media.

Tabel 1. Pre-test and Post-test Scores

No	Students Initials	Pre-test		Post-test	
		Score	Grade	Score	Grade
1	BT	9	60	13	86
2	TN	9	60	13	86
3	BA	8	53	11	73
4	YS	5	33	9	60
5	FK	11	73	14	93
6	MB	11	73	14	93

These results were further supported by a comparison of the students’ average scores before and after the intervention, which involved a ball-and-can game using cans labeled with numbers. The difference in these scores indicates an improvement in number symbol recognition skills among students with mild intellectual disabilities. The results of the written test on number symbol recognition are as follows.

Table 2. 2. Changes in test scores for number symbol recognition before and after the use of the “*bola boy*” game which involves cans labeled with numbers among fourth-grade students with mild intellectual disabilities at Bhakti Luhur Baumata Special Education School.

Tabel 2. Individual Pre-test and Post-test Scores in Number Symbol Recognition

No	Subject	ΣX	ΣY	Gain	Sign Change Y-X
1	BT	60	86	26	+
2	TN	60	86	26	+
3	BA	53	73	20	+
4	YS	33	60	27	+
5	FK	73	93	20	+
6	MB	73	93	20	+
Average		51.5	76.25	24.75	$\Sigma 6$

Evidence of this improvement is more clearly illustrated by the graph summarizing the pre-test and post-test scores, which shows a significant difference in learning outcomes following the implementation of the game-based method.

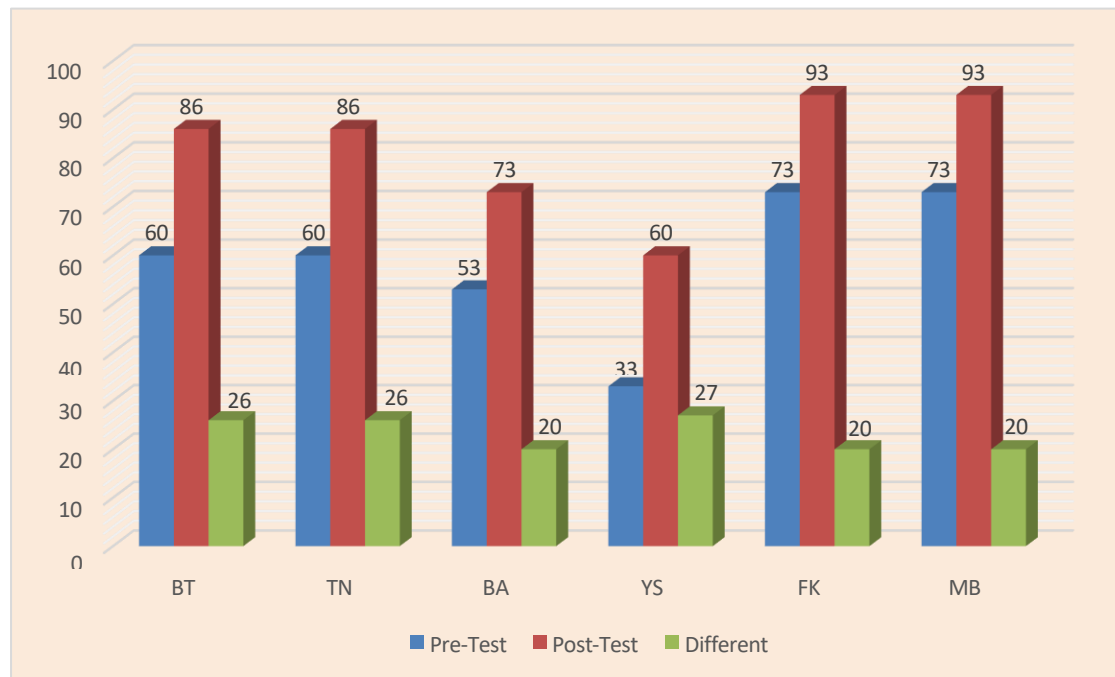


Figure 1. Mean Percentage Scores Across the Baseline (A) and Intervention (B) Phases

Table 3. Normalitas Test

	Kolmogrov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.202	6	.200*	.888	6	.309
Post-test	.293	6	.118	.858	6	.183

*. This is a lower bound of the true significance

a. Lilliefors Significance Correction

Based on the results of the normality tests using the Kolmogorov-Smirnov and Shapiro-Wilk tests, the significance values for the pre-test data were 0.200 and 0.309, respectively, and for the post-test data, 0.118 and 0.183. All significance values were greater than 0.05, so it can be concluded that the data are normally distributed. Given that the sample size is less than 50, the primary reference is the Shapiro-Wilk test, which also indicates a normal distribution. Thus, the assumption of normality is met, and the analysis can proceed using a parametric test, namely the paired-sample t-test.

Table 4. Paired Samples Correlations Test

	N	Correlation	Significance	
			One-Sided p	Two-Sided p
Pair 1 Pre Test & Post Test	6	.978	<.001	<.001

The results of the Paired Samples Correlations test showed a very strong and significant relationship between pre-test and post-test scores ($r = 0.978$; $p < 0.001$). This indicates that students with high initial scores also tended to achieve high final scores, reflecting consistency in individual ability patterns before and after the intervention. However, this correlation cannot be interpreted as evidence of the learning medium's effectiveness, as correlation only measures the linear relationship between variables, not the effect of the treatment (Field, 2018). The effectiveness of the treatment is measured by the difference (gain) between pre-test and post-test scores, which was analyzed using a paired-samples t-test.

Table 5. Paired Samples Test

	Paired Differences					t	df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
				Lower	Upper				
Pair 1 Pre Test - Post Test	-23.167	3.488	1.424	-26.837	-19.506	-16.269	5	<.001	<.001

The results of the paired samples t-test show a calculated t-value of -16.269 with degrees of freedom (df) = 5 and a significance level (Sig.) < 0.001. The mean difference of -23.167 indicates that the average post-test score is 23.167 points higher than the pre-test score. The large absolute value of the calculated t-value indicates a very strong difference between the pre-test and post-test scores. The significance value, which is far smaller than 0.05 ($p < 0.001$), indicates that this difference is statistically significant. The 95% confidence interval (CI) range of -26.827 to -19.506 does not cross the zero line, further reinforcing that the observed difference is truly significant and not due to chance (Sugiyono, 2019).

B. Discussion

The results of the study indicate that the “ball-and-can” game with numbered cans has a positive effect on improving number symbol recognition skills among students with mild intellectual disabilities in the fourth grade at Bhakti Luhur Baumata Special Education. All six research subjects showed an increase in scores from the pretest to the posttest, with an average increase of 23.16 points (from 58.67 to 81.83). The results of the Paired Samples t-test showed a t-value (5) of -16.269 with $p < 0.001$ (< 0.05), indicating that this improvement is statistically significant. These findings suggest that the “ball-and-numbered-cans” game has a significant positive impact on the ability to recognize number symbols among students with mild intellectual disabilities. These findings also address the challenge identified by (Prendergast et al., 2017), who highlighted the ongoing lack of research on the development of mathematics instruction for individuals with intellectual disabilities.

The success of this game is closely tied to the suitability of the medium for the learning characteristics of children with mild intellectual disabilities, namely difficulty with abstract thinking and a tendency to learn through concrete experiences; in addition, they struggle with abstract thinking, have limited short-term memory, are easily distracted, and tend to learn through direct experience and physical activities (Maulidiyah, 2020). The “Bola boy” game with numbered cans is designed to address these characteristics simultaneously. This medium presents numbers in a concrete form physical cans that can be held and seen directly. The presence of real objects allows children to experience number concepts firsthand, rather than merely imagining them. The activities of throwing the ball, picking up the fallen cans, reading the numbers, and rearranging the cans in order create natural repetition that reinforces memory without making the child feel as though they are being made to memorize. The fun elements of the game help sustain the attention of children who are easily distracted. Children with intellectual disabilities often exhibit delays in various cognitive domains and require a concrete approach to learning (Tosolini et al., 2025; Megari & Smyrli, 2025).

This finding is supported by Dienes's theory, which states that every concept or principle in mathematics presented in a concrete form can be well understood. This implies that objects or materials in the form of games play a crucial role when effectively manipulated in mathematics instruction (Jannah, 2013). The "ball-and-numbered-cans" game facilitates all three stages in an integrated manner. During the play stage, children are encouraged to throw a ball at a pyramid-shaped stack of cans, creating a fun learning atmosphere and reducing anxiety about mathematics. In the concrete activity stage, children interact directly with the cans labeled with the numbers 1 through 10, touching, holding, observing, and arranging them in sequence. This physical experience makes number concepts tangible and meaningful. In the abstraction stage, through repeated play activities, children begin to understand the internal relationship between numerical symbols and their sequence, which can then be internalized as abstract knowledge.

Another key factor is the integration of motor activities and cognitive processes that occur simultaneously in this game. Throwing the ball helps develop hand-eye coordination and concentration. Picking up the falling cans helps develop visual discrimination and decision-making skills. Reading the numbers on the cans helps develop symbol recognition and visual memory. Arranging the cans in order develops an understanding of sequences and logical reasoning. Research in neuroscience shows that motor activities stimulate the release of neurotransmitters such as dopamine and serotonin, which enhance concentration, memory, and positive mood (Sadzali & Azis, 2025). For children with intellectual disabilities who often face challenges in regulating their attention, physical activities help improve alertness and readiness to learn. This game also provides multisensory experiences visual, tactile, motor, and auditory that create stronger memory traces compared to passive media such as picture cards or videos.

These findings align with the results of a previous study (Prasetya, 2017), which showed that the dakon game effectively improved multiplication performance among fifth-grade students with mild intellectual disabilities at State Special Education School No. 1, Yogyakarta, with all subjects experiencing an average score increase of 40–50% from the pre-intervention to the post-intervention phase of Cycle II, (Hestyaningsih and Pratisti, 2021), which demonstrated that the traditional dakon game effectively improved arithmetic skills in children with intellectual disabilities using a one-group pretest-posttest design involving three students with intellectual disabilities. Similarly, a study by (Nuraena et al., 2023) showed an improvement in the arithmetic skills of students with mild intellectual disabilities through the congklak game, from 25% in the pre-cycle to 100% in Cycle II, with the class average score rising from 60.75 to 94.5. A study (Oktiawati, A., & Ningrum, 2025) also confirmed the positive impact of the congklak game on the arithmetic skills of children with mild intellectual disabilities. The manipulation of real objects in mathematics learning serves as the foundation for games like "Treasure Hunt" to support the mastery of number concepts among children with intellectual disabilities (Vyas et al., 2022).

This demonstrates that the arithmetic skills of children with mild intellectual disabilities need to be developed through engaging learning activities. Play-based learning has the potential to improve the numeracy skills of children with intellectual disabilities, as it involves cognitive, social, and emotional aspects (Hayati et al., 2023). Game-based learning media utilize concrete objects that children with intellectual disabilities can see, hold, and explore to help improve their numeracy skills (Pramana et al., 2013). Therefore, it can be concluded that games are an engaging medium or tool for teaching numeracy to improve the numeracy skills of children with intellectual disabilities. Traditional games are needed as learning media to enhance the numeracy skills of children with intellectual disabilities.

This study has important implications for mathematics education for children with intellectual disabilities. These games can serve as a bridge between concrete experiences and abstract understanding of numbers. Furthermore, these games are easy to make from recycled materials and can be replicated by teachers and parents at no significant cost. Teachers in special education programs facing resource constraints can utilize these games as an effective alternative learning medium. This study also opens opportunities for further development, such as using a wider range of numbers (1-20), integrating simple arithmetic operations, or developing worksheets to track student progress. Specifically, to address students' difficulty in distinguishing between the numbers 9 and 6, the activity can be modified by adding distinguishing marks to the cans such as an underline on the number 9 and an overline on the number 6, so that students can more easily recognize the correct orientation of the numbers. This aligns with the research by Solikhah and Amin (2021), which found that children with mild intellectual disabilities often experience difficulties with visual discrimination and spatial perception.

IV. Conclusion and Suggestion

Based on the research findings and discussion above, it can be concluded that the “ball-and-numbered-cans” game has a significant effect on improving number symbol recognition skills among students with mild intellectual disabilities in the fourth grade at Bhakti Luhur Baumata Special Education School. This is evidenced by an increase in the students’ average score from 58.67 on the pretest to 81.83 on the posttest, representing an average increase of 23.16 points. The results of the Paired Samples t-test showed a t-value (5) = -16.269 with a significance level of $p < 0.001$ (< 0.05), indicating that the difference is statistically significant and not due to chance.

The effectiveness of this medium stems from its alignment with the learning characteristics of children with mild intellectual disabilities who are at the concrete operational stage, the integration of motor and cognitive activities that provide multisensory experiences, and the inclusion of stages involving play, concrete concepts, and abstraction. This game is also easy to make from recycled materials and can be replicated by teachers or parents without high costs.

Thus, the “bola boy” game with numbered cans can serve as an effective, contextual, and locally-based learning medium to support mathematics learning among children with mild intellectual disabilities. This study also opens opportunities for further development, such as using larger numbers, incorporating simple arithmetic operations, or adding distinguishing marks to help students who have difficulty distinguishing between the numbers 9 and 6.

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