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Development of Loose Part-Based Smart Wheel Media in Recognizing Concept of Numbers and Symbols in Early Childhood Numeracy

Umaroh, S.[1], Fitri, B.[2] & Widjanarko, M.[3]

[1,2,3]Universitas Muria Kudus, Kudus, Central Java 59327, INDONESIA

*Corresponding Author: m.widjanarko@umk.ac.id

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Abstract: The purpose of this study is to 1) Analyze the needs of the loose part-based smart wheel media development model in recognizing the concept of numbers and symbols of early childhood numbers, 2) Formulate a loose part-based intelligent wheel media development model design in recognizing the concept of numbers and symbols of early childhood numbers, 3) Analyze the feasibility of the loose part-based smart wheel media development model in recognizing the concept of numbers and symbols of early childhood numbers, 4) Analyze the effectiveness of the loose part-based smart wheel media development model in recognizing the concept of numbers and symbols of early childhood numbers. This research method uses the R&D method. The data collection techniques used by researchers are 1) Interviews with educators, students and kindergarten principals; 2) Observation; 3) Questionnaire; 4) Validation 5) Documentation. Data sources in this study are teachers, children, kindergarten principals and design and material experts. The results of the t test for wide-scale field trials are t count of 21.189, while t table is 4.388 then or 21.189 > 4.381. Ho was rejected and Ha was accepted, meaning that there was a significant change in the recognition of the concept of numbers and symbols of numbers in early childhood. While the N-Gain value is 0.71 in the high category and the % N-Gain value is 71 in the effective category. This means that the use of smart wheel game media is effectively used to introduce the concept of numbers and symbols of numbers in early childhood.

Keywords: Smart wheel, loose parts, number concept

1. Introduction

Law Number 20 of 2003 on the National Education System defines Early Childhood Education as a systematic effort to provide stimulation or guidance to children from birth to six years old, fostering their physical and spiritual growth. This foundational stage is crucial as it prepares children for further education through educational stimuli (National Education Law). Martin Jamaris underscores that education plays a critical role in consciously guiding students toward maturity, where maturity involves not only personal responsibility but also accountability to family, society, nation, and state (Khadijah & Amelia, 2020).

Research by Bloom and colleagues indicates that a child's intellectual development occurs rapidly during the early years of life, with approximately 50% of adult intelligence variability evident by age four, and an additional 30% increase by age eight (Pratiwi, 2017). Sood and Mackey (2015) emphasize the importance of introducing number concepts in early childhood, as this foundation facilitates the subsequent learning process, particularly in mathematics. They argue that understanding numerical concepts is essential for mastering more complex mathematical skills (Roliana, 2018; Ali, 2017).

Sumirat et al. (2023) also highlight that early mathematics education significantly contributes to developing children's mathematical logic and intelligence. Effective mathematics instruction begins with tangible and interactive experiences, helping students to visualize and engage with the concepts. Early math lessons are crucial in cultivating critical thinking, reasoning, creativity, problem-solving skills, and effective communication (Febrizalti & Saridewi, 2020; Clements & Sarama, 2020).

According to Naja (2018), early childhood education should include foundational concepts such as: 1) Numbers—developing number sense is essential; 2) Algebra—introducing algebra through sorting, comparing, and

**Corresponding author: m.widjanarko@umk.ac.id*

arranging objects; and 3) Classification—enabling children to categorize objects, which is fundamental for number concept development (Wardhani, 2017; Tarr et al., 2013).

Despite these established guidelines, observations at Tunas Bhakti 2 Kindergarten reveal that teachers have yet to develop appropriate learning media for early childhood. Instruction is predominantly one-way, relying on textbooks and ready-made game tools, which limits children's opportunities to engage in realistic problem-solving. Teachers report that children struggle with recognizing numbers and understanding numerical concepts, leading to lower learning outcomes.

Relevant studies, such as Alawiyah's (2023), demonstrate that using flannel boards as a teaching medium effectively supports mathematics learning. These tools help children visualize numerical concepts and reinforce their learning. Additionally, Malapata and Wijayanigsih (2019) found that using counting barns as a learning tool enhances children's numeracy skills by making counting enjoyable and engaging. Utami & Eliza, 2022 and Asbari et al. (2019) also found that loose parts play activities effectively teach numerical concepts to children aged 5-6 years.

Interviews with kindergarten teachers in the Srikandi Cluster confirmed these challenges. The lack of innovative learning media tailored to early childhood needs resulted in children not being exposed to realistic problem-solving scenarios. Despite efforts to incorporate cognitive development activities, students' outcomes in recognizing numbers and numerical symbols did not meet the developmental milestones expected for 4-5-year-old children.

One potential solution is the use of loose part-based smart wheels as educational tools in kindergartens. These tools, designed to be both engaging and educational, can help children understand numerical concepts through play. The Rodas game involves spinning the wheel, selecting loose parts, counting objects, and matching them with number cards, making learning both fun and effective.

The uniqueness of the smart wheel is expected to enhance early childhood education by providing a playful yet structured approach to learning numerical concepts and symbols. The objectives of this study are fourfold: 1) to analyze the need for developing a loose part-based smart wheel media model to help early childhood recognize number concepts and symbols; 2) to design a development model for this media; 3) to assess its feasibility; and 4) to evaluate its effectiveness in enhancing children's understanding of numerical concepts and symbols.

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2. Methodology

To evaluate the effectiveness of the loose part-based smart wheel media in helping early childhood (Group A) within the Srikandi Cluster of Sarang District recognize numbers and symbols, this study utilizes a quasi-experimental non-equivalent control group design. The research involves selecting an experimental group, which will use the smart wheel media, and a control group, which will follow the standard teaching methods.

Data analysis will be conducted using independent paired-sample t-tests to compare pre-test and post-test scores between the groups. Additionally, the Normalized Gain (N-Gain Score) will be calculated to assess the improvement in students' understanding of numbers and symbols.

Before the main analysis, preliminary assessments, including normality and homogeneity tests, will be performed to ensure that the data meet the necessary assumptions for parametric testing. These steps are crucial to validate the reliability and accuracy of the findings, allowing the study to draw meaningful conclusions about the impact of the smart wheel media on early childhood numerical concept recognition.

3. Results and Discussion

To determine the effectiveness of developing loose parts-based smart wheel media for recognizing the concept of numbers and symbols in early childhood within Group A of the Srikandi Cluster, Sarang District, this study utilizes a quasi-experimental design with a non-equivalent control group, where both an experimental group and a control group are selected. Subsequently, the data is analyzed using independent paired-sample t-tests and Normalized Gain (N-Gain Score). However, before conducting the tests, preliminary assessments are conducted, including tests for normality and homogeneity.

If the calculated p-value (Sig.) is greater than the table p-value (Sig.) with a sig value > 0.05, then the data is considered to be normally distributed. Table 1 shows the extensive results of the normality test that has been conducted. The normality test table for the pre-test values yielded a calculated p-value (Sig.) of 0.470, and for the post-test, the calculated p-value was 0.087. With a significance level set at 0.05, the calculated p-value is > significant (0.15). This indicates that it can be concluded that all the data follows a normal distribution. Therefore, the data from the product trials can be widely used for research purposes.

Table 1 - Normality test pre- test wide trial test of normality.

		Kolmogorov Smirnov			Shapiro-Wilk		
		Statistics	**df**	**Sig.**	**Statistics**	**df**	**Sig.**
Observation value	Pre-test value	113	20	200[a]	956	20	470
	Post-test value	150	20	200[a]	917	20	087

Based on the homogeneous test table above, the Besed on Mean significance value (sig) is obtained at 0.532 > 0.05, Therefore, it can be concluded that the data from the product trial is largely consistent or homogeneous (Table 2).

Table 2 - Wide trial homogeneity test test of homogeneity of variance.

		Lavene statistics	df	df2	Sig.
Observation value	Based on Mean	398	1	38	532
	Based on Median	391	1	38	535
	Based on Median and with adjusted df	391	1	37.999	535
	Based on trimmed mean	376	1	38	544

The t-test widely used in the trial is the paired sample t-test. Here is; The calculation results in the paired t-test table indicate that: The average value for the difference between the pre-test is 49.95, and for the post-test, it is 85.70. The calculated t-value is 21.189, which is greater than the critical t-table value. Therefore, the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha) is accepted (Table 3).

Table 3 - Paired sample t test.

		Mean	N	Std. Deviation	Std Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
						Lower	Upper			
Pair 1	Pre test value	85.70	20	5.162	1.154	32.219	39.281	21.189	19	.000
	Post test value	49.95	20	4.751	1.062					
		35.750	20	7.545	1.687					

Based on Table 4, the result of calculating the Gain value is 0.71, which falls within the high category in the range of > 0.70. This indicates that there is a significant improvement in the ability to recognize the concept of numbers and number symbols, categorized as high. The N-Gain % value of 71 falls within the effective category. This means that the use of loose parts-based smart wheel learning media is effectively employed in recognizing the concept of numbers and symbols in early childhood within the Srikandi Cluster, Sarang District, Rembang Regency.

Table 4 - Gain test results.

No	Value	Class
1	N-Gain	0.71
2	Criterion	Tall
3	N- Gain %	71
4	Interpretation	Effective

4. Conclusion

Based on the study's findings, it has been determined that learning to recognize the concept of numbers and number symbols benefits from the use of a loose parts-based smart wheel learning media. Many students in the Srikandi Cluster, Sarang District, Rembang Regency, who are not familiar with this game tool, struggle with numeracy concepts. Through the development of loose parts-based smart wheel learning media, it is expected that students will engage more enthusiastically in learning to recognize the concept of numbers and number symbols because they can learn in a contextual manner. Contextual learning media is crucial in helping students achieve their learning objectives.

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Conflict of Interest

The authors declare no conflicts of interest.

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