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Analysis of the Use of GERATIF (Interactive Numeracy Game) on the Numeracy Skills of Children Aged 5–6 Years

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ABSTRACT

This study was motivated by the problem of low numeracy skills among children aged 5–6 years, which is frequently encountered in early childhood education settings. This condition is influenced by learning activities that are insufficiently engaging and fail to motivate children. Meanwhile, technological advancements require the education sector to integrate digital media into the learning process. This study aimed to determine the effect of using GERATIF (Interactive Numeracy Game) on the numeracy skills of children aged 5–6 years. The study employed a quantitative approach using a quasi-experimental method with a nonequivalent control group design. The participants consisted of 40 children, comprising 20 children in the experimental group and 20 children in the control group. Data were collected through observation and documentation. The data obtained from both

the experimental and control groups were analyzed using the Independent Samples *t*-Test. The results of the analysis indicated an Equal Variances Assumed significance value (Sig. 2-tailed) of 0.025. Since the significance value was less than 0.05, the alternative hypothesis (Ha) was accepted and the null hypothesis (H_0) was rejected. These findings demonstrate that the use of GERATIF (Interactive Numeracy Game) has a significant effect on the numeracy skills of children aged 5–6 years.

Introduction

Technological advancement has brought significant changes to the teaching and learning process, particularly in transforming the learning paradigm from one that was previously teacher-centered to one that positions children as the central focus of the learning process (Sabaruddin, 2022). This transformation not only enhances children's active participation but also encourages them to develop critical thinking skills, collaborate, innovate, and solve problems in real-life contexts (Mashudi, 2021). Education must continuously adapt to the changing times to prepare future generations to face emerging challenges (Habibah et al., 2021). Furthermore, education should be capable of utilizing technology by integrating it into the learning process, including early childhood education (Sukmawati & Rakhmawati, 2023).

In early childhood education, technology can serve as an innovative and interactive medium to enhance the effectiveness of learning (Luthfatun, 2020). Learning media play an essential role in supporting children's understanding of instructional materials through concrete visual representations while reducing

boredom and increasing children's motivation to participate actively in learning activities (Rakhmawati et al., 2025). Therefore, technology should be integrated wisely into learning activities designed for young children. When used appropriately, technology can positively influence various aspects of children's skills and development, including cognitive development.

Cognitive development is one of the fundamental stages of child development through which children acquire basic skills such as problem-solving and understanding the surrounding environment (Rakhmawati et al., 2020). The development of cognitive abilities during early childhood is an essential aspect that should not be overlooked in the provision of appropriate stimulation because optimally developed cognitive abilities enable children to utilize all of their senses to observe and explore their environment (Rakhmawati et al., 2020). One of the cognitive competencies that should be developed in early childhood is numeracy skills, as numeracy constitutes a crucial component of mathematical literacy and serves as a foundational life skill required in everyday activities.

According to Ojose (2011), mathematical literacy refers to the knowledge related to understanding and applying fundamental mathematical concepts to meet various needs encountered in daily life. A comprehensive understanding of numeracy forms an essential foundation for supporting individuals' success across various life situations (Sidiq et al., 2023). Based on Jean Piaget's theory of cognitive development, children aged 5–6 years are in the preoperational stage (2–7 years), during which they use language, symbols, and imagination

to understand the world around them (Alitha & Hasibuan, 2021). Therefore, to optimize children's numeracy skills, learning activities should be designed to be enjoyable, contextual, and relevant to children's everyday environment and experiences (Retnaningsih & Khairiyah, 2022).

Numeracy skills can be integrated into learning activities that provide meaningful and positive experiences for young children through the use of relevant technological media. This is consistent with the findings of Nisa (2012), who explained that technology can be utilized as a medium for introducing numbers and mathematical concepts to children. Accordingly, numeracy skills play an important role in establishing the foundation of mathematical competence while fostering critical thinking skills. By developing a deeper understanding of numeracy concepts from an early age, children will find it easier to comprehend mathematics at more advanced educational levels and will be able to apply these competencies in various situations (Pratistiningtyas & Rakhmawati, 2023).

However, the current situation indicates that children's numeracy skills have not shown significant improvement. Based on observations conducted by the researchers regarding numeracy learning in early childhood classrooms, several problems were identified in Group B of RA Insan Kamila, located in Kramat Jegu Village, Sidoarjo Regency. Some children still experienced difficulties in performing basic arithmetic operations, while others had difficulty comparing object sizes. During learning activities involving arithmetic operations and size comparisons, teachers were not yet able to

maximize the use of available loose parts and educational play equipment (APE). Furthermore, technology-based learning media had never been implemented, particularly game-based media for numeracy learning.

These findings are supported by the study conducted by Yusra et al. (2023), which reported that the numeracy abilities of children aged 5–6 years had not yet developed optimally. This was evidenced by the large number of children who were unable to count objects accurately, had limited understanding of object classification, and experienced difficulties distinguishing quantities, such as identifying "more" and "fewer." In addition, some children remained confused when differentiating between tall and short objects and continued to experience difficulties understanding the concepts of addition and subtraction. Based on these issues, numeracy learning should be introduced from an early age to equip children with numeracy skills and the ability to apply mathematical concepts in various real-life situations beyond the school environment. Learning activities in early childhood education should be further developed in engaging ways to maintain children's focus and enthusiasm throughout the learning process. One promising instructional strategy is the incorporation of play-based learning through interactive game media.

Games can therefore serve as an enjoyable learning medium that provides a structured set of rules requiring players to learn and make independent decisions in solving problems (Humaida & Suyadi, 2021). In early childhood education, game-based media function as interactive learning tools (Dewi & Agung, 2021). Interactive games are digital learning media designed to

facilitate two-way interaction between users and game content (Pertiwi & Wardhani, 2024). Moreover, game-based media can stimulate children's learning motivation because their engaging features attract children's attention and encourage them to actively participate in learning while playing (Nabila et al., 2025).

Previous studies on game-based learning media conducted by Adawiyah and Rakhmawati (2019) demonstrated that Computer-Assisted Instruction (CAI) games had a significant effect on children's ability to recognize geometric shapes. CAI games facilitated children's understanding of geometric concepts while enhancing their creativity. Similarly, Suryana et al. (2023) argued that interactive games constitute an appropriate medium for improving children's mathematical intelligence. These games incorporate educational content that enables children to learn while playing because they are specifically designed to develop symbolic thinking and problem-solving skills. Furthermore, interactive games create engaging and enjoyable learning experiences and can be used daily, as they are accessible through smartphones and other technological devices.

Considering the various issues and previous findings regarding instructional media and children's numeracy skills, the researchers concluded that early childhood learning requires innovative approaches capable of attracting children's attention while simultaneously enhancing their developmental outcomes. Such innovation involves integrating instructional media with educational technology through game-based learning, as game

media can provide meaningful learning experiences. Therefore, this study aims to examine the effect of using an interactive numeracy game on the numeracy skills of children aged 5–6 years.

Method

This study employed a quantitative approach using an experimental research method. The experimental design adopted in this study was a quasi-experimental design (Syahrizal & Jailani, 2023). The purpose of this research was to analyze whether the implementation of GERATIF (Interactive Numeracy Game) had an effect on improving the numeracy skills of children aged 5–6 years. The study implemented a nonequivalent control group design, involving two groups for comparison: an experimental group and a control group. The experimental group received instruction through a learning model integrated with GERATIF (Interactive Numeracy Game), whereas the control group received conventional instruction using educational play equipment (APE) and loose parts.

Table 1. Research Design

Experimental Group	
O_1	X
Control Group	
O_3	

Notes:

O_1 = Pretest of the Experimental Group

O_2 = Posttest of the Experimental Group

O_3 = Pretest of the Control Group

O_4 = Posttest of the Control Group

X = Implementation of **GERATIF (Interactive Numeracy Game)**

The study was conducted in two different schools with similar characteristics. RA Insan Kamila, located on Kramat Jegu Street, Taman District, Sidoarjo Regency, East Java Province, served as the experimental group, while TK Dharma Wanita Persatuan Bohar, located on Bagus Santri Street, Taman District, Sidoarjo Regency, East Java Province, served as the control group.

Data were collected through observation, beginning with the administration of the pretest, followed by the implementation of the treatment, and concluding with the posttest. The participants consisted of 40 children aged 5–6 years, comprising children from both the experimental and control groups.

The research instrument was adapted from the work of Ojose (2011), an academic specializing in mathematical literacy. Furthermore, the instrument was adjusted to align with the numeracy achievement indicators for children aged 5–6 years as outlined in the Numeracy Development Handbook. The research instrument blueprint is presented below.

Table 2. Research Instrument

No.	Aspect	Indicator	Item
1	**Arithmetic**	Counting (addition of numbers 1–20)	Children are able to count the number of clothing pictures

			correctly.
			Children are able to match the number of pictures with the corresponding number symbols.
2	**Measurement**	Comparing measurements (long–short; large–small)	Children are able to compare long and short objects.
			Children are able to compare large and small objects.
3	**Algebra**	Classification	Children are able to classify clothing pictures according to their colors.
			Children are able to classify clothing pictures according to clothing type based on summer and winter seasons.

The validity of the research instrument was assessed using Aiken's V coefficient, based on evaluations provided by expert validators (Utami et al.,

2024). The decision criterion for Aiken's V ranges from 0 to 1, with values approaching 1 indicating higher content validity. Meanwhile, instrument reliability was examined using the Percentage of Agreement (PA) involving two validators. An instrument was considered reliable when the agreement percentage exceeded 75%. Conversely, if the agreement percentage was below 75%, the instrument required further revision and re-evaluation by the validators. All validity and reliability calculations were performed using Microsoft Excel.

The data were analyzed using the Shapiro–Wilk normality test, the Levene's test for homogeneity of variance, and the Independent Samples *t*-Test for hypothesis testing with the assistance of SPSS version 25. The decision criterion for the *t*-test was based on the significance value: if $p < 0.05$, the treatment was considered to have a significant effect. Conversely, if $p > 0.05$, no significant effect was found.

Results and Discussion

Data collection in this study was conducted through direct observation to obtain pretest and posttest data regarding the numeracy skills of children aged 5–6 years before and after the treatment was administered. The experimental group received treatment through the implementation of GERATIF (Interactive Numeracy Game), whereas the control group participated in conventional learning activities using the available educational play equipment (APE) and loose parts. The pretest and posttest results for both the experimental and control groups are presented below.

Table 3. Descriptive Statistics

	N	Range	Min.	Max.	Mean	Std. Deviation
Experimental Pretest	20	8	11	19	14.50	2.646
Experimental Posttest	20	6	18	24	21.30	1.895
Control Pretest	20	7	13	20	16.20	2.308
Control Posttest	20	9	15	24	19.65	2.540

Based on the descriptive statistics presented above, it can be concluded that both the experimental and control groups demonstrated improvements in learning outcomes from the pretest to the posttest. However, the improvement in the experimental group was more substantial than that in the control group. This finding is reflected in the higher increase in the experimental group's mean score, the greater improvement in both the minimum and maximum scores, and the decrease in the standard deviation, indicating that the learning outcomes among children in the experimental group became more consistent.

Following the collection of the pretest and posttest data, statistical analyses were conducted, beginning with the **Shapiro–Wilk normality test**. The results of the normality test for the pretest and posttest scores of both groups are presented below.

Table 4. Normality Test

Variable	Group	Shapiro–Wilk Statistic	df	Sig.

Numeracy Skills of Children Aged 5–6 Years	Experimental Pretest	0.918	20	0.089
	Experimental Posttest	0.927	20	0.133
	Control Pretest	0.937	20	0.211
	Control Posttest	0.949	20	0.346

The results of the normality test indicated that all significance values were greater than **0.05**, demonstrating that the data from both groups were normally distributed. Since the assumption of normality was satisfied, the analysis proceeded with a parametric Independent Samples *t*-Test.

Table 5. Hypothesis Testing

Independent Samples Test									
	Levene's Test for Equality of Variances		*t-test for Equality of Means*						
								95% Confidence Interval of the Difference	
	F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*Lower*	*Upper*
Equal variances assumed	*1,085*	*,304*	*2,329*	*38*	*,025*	*1,650*	*,709*	*,216*	*3,084*
Equal variances not assumed			*2,329*	*35,147*	*,026*	*1,650*	*,709*	*,212*	*3,088*

The results of the hypothesis test showed an Equal Variances Assumed significance value (Sig. 2-tailed) of 0.025. Because the significance value was less than 0.05, the alternative hypothesis (Ha) was accepted and the null hypothesis (H_0) was rejected. Accordingly, the findings indicate that the use of GERATIF (Interactive Numeracy Game) has a significant effect on the numeracy skills of children aged 5–6 years.

The research hypothesis stating that the implementation of GERATIF

(Interactive Numeracy Game) influences the numeracy skills of children aged 5–6 years was therefore supported by the hypothesis testing results obtained in this study. The findings revealed that children in the experimental group experienced significantly greater improvements in numeracy skills than those in the control group. These improvements were evident across all measured indicators, including arithmetic skills, measurement skills (comparing long and short objects as well as large and small objects), and classification skills (categorizing clothing by color and by seasonal type).

These findings are consistent with Jean Piaget's theory, which emphasizes that learning during the preoperational stage should be delivered through concrete experiences involving direct interaction with the surrounding environment (Alfadhilah, 2025). Accordingly, the interactive numeracy game featuring clothing-related learning materials reflects these characteristics by presenting realistic contexts that are familiar to children, thereby facilitating their understanding of numeracy concepts.

The positive effect of the intervention was not only reflected in the improvement of children's scores but also in observable changes in their learning behavior throughout the treatment sessions. Based on classroom observations and direct conversations with the children, several participants initially exhibited confusion when completing the assigned tasks before receiving the intervention. However, after repeated exposure to the treatment, they demonstrated positive behavioral changes. The children became capable of completing the tasks correctly by counting carefully and sequentially. In

addition, they paid closer attention when comparing large and small objects as well as long and short objects, and they were also able to classify different types of clothing accurately.

These findings further reinforce the notion that the implementation of an interactive numeracy game represents a developmentally appropriate instructional approach for young children. The interactive game effectively stimulates children's learning motivation, enhances their concentration, encourages enthusiasm, and actively engages them throughout the learning process (Deng et al., 2020). Likewise, Setiawan et al. (2019) argued that learning activities for young children become more effective when they incorporate play elements that correspond to children's developmental characteristics. Overall, the findings demonstrate that the numeracy skills of children aged 5–6 years improved significantly following a series of systematically designed learning activities.

The improvements experienced by the children were not limited to the increase in pretest and posttest scores but also encompassed a more mature understanding of numeracy concepts throughout the learning process. Therefore, this study indicates that providing concrete, engaging, and developmentally appropriate learning experiences can strengthen children's foundational numeracy skills while supporting their readiness to understand mathematical concepts at subsequent educational levels.

Conclusion

Based on the findings of this study regarding the implementation of an

interactive numeracy game to improve children's numeracy skills, it can be concluded that the learning media has a positive effect on enhancing the numeracy skills of children aged 5–6 years. This conclusion is supported by the results of the hypothesis test, which yielded a Sig. (2-tailed) value of 0.025. Since the significance value was less than 0.05, the alternative hypothesis (Ha) was accepted and the null hypothesis (H_0) was rejected. Learning through the implementation of the game-based learning media was proven to enhance children's active engagement throughout the learning process. The children demonstrated high levels of enthusiasm, enjoyment, and positive interaction while completing the challenges presented in the game. Therefore, the use of an interactive numeracy game can serve as an innovative and effective alternative learning medium for overcoming learning difficulties and improving the numeracy skills of young children.

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