

THE EFFECT OF PROJECT-BASED LEARNING ON EARLY NUMERACY SKILLS OF CHILDREN AGED 5–6 YEARS AT TK TA MUSLIMAT NU 12 NOLOKERTO, KALIWUNGU DISTRICT, KENDAL REGENCY

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Abstract: This study aimed to determine the effect of Project-Based Learning (PjBL) on the early numeracy skills of children aged 5–6 years at TK TA Muslimat NU 12 Nolakerto. The study employed a quantitative approach with a pre-experimental one-group pretest–posttest design. The participants consisted of 59 children. Data were collected through observation, questionnaires, and documentation, and analyzed using a Paired Samples t-test. The results showed a significant difference between pretest and posttest scores ($\text{Sig.} = 0.000 < 0.05$; $t = 8.405$), indicating that Project-Based Learning significantly improved children's early numeracy skills.

Keywords: *Project Based Learning, Beginning Numeracy Skills*

INTRODUCTION

Early childhood refers to children aged 0–6 years, a period characterized by the most rapid and fundamental stage of human development. During this phase, children experience significant growth across multiple developmental domains, including physical, cognitive, language, social-emotional, and moral development. This period is widely recognized as a sensitive stage in which children's growth and development occur optimally. According to Jamaris (as cited in Sujiono, 2009), development is cumulative in nature, meaning that earlier developmental achievements provide the foundation for subsequent development. Therefore, delays or obstacles in earlier developmental stages may negatively affect children's future development.

Susanto (2011) states that every child possesses the potential to develop optimally. This developmental process begins within the child's immediate environment and gradually progresses toward understanding numerical concepts, including addition and subtraction. Learning activities should be enjoyable and consistent with the characteristics of early childhood by incorporating play, singing, dancing, and meaningful daily-life experiences. Children's cognitive development strongly influences their readiness for subsequent educational stages, particularly in reading, writing, and mathematics. Counting skills are one of the essential learning components that contribute to cognitive development. Early numeracy serves as the foundation for later mathematical competence and should therefore be developed from an early age (Oktriyani, 2017; Nasution et al., 2019).

According to Aunio et al. (2015), numeracy development among children aged 5–6 years begins with number recognition, including counting numbers from 1 to 20 sequentially and

understanding that the last number counted represents the total quantity of objects. Children are subsequently introduced to numeral symbols and simple addition and subtraction activities using concrete objects.

Early numeracy is one of the essential competencies taught in Early Childhood Education (ECE), particularly for children aged 5–6 years in Kindergarten B, as preparation for primary school. Slamet (2011) defines early numeracy as the ability that enables children to gradually develop mathematical understanding based on their experiences and immediate surroundings. As children's age and cognitive abilities increase, they begin to comprehend addition and subtraction, which are essential not only for everyday life but also for future mathematics learning. According to the revised Learning Outcomes issued by the Agency for Educational Standards, Curriculum, and Assessment (BSKAP No. 033/H/KR/2022), mathematics learning outcomes for children aged 5–6 years include recognizing and applying pre-mathematical concepts in real-life contexts, enabling children to demonstrate critical thinking, creativity, and collaborative skills.

Young children learn numeracy by recognizing fundamental concepts such as shapes, sizes, quantities, and patterns through developmentally appropriate play activities. When these foundational skills are nurtured early, children become better prepared to understand more complex mathematical concepts during formal schooling. Since early childhood is fundamentally a period of learning through play, numeracy instruction should be implemented through enjoyable and meaningful learning experiences.

Parents generally expect their children to acquire numeracy skills at an early age to ensure academic readiness before entering formal education. Many parents perceive numeracy competence as an indicator of children's intelligence and school readiness. However, preliminary observations conducted at TK TA Muslimat NU 12 Nolakerto revealed that several children experienced difficulties in recognizing numbers, reciting number sequences, and understanding the relationship between quantities and numeral symbols. Furthermore, some children were unable to distinguish concepts such as larger and smaller quantities or consistently recognize patterns and geometric shapes, all of which are integral components of early numeracy development.

These findings indicate that children's early numeracy skills have not yet developed optimally. One possible contributing factor is the predominance of monotonous instructional practices that rely heavily on worksheets and provide limited opportunities for active child participation during the learning process.

To address this issue, this study employed Project-Based Learning (PjBL) as an instructional approach to optimize children's learning outcomes. According to Hamdayama (2016), Project-Based Learning is an instructional strategy that utilizes authentic real-life situations as the basis for learning. This approach is considered capable of increasing children's motivation because learning activities become more contextual, meaningful, and relevant to their everyday experiences.

Project-Based Learning is particularly suitable for early childhood education because young children naturally enjoy exploration and learn most effectively through direct experiences.

Rahman et al. (2012) argue that this approach actively engages children in child-centered learning activities. Furthermore, project-based activities provide valuable learning experiences while simultaneously promoting children's cognitive, social, motor, creative, and emotional development (Sumartini, 2015; Sujiono, 2009; Moeslichatoen, 2011).

According to Wena (as cited in Al-Tabany, 2014), project-based learning begins with challenging questions or authentic problems that require learners to complete complex tasks. This process encourages children to solve problems independently by designing solutions, making decisions, and conducting investigations. Similarly, Roopnarine and Johnson (2011) explain that projects involve in-depth investigations of meaningful topics that require children's sustained commitment, clear objectives, and defined timelines.

Project-Based Learning offers numerous educational benefits. These include: (1) increased learning motivation, reflected in greater persistence and enthusiasm; (2) improved problem-solving skills, particularly in addressing complex problems; (3) enhanced research skills through gathering information from various sources, including digital resources; (4) improved collaboration and communication through group work; (5) greater engagement in collaborative online and offline learning activities; and (6) strengthened resource management skills, including effective time management and appropriate use of learning materials.

Research conducted by Hasni and Amanda (2022) further demonstrated that Project-Based Learning significantly improves logical thinking and communication skills among young children. These findings are consistent with the present study, in which children became more active, enthusiastic, and directly engaged in numeracy learning through classroom project activities.

Therefore, the implementation of Project-Based Learning is considered important because it provides engaging and meaningful learning experiences. Through active participation in authentic and simulated activities, children are encouraged to develop critical thinking, problem-solving abilities, and other higher-order cognitive skills while becoming more independent and responsible learners.

Based on the foregoing discussion, this study was conducted to investigate the effect of Project-Based Learning on the early numeracy skills of children aged 5–6 years at TK TA Muslimat NU 12 Nolakerto, Kaliwungu District, Kendal Regency. In this study, early numeracy learning was integrated into a classroom decoration project designed to foster creativity and collaboration. Through activities involving the creation of learning materials and numeracy games, children learned to recognize numbers, understand number sequences, and develop early counting skills in meaningful and enjoyable learning contexts.

METHODS

This study employed a quantitative research approach using a pre-experimental method with one group pretest–posttest design. This design was selected to examine changes in children's early numeracy skills before and after the implementation of the Project-Based Learning (PjBL) intervention. The one-group pretest–posttest design enables researchers to compare

participants' performance before and after receiving the treatment, thereby allowing the effectiveness of the intervention to be evaluated.

The participants consisted of 59 children aged 5–6 years enrolled at TK TA Muslimat NU 12 Nolakerto, Kaliwungu District, Kendal Regency, Indonesia.

Data were collected through observation, questionnaires, and documentation. Observations were conducted throughout the learning process to assess children's early numeracy skills. The questionnaire employed a five-point Likert scale consisting of both favorable and unfavorable statements, with response scores ranging from 1 to 5. Documentation, including school records and photographs of learning activities, was collected to support and complement the research findings.

Prior to data collection, the research instrument was subjected to validity and reliability testing. The validity test was conducted on 42 questionnaire items administered to the 59 participants. The results indicated that 30 items met the validity criteria (item discrimination index > 0.05), while 12 items did not meet the required validity standard (item discrimination index < 0.05) and were therefore excluded from further analysis.

Instrument reliability was assessed using Cronbach's Alpha coefficient, resulting in a reliability value of 0.945. According to Sujarweni (2014), a Cronbach's Alpha coefficient greater than 0.60 indicates that the instrument possesses high internal consistency. Therefore, the instrument used to measure children's early numeracy skills was considered highly reliable.

Data were analyzed using both descriptive and inferential statistics. Descriptive statistical analysis was conducted to summarize the characteristics of the data, including the minimum score, maximum score, mean, and standard deviation.

Before hypothesis testing, a normality test was performed using the One-Sample Kolmogorov–Smirnov Test with the assistance of IBM SPSS Statistics version 22. The decision criteria for the normality test were as follows:

- If the significance value (p) was greater than 0.05, the data were considered normally distributed.
- If the significance value (p) was less than 0.05, the data were considered not normally distributed.

RESULT AND DISCUSSION

The descriptive analysis was conducted to examine the minimum, maximum, mean, and standard deviation values of the research variables. This section presents the findings obtained from the collected data. The data analysis employed descriptive statistics to describe the children's early counting skills before and after the implementation of Project-Based Learning (PjBL).

Table 1. Descriptive Analysis of Pretest and Posttest Scores

Descriptive Statistics		
Statistic	Pretest	Posttest
Minimum	72	77
Maximum	124	143
Mean	107.29	122.49
Standard Deviation	12.869	11.761

The descriptive analysis indicates an improvement in the posttest scores compared to the pretest scores. The minimum score increased from 72 to 77, while the maximum score increased from 124 to 143. Furthermore, the mean score improved from 107.29 in the pretest to 122.49 in the posttest. The standard deviation decreased slightly from 12.869 to 11.761, indicating that the posttest scores became relatively more homogeneous.

A normality test was subsequently conducted to determine whether the pretest and posttest data were normally distributed. The test employed the One-Sample Kolmogorov–Smirnov analysis using SPSS version 22.

Table 2. Normality Test Results

Asymp. Sig. (2-tailed)	
Variable	Asymp. Sig. (2-tailed)
Pretest	0.200
Posttest	0.200

The normality test results show that the significance value for both datasets was 0.200, which is greater than 0.05. Therefore, the data were normally distributed and met the assumptions for parametric testing.

After confirming normality, a Paired Samples t-Test was conducted to test the research hypothesis.

Table 3. Paired Samples t-Test Results

Sig. (2-tailed) = 0.000	
Statistic	Value
Mean Difference	-15.203
t-value	-8.405
df	58
Sig. (2-tailed)	0.000

Based on the Paired Samples t-Test, the obtained t-value was 8.405, which was greater than the t-table value of 2.042. The significance value was 0.000, which is less than 0.05. Therefore, H_0 was rejected and H_1 was accepted, indicating a significant effect of Project-Based Learning on the early

counting skills of children aged 5–6 years.

Table 4. Mean Score Improvement

Variable	Mean
Pretest	107.29
Posttest	122.49
Difference	15.20

The table above demonstrates an increase in the mean score from 107.29 to 122.49, representing an improvement of 15.20 points after the implementation of Project-Based Learning.

Discussion

This study investigated the effect of Project-Based Learning (PjBL) on the early counting skills of children aged 5–6 years at TK TA Muslimat NU 12 Nolakerto. The findings revealed a significant improvement in children's early counting abilities following the implementation of project-based activities.

Before the treatment, many children experienced difficulties in recognizing number symbols, counting sequentially, and matching quantities with the corresponding numbers. After participating in project-based learning activities, such as creating number calendars, counting ingredients, and designing number posters, the children became more active, enthusiastic, and engaged in the learning process. From a theoretical perspective, these findings support the constructivist theory, which emphasizes that children build knowledge through direct experiences. During project activities, children observed, explored, discussed, and produced tangible products, making learning more meaningful and long-lasting.

The statistical analysis further confirmed the effectiveness of the intervention. The significance value of 0.000 ($p < 0.05$) and the t-value of 8.405 demonstrated a significant difference between the pretest and posttest scores. Thus, Project-Based Learning positively influenced children's early counting skills.

These findings are consistent with Jean Piaget's theory, which states that children aged 5–6 years are in the preoperational stage, where learning occurs most effectively through concrete experiences. Project-Based Learning provides such concrete and meaningful experiences, making it appropriate for children at this developmental stage.

The results also align with previous studies. Azizah and Widajati (2013) found that project methods improved children's understanding of number concepts and social cooperation. Similarly, Irianti and Aminin (2013) reported positive effects of project methods on children's recognition of geometric shapes, indicating that project-based approaches can broadly support early mathematical development.

Furthermore, Hasni and Amanda (2022) demonstrated that PjBL enhances logical thinking and communication skills in early childhood. The present study similarly observed that children became more active and directly involved in counting activities through classroom projects.

The closest similarity was found in Lestari (2023), who employed a One Group Pretest–Posttest design and reported significant improvements in children's understanding of number concepts through project methods. Therefore, the present findings strengthen previous evidence regarding the effectiveness of Project-Based Learning, particularly in the subdomain of early counting skills.

In conclusion, the findings of this study support previous research and reinforce the view that Project-Based Learning is an effective approach for developing early counting skills in young children. Through meaningful project activities, children not only learn number symbols but also understand the practical meaning of numbers in everyday life while participating actively in enjoyable and meaningful learning experiences.

CONCLUSION

Based on the findings of this study conducted at TK TA Muslimat NU 12 Nolakerto, it can be concluded that Project-Based Learning (PjBL) has a positive and significant effect on the early counting skills of children aged 5–6 years. Through active participation in contextual and enjoyable project activities, children became more motivated to recognize number symbols, count objects, and develop logical thinking skills naturally.

The statistical analysis using the Paired Sample t-test revealed a significant difference between the pretest and posttest scores. The obtained t-value (8.405) exceeded the critical t-value (2.042), while the significance value was 0.000 ($p < 0.05$). Therefore, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_a) was accepted. These findings confirm that the implementation of Project-Based Learning significantly improves the early counting skills of children aged 5–6 years.

Furthermore, the children's mean score increased from 107.29 in the pretest to 122.49 in the posttest, representing an improvement of 15.20 points. This result demonstrates that Project-Based Learning provides meaningful learning experiences by integrating mathematical concepts into authentic and engaging activities. Consequently, children not only develop their counting abilities but also enhance their motivation, creativity, collaboration, and problem-solving skills.

Overall, this study suggests that Project-Based Learning is an effective instructional approach for promoting early mathematical development and can be recommended as an alternative learning model in early childhood education settings.

SUGGESTIONS

Based on the findings of this study, the following recommendations are proposed:

1. For Teachers

Teachers are encouraged to implement more diverse, creative, and engaging instructional methods and learning media, particularly Project-Based Learning, to enhance children's early counting skills. Learning activities should be designed according to children's developmental characteristics and should provide meaningful, hands-on experiences that stimulate active participation.

2. For Future Researchers

Future studies are recommended to involve children from a wider range of age groups, educational settings, and socio-cultural backgrounds to improve the generalizability of the findings. Researchers are also encouraged to explore various types of creative and contextual projects that may influence different aspects of early mathematical development, including number sense, problem-solving, and logical reasoning.

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