Journal of Education and Teacher Training Innovation (JETTI)
Published by Pusmedia Group Indonesia

**Journal of Education and Teacher Training Innovation**
Volume 4 Issue 1 Year 2026 Pages 172-195
e–ISSN : 3025-3500
DOI: 10.61227
e-mail : jetti.pusmedia@gmail.com
https://journal.pusmedia.com/index.php/JETTI

# Optimizing the Use of Building Blocks to Improve the Mathematical Skills of 5- to 6-Year-Old Children Through Lego Duplo Play

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**Abstract**: This study aims to describe efforts to optimize the use of building blocks (Lego Duplo) in improving the numeracy skills of 5–6-year-old children at Aisyiyah 1 Kindergarten in Bima City, while also analyzing the development of these skills and identifying supporting and inhibiting factors. This study employed a mixed-methods design with a qualitative focus through a classroom-based intervention case study, utilizing data collection techniques such as observation, interviews, documentation, and a numeracy skills rubric, all analyzed descriptively. The results indicate that the intervention was optimized through three structured phases: planning which included developing lesson plans and 10 play scenarios; implementation progressing from an exploratory phase to the gradual integration of numeracy content; and formative and summative evaluations. The use of Lego Duplo demonstrated a significant improvement in children's practical numeracy skills, as evidenced by progress in number recognition (1–10), understanding of number concepts, and the ability to perform simple arithmetic operations. Supporting factors in this study included high levels of children's enthusiasm, support from teachers and the school principal, the suitability of the educational medium's characteristics, and the variety of games used. Meanwhile, the limiting factors include time constraints, differences in children's learning speeds, limited resources, and teachers' prior experience. Overall, this study confirms that Lego Duplo has the potential to serve as a contextual, interactive, and enjoyable medium for teaching numeracy to young children.

**Keyword :** Building Blocks, Lego Duplo, Numeracy Skills, Young Children.

**Article info:** Submitted : 2026-05-05 | Accepted : 2026-05-19 | Published : 2026-06-03



How to Cite :

## Introduction

Early Childhood Education (PAUD) is the educational stage that precedes a child's entry into elementary school, designed for children aged 0 to 6 years. PAUD plays a vital role in instilling moral values and character, as well as laying the foundation for children's social and cognitive skills. Studies show that early childhood is a golden period of development, during which 80% of the human brain develops rapidly in the first five years of life. Therefore, optimal attention to children's education during this period is essential as a long-term investment for the nation (Kasmiati, 2025).

Early Childhood Education (PAUD) is the cornerstone of shaping the quality of future human resources. Between the ages of 0 and 6, children are in their "golden

age"—a critical period that is pivotal to their individual development. During this time, children's brains develop rapidly, reaching approximately 80% of an adult's brain capacity (Latif & Rachmawati, 2022). One of the fundamental cognitive skills that should be developed from an early age is numeracy. This skill is not limited to recognizing numerical symbols, but also encompasses an understanding of numbers, quantities, and patterns, as well as their application in everyday life. Numeracy in early childhood is a foundational skill that needs to be nurtured from the start because it is closely linked to logical thinking and problem-solving skills (Sulistiyaningsih, 2023).

A learning approach that is too abstract and lacks meaning has the potential to create difficulties in understanding mathematical concepts from an early age, as young children primarily learn through real-world experiences and hands-on activities. In this context, learning that does not provide opportunities for exploration and active engagement tends to hinder children's cognitive development. This aligns with research in early childhood education, which emphasizes that learning should be designed in accordance with children's active, exploratory nature and their tendency to learn through direct experience (Kusniasari, 2026).

One type of educational toy with great potential for developing early childhood numeracy skills is building blocks, particularly Lego Duplo. This toy is specifically designed for children aged 1.5–6 years, with larger blocks that are safe and easy for children to use. Lego Duplo's colorful design, flexibility for building and taking apart, and variety of shapes provide children with the opportunity to learn about concepts such as color, shape, size, patterns, and numbers in an integrated way through play.

The use of constructive play materials such as Lego has been shown to be effective in supporting children's cognitive development and thinking skills, as children are directly involved in the process of exploring and manipulating objects (Aristi, 2021). In addition, research in Indonesia has also shown that playing with Lego can enhance creativity, problem-solving skills, and critical thinking skills in young children through interactive and enjoyable learning experiences (Atikah & Lismayani, 2025). Thus, using Lego Duplo as a learning tool not only provides an engaging play experience but also plays a crucial role in optimally developing children's numeracy skills and cognitive abilities through a concrete and meaningful learning approach.

Numerous studies have been conducted on the use of educational media to improve early childhood numeracy skills, but most still focus on simple materials such as flashcards, number sticks, and other printed materials. The results of the study indicate that the use of number sticks significantly improves children's early numeracy skills, as evidenced by improved learning outcomes in each learning cycle (Ayu et al., 2017). In addition, research on the development of number stick teaching aids has also shown a very high level of feasibility, as assessed by both media experts and subject matter experts, leading to the conclusion that this teaching aid is effective for teaching

early childhood arithmetic (Nurmeiyati, 2024). Other studies have also shown that the use of number sticks is significantly associated with improvements in children's numeracy skills, as evidenced by statistical test results indicating a positive correlation between the use of this teaching aid and children's numeracy skills (Fauziah, 2023).

Nevertheless, research on optimizing the use of building blocks such as Lego Duplo to improve the numeracy skills of 5–6-year-olds remains limited, particularly in the context of early childhood education in Indonesia. Most existing studies tend to focus on the effectiveness of using such materials, without comprehensively examining how the process of optimizing their use is applied in daily classroom instruction.

Aisyiyah 1 Kindergarten in Bima City, as one of the early childhood education institutions in West Nusa Tenggara Province, still faces challenges in teaching early childhood numeracy. Initial observations indicate that learning activities tend to be conventional, such as the use of worksheets and number memorization exercises. The teaching materials used are also limited to number cards and posters, while manipulatives such as building blocks have not been fully utilized. Initial data shows that out of 15 children, only 5 children (33.3%) were able to correctly identify numbers 1–5, while 10 children (66.7%) still required guidance in recognizing numbers, reciting number sequences, and matching number symbols with the quantity of objects. These findings are supported by the teacher's observation that some children still frequently confuse the numbers 5 and 6, forget the numbers after 8, and are inconsistent when asked to pick up objects corresponding to the numbers called out. This situation indicates that the implemented learning strategies are not yet fully aligned with the learning characteristics of young children, who require concrete, interactive, and enjoyable learning experiences.

These conditions served as the key basis for conducting a classroom-based intervention case study at Aisyiyah 1 Kindergarten in Bima City, one of the early childhood education centers in Rasanae Barat Subdistrict, Bima City, West Nusa Tenggara. The term "intervention" in this study refers to the implementation of a learning intervention consisting of 10 Lego Duplo play sessions that were systematically designed, conducted, and evaluated to optimize numeracy learning. This study is not categorized as action research because it does not use the spiral cycle of planning, action, observation, and repeated reflection as in action research; the research focus is directed toward a deep understanding of the learning process, responses, and outcomes within a specific case context.

The selection of Lego Duplo as an intervention tool is based on several advantages it offers over conventional building blocks. First, Lego Duplo is designed with a size that is appropriate for children aged 5–6 years, so it is not too small to pose a choking hazard, yet remains easy for children to grasp and manipulate. The larger size of Duplo blocks is specifically designed to be safe and suitable for young children.

Second, Lego Duplo features an interlocking system that allows each block to connect securely, enabling children to build more stable structures. This differs from conventional wooden blocks, which tend to collapse easily, thus failing to support sustained constructive exploration. Third, Lego Duplo is available in various educational themes, one of which is the number theme like "My First Number Train," designed to introduce number concepts to children through fun play activities. This set uses numbered blocks to help children recognize numbers and count through sorting and sequencing activities. With these various advantages, Lego Duplo serves not only as a play medium but also as an effective learning tool for introducing basic mathematical concepts in a concrete, interactive way that aligns with the developmental characteristics of young children.

This study offers a novel perspective compared to previous studies, as it not only focuses on measuring the effectiveness of learning media but also examines in depth the process of optimizing its use in real-world learning contexts. The qualitative approach used allows researchers to holistically understand how interactions between teachers, children, and Lego Duplo media occur in daily learning activities. This aligns with the characteristics of qualitative research, which emphasizes the contextual and comprehensive interpretation of phenomena through direct observation in natural settings (Abdullah, 2024). In addition, this study also identified factors that support and hinder the process of optimizing the use of building block media. An examination of these aspects is important, given that the implementation of learning in early childhood education often faces various challenges, such as limited resources, a lack of methodological variety, and the suboptimal use of learning media (Nina Kurniah, Nesna Agustriana, 2025).

This study aims to: (1) describe the process of optimizing the use of building blocks through Lego Duplo play among 5–6-year-old children at Aisyiyah 1 Kindergarten in Bima City; (2) analyze improvements in children's numeracy skills following Lego Duplo play activities; and (3) identify various factors that support and hinder the optimization of building block use to enhance children's numeracy skills.

## Methodology

This study employs an interpretivist/constructivist paradigm because early childhood numeracy learning is understood not as a self-contained reality, but rather as something shaped through interactions among children, teachers, learning materials, and the classroom environment. This paradigm is particularly relevant for qualitative research because it places experience, subjective meaning, and social context at the core of understanding educational phenomena. From an interpretivist perspective, social reality is understood through the interpretation of participants' experiences, whereas constructivism views knowledge as the result of active construction through interaction with the environment. Therefore, observation,

interviews, and documentation are used to gain a natural understanding of children's numeracy learning experiences in the classroom (Pervin et al., 2022).

This study employed a mixed-methods approach with a qualitative focus using an embedded case study design. Primary data were obtained from observations, interviews, documentation, and field notes, while simple quantitative data—specifically the frequency of children's achievement on the numeracy skills rubric—were used as supplementary data. This study is a classroom-based intervention case study conducted through 10 sessions of Lego Duplo play in numeracy learning for 5–6-year-old children in Class B of Aisyiyah 1 Kindergarten in Bima City. This study does not use a repeated cycle pattern as in classroom action research but focuses on an in-depth examination of the learning intervention process.

The research subjects included 15 children in Class B of Aisyiyah 1 Kindergarten in Bima City, selected through purposive and total sampling techniques, as all children in that class were involved in the learning program that was the focus of the intervention. In addition to the children as the primary subjects, this study also involved supporting informants, namely three classroom teachers/assistants, one school principal, and one parent. The research data were derived from primary and secondary sources. Primary data were obtained through observations of Lego Duplo play sessions, interviews, and a children's numeracy skills rubric, while secondary data were derived from lesson plans, learning evaluation records, photographic documentation of activities, children's assessment records, as well as relevant literature and scientific journals. Data collection was conducted through observations over 10 sessions, semi-structured interviews, documentation, and the use of a numeracy skills rubric.

The qualitative data analysis in this study employs the Miles, Huberman, and Saldaña model, which includes the stages of data condensation, data presentation, and the drawing and verification of conclusions (Matthew B. Miles, 2014). Meanwhile, simple quantitative data were analyzed descriptively by calculating the frequency of children's achievements on each arithmetic skill indicator. Data integration was conducted by comparing the results of observations, interviews, documentation, and assessment rubrics, thereby yielding a comprehensive understanding of the learning process and the development of children's arithmetic skills. To ensure the validity of the findings, this study employed triangulation. Member checking was conducted by reconfirming the interview results and summaries of initial findings with informants, particularly classroom teachers and mentors. Cross-checking was performed by matching the researcher's field notes with supporting documents. An audit trail was also implemented to ensure the research results met the principles of credibility, transferability, dependability, and confirmability.

## Result and Discussion

### Finding

Aisyiyah 1 Kindergarten in Bima City is an early childhood education institution located in Nae Village, West Rasanae District, Bima City, West Nusa Tenggara Province. The institution was established in 1987 and operates as a private school under the Ministry of Education. In its operations, Aisyiyah 1 Kindergarten provides educational services for early childhood, with learning groups organized by age range, supported by educators and school administrators. Available facilities include classrooms, a play area, and other learning support resources, although there are still limitations in certain aspects of educational infrastructure.

The learning materials used at this school generally consist of simple teaching aids such as number cards, posters, and other educational games. However, the use of more varied manipulatives, such as building blocks, has not yet been optimized. In fact, prior to the study, Lego Duplo was not available as a learning tool at Aisyiyah 1 Kindergarten in Bima City. This situation indicates an opportunity to develop more interactive learning media innovations that align with the learning characteristics of young children.

### 1. Optimizing the Use of Building Blocks for Children Aged 5–6

Based on the results of observations and interviews, the optimization of the use of building blocks (Lego Duplo) at Aisyiyah 1 Kindergarten in Bima City was carried out through three main stages: planning, implementation, and evaluation. These stages align with the learning process in early childhood education, which generally encompasses these three main components as a systematic whole (Mania, 2019). During the planning phase, teachers and researchers collaborated to develop Daily Lesson Plans (DLPs) by integrating Lego Duplo play activities into the children's numeracy skill indicators. These lesson plans served as a guide for teachers in determining the objectives, content, methods, materials, and assessment tools to be used in the learning activities. In this study, 10 play scenarios were developed, designed in stages according to difficulty level, so they could be adapted to the children's developmental abilities.

Interview with the Class B teacher, Mrs. SA, revealed:

> *"Previously, we had never used Lego Duplo. After receiving an explanation and training, I understood that Lego Duplo can be used to teach counting in an enjoyable way. The children are invited to play while learning, unlike the usual method that uses worksheets."*

At the implementation stage, the activity began with an introduction to Lego Duplo media for the children as an initial form of stimulation before entering more structured learning activities. In the first two sessions, the children were given the freedom to explore independently without specific instructions from the teacher. This approach aimed to provide an enjoyable initial experience while also fostering the children's curiosity about the media being used.

Based on the observation results, all children showed a very high level of enthusiasm toward the use of Lego Duplo. This interest was evident from the children's responses to the bright colors and the shapes of the blocks that attracted their attention. Some children immediately engaged in arranging the blocks into various forms, while others first explored them by grouping the blocks according to color.

As further supported by the statement of Mrs. SA, the classroom teacher, who said:

> *"The children were very enthusiastic when they first saw the Lego Duplo. They immediately came closer and wanted to touch it. Even children who were usually passive in class became actively involved in playing. This was different from when I taught counting using other methods, such as number cards, which tended to make the children bored quickly."*

**Figure 1. Documentation of Lego Duplo Play Activity**

This finding is in line with studies stating that early childhood learning is more effective when carried out through play activities that provide opportunities for active

exploration of concrete objects, thereby optimally increasing children's engagement and interest in learning (Hasanah & Purnama, 2024).

In the next stage, from the 3rd to the 10th session, the teacher began integrating Lego Duplo play activities with counting material. Each learning session lasted 45–60 minutes and consisted of an opening activity (5–10 minutes), a core activity involving Lego Duplo play (30–40 minutes), and a closing activity (5–10 minutes).

In its implementation, the teacher applied a gradual approach, starting from simple concepts and moving toward more complex ones. In the 3rd session, the children were introduced to numbers 1–5 using Lego Duplo blocks that had been labeled with number stickers. Then, in the 4th session, the children began learning to count the number of blocks used to build a form, such as a tower. In the 5th session, the activity focused on the children's ability to match number symbols with the corresponding number of blocks.

Entering the 6th to 8th sessions, the learning activities were expanded by introducing numbers 6–10, while in the 9th and 10th sessions, the children began to be introduced to simple arithmetic operations, such as addition and subtraction. This gradual learning pattern is in line with the principles of early childhood education, which emphasize the importance of learning experiences that are organized systematically and continuously through meaningful play activities (Lilis, 2024).

Observation results in the 7th session showed clear development in the children's counting ability. This was evident in one boy, Alif (a pseudonym), who successfully built a tower using eight blocks while counting sequentially from one to eight correctly. When the teacher asked how many blocks he had used, Alif was able to answer correctly and connect it to the number symbol 8 shown on the block. Similar progress was also observed in several other children. Based on the teacher's notes, by the end of the 8th session, 12 out of 15 children were able to count objects within the number range of 1–10 with the help of Lego Duplo media. This finding indicates that the use of concrete media in play activities can help children understand the concept of numbers more optimally.

The optimization of the learning process was also carried out through the implementation of various games to maintain the children's interest and engagement throughout the activity. The teacher developed several types of games, including: (1) Chain Blocks, an activity in which children arranged blocks according to number sequences; (2) Finding Pairs, an activity of matching number blocks with cards showing corresponding quantities; (3) Giant Building, a collaborative activity in which children built a structure using a specific number of blocks; and (4) Number Train, an activity of arranging blocks into a train sequence with numbers in systematic order.

The implementation of these game variations proved effective in preventing boredom and maintaining the children's learning interest throughout the 10 intervention sessions. This is consistent with research findings showing that varied

play-based learning approaches can significantly increase engagement and learning motivation among early childhood learners (Sehati & Pohan, 2025). In addition, varied play activities also contribute to improving children's focus, memory, and cognitive skills (W. P. Sari et al., 2025).

Based on the field notes, there was an increase in the children's concentration span from an average of 5–7 minutes in the initial sessions to approximately 15–20 minutes in the final sessions. This finding indicates that the use of interesting and interactive game variations can extend children's attention span, making the learning process more optimal.

The learning evaluation stage was carried out in two forms: formative evaluation, conducted at the end of each session, and summative evaluation, conducted at the end of the entire intervention series. Formative evaluation was carried out through direct observation of the children's level of participation and achievement in each game activity. The teacher documented each child's individual development in a special notebook as material for learning reflection.

The formative evaluation results showed a gradual improvement in the children's abilities in each session. In the 3rd session, only 5 children were able to correctly recognize numbers 1–5. However, by the 5th session, this number had increased to 11 children, and by the 8th session, 14 children were able to recognize and count numbers 1–10. This finding indicates that formative assessment plays an important role in monitoring children's development and providing feedback to improve the learning process (Affandi, 2023). Furthermore, the summative evaluation conducted at the end of the intervention showed that 13 out of 15 children had met the mastery criteria for all indicators of counting ability. This summative evaluation provided a comprehensive overview of the children's learning achievement after participating in the series of learning activities.

**Table 1. Summary of the Development of Children's Counting Ability Achievement During the Lego Duplo Intervention**

| Stage/Session | Activity Focus | Dominant Indicator | Children's Achievement | Development Interpretation |
|---|---|---|---|---|
| Pre-intervention/Initial Observation | Counting learning using worksheets, number cards, and posters. | Recognizing numbers 1–5 and reciting number sequences. | 5 out of 15 children (33.3%) were able to correctly recognize numbers 1–5. | Most children still needed concrete media and intensive guidance. |

| | | | | |
|---|---|---|---|---|
| Session 1–2 | Free exploration of Lego Duplo. | Engagement, interest, and initial concentration. | All 15 children showed interest in the media; the average concentration span was 5–7 minutes. | The media attracted the children's attention and became the basis for more structured counting learning. |
| Session 3–5 | Introduction to numbers 1–5, counting blocks, and matching numbers with quantities. | Recognition of number symbols and one-to-one correspondence. | Achievement increased from 5 children in the 3rd session to 11 children in the 5th session. | The children began to connect number symbols with quantities of concrete objects. |
| Session 6–8 | Introduction to numbers 6–10 and arranging blocks according to numerical order. | Counting objects from 1–10 and ordering numbers. | 12 out of 15 children were able to count objects from 1–10 with the help of Lego Duplo; 14 children were able to recognize and count numbers 1–10. | Development was evident in the children's counting accuracy and their confidence in answering the teacher's questions. |
| Sessions 9–10/Final Evaluation | Simple addition and subtraction using groups of blocks. | Simple arithmetic operations and understanding the concept of quantity. | 13 out of 15 children met the mastery criteria for all indicators of counting ability. | Most children demonstrated a more complete understanding of number concepts and simple arithmetic operations. |

## 2. Improving Children's Counting Ability through Lego Duplo Play

The research results showed clear development in the children's counting ability after participating in 10 sessions of Lego Duplo play. Based on an interview with the Class B teacher, Mrs. SA, before the intervention was implemented, the children's counting ability was still relatively low and had not developed optimally. This condition indicates that the previous learning approach had not been able to provide maximum numeracy stimulation for the children. Mrs. SA stated that:

> *"Before using Lego Duplo, many children were unable to recite number sequences correctly. The children often reversed the numbers 5 and 6 or forgot the number after 8. In matching numbers with the quantity of objects, nearly half of the children still experienced difficulties. They could say the numbers but did not understand their meaning. For example, when I showed the number 4 and asked a child to take 4 blocks, they sometimes took 3 or 5."*

This finding is in line with research results stating that learning approaches that are less varied and not based on play activities tend to lead to low engagement and limited development of early childhood abilities. Conversely, the implementation of play-based learning has been proven to significantly improve children's interest, participation, and cognitive development (Sehati & Pohan, 2025).

The assessment results obtained through the counting ability rubric before and after the intervention showed development across all observed indicators. In the initial stage, most children still experienced difficulties in reciting number sequences, counting the number of objects, and matching number symbols with the corresponding quantities. In addition, their understanding of number symbols and their ability to perform simple arithmetic operations were still limited.

After the implementation of the intervention through Lego Duplo play, a fairly clear change occurred in the children's abilities. The children began to recite number sequences more accurately, count objects more precisely, and connect number symbols with the appropriate quantities. Their understanding of number symbols also continued to develop, and some children demonstrated the ability to perform simple arithmetic operations, although they still needed assistance in certain situations.

This was also supported by the statement of Mrs. H, the Class B teacher at TK Aisyiyah 1 Kota Bima, who explained that:

> *"The changes I observed were very impressive. Children who were previously passive and afraid of making mistakes when asked to count are now more courageous and confident. They are not only able to recite numbers but also understand the concept of quantity. For example, when I asked them to take 7 blocks, they could immediately take*

*exactly 7 without counting repeatedly. They have also begun to identify the numbers mentioned by pointing to the blocks labeled with those numbers."*

The improvement in the children's counting ability was also evident in their ability to complete various challenges given by the teacher during the learning process. In one session that focused on simple addition, the teacher presented a problem situation involving the combination of two groups of blocks with different colors. One child, Siti (a pseudonym), showed an appropriate response by taking a number of blocks according to the instructions, then combining them and counting sequentially while pointing to each block until she obtained the correct result.

A similar process was also demonstrated by most of the other children, who were able to complete the task by combining concrete objects and counting them directly. This shows that the children were not merely memorizing, but were beginning to understand the concept of addition through real experiences. This finding is in line with studies stating that the use of concrete media in counting activities helps children understand number concepts through manipulative activities and direct experience (R. Sari, 2025). In addition, play-based learning such as this has also been shown to improve children's engagement and problem-solving skills, as children are actively involved in a meaningful learning process (W. P. Sari et al., 2025). Thus, the improvement in counting ability was not only evident in the final results but also in the children's thinking processes and the strategies they used to solve problems.

This was reinforced by the statement of Mrs. M, one of the students' parents, who stated that the child's counting ability had begun to transfer into home activities. Alif, for example, was seen learning more often through play, such as counting the number of toys and adding them in a simple way, as well as beginning to recognize numbers on objects around him. This finding indicates that the optimization of building blocks (Lego Duplo) at TK Aisyiyah 1 Kota Bima was successfully implemented systematically through the stages of planning, implementation, and evaluation. This success was reflected in the children's high enthusiasm, increased engagement and concentration, and the development of their ability to recognize and understand number concepts through Lego Duplo media.

### 3. Supporting and Inhibiting Factors in Optimizing the Use of Building Blocks

This study revealed various factors that played a role in supporting and inhibiting the optimization of building block use in improving children's counting ability. The main supporting factors included the children's high enthusiasm and learning motivation during the activities, strong support from the teachers and principal, the characteristics of Lego Duplo media that suited the children's needs and developmental stages, the implementation of a gradual learning approach, the

availability of a conducive learning environment, and the use of varied games that helped maintain the children's interest.

This condition is in line with research findings stating that children's intrinsic motivation in play, a supportive learning environment, and the use of engaging media are important factors in increasing the engagement and learning success of early childhood learners (Agustina et al., 2025). In addition, teachers' competence in designing varied play activities that are appropriate to children's developmental stages is also a key factor in the successful implementation of play-based learning (Sehati & Pohan, 2025). Thus, the combination of children's internal factors and external factors, such as environmental support and the teacher's role, becomes an important element in optimizing the use of play-based learning media in early childhood education.

The children's enthusiasm became the main supporting factor in counting learning using Lego Duplo. From the initial introduction, the children showed high interest, were actively involved, felt happy, and wanted to continue using the media. Mrs. SA explained that the children even wanted to keep playing during break time and often asked whether they would play with Lego again in the next meeting, making the counting material easier to understand compared to the use of books or number cards. In addition, support from the teachers and principal also strengthened the success of this activity. The principal of TK Aisyiyah 1 Kota Bima, Mrs. HF, stated that the use of Lego Duplo was in line with the school's vision of creating enjoyable and meaningful learning and was expected to continue being used after the research was completed.

The principal's role in providing such support is very important, as effective leadership can influence teachers' performance and innovation in the learning process. A principal who acts as a motivator, facilitator, and driving force can encourage teachers to develop more creative and innovative learning methods. In addition, support in the form of facilities, training, and collaborative space also serves as a factor that strengthens the successful implementation of learning in early childhood education (Sina, 2024).

With this support, teachers became more motivated to optimize the use of learning media, making the learning process more effective and aligned with children's developmental needs.

The characteristics of Lego Duplo, which is colorful, safe, and easy to use, also served as supporting factors in the learning process. Compared to conventional building blocks, which tend to collapse easily, Lego Duplo is equipped with a connecting system that allows each piece to attach firmly, making children's constructions more stable and less likely to fall apart. This condition helps reduce children's frustration during play, enabling them to focus more and feel comfortable in learning activities.

In addition, the relatively larger size of Lego Duplo compared to ordinary blocks makes it safer for early childhood learners and easier for them to grasp and manipulate. Thus, the physical and functional characteristics of Lego Duplo contribute positively to creating a safe, enjoyable, and effective learning experience for young children.

In addition to supporting factors, this study also identified several inhibiting factors in optimizing the use of building blocks to improve children's counting ability. These obstacles included the limited duration of each learning session, differences in children's learning pace, the limited number of Lego Duplo media requiring children to take turns using them, children's physical conditions that were not always optimal, and teachers' limited experience in utilizing the media as a learning tool.

This finding is in line with research results stating that limited facilities and infrastructure, variations in children's abilities, and teachers' competence in managing learning are factors that can hinder the effectiveness of learning implementation in early childhood education. In addition, teachers' lack of understanding and experience in applying innovative learning methods can also affect the quality of the learning process (Nina Kurniah, Nesna Agustriana, 2025). Thus, these various obstacles need to be considered in the planning and implementation of learning, so that the use of play media such as Lego Duplo can be optimized more effectively according to the needs and characteristics of early childhood learners.

Limited time became one of the obstacles in implementing learning activities using Lego Duplo. The duration of each session, which was only around 45–60 minutes, required the teacher to manage time effectively between free exploration, guided activities, and closing activities. Mrs. NH explained that the time often felt too short because the children had just begun to enjoy the game when the activity had to end. Ideally, the learning session would last around 75–90 minutes so that children would have more opportunities to explore while also participating in structured activities. However, due to schedule limitations, the activity could only be conducted for about one hour.

This finding is in line with studies showing that time limitations and the demands of managing learning activities are among the obstacles often faced by early childhood education teachers in implementing innovative and meaningful learning (Nina Kurniah, Nesna Agustriana, 2025).

Differences in children's learning pace also became a challenge in the implementation of learning. Some children needed more time to understand the concepts being taught, while others were able to follow the material more quickly and were ready for a higher level of difficulty. This condition required the teacher to manage learning in a differentiated manner by providing attention and guidance tailored to each child's needs. This is in line with studies stating that differences in children's characteristics and abilities are factors that need to be considered in the early

childhood education learning process in order to prevent developmental gaps (Susilowati et al., 2025).

Teachers' limited experience in using Lego Duplo as a learning medium also became one of the inhibiting factors, especially in the initial stage of the intervention. Mrs. SA revealed that at first, there was still some confusion in integrating the media into counting learning activities. This condition is in line with research findings showing that limited teacher competence and experience in using innovative learning media can affect the effectiveness of the learning process in early childhood education (Siti et al., 2024)

## Discussion

### 1. Optimizing the Use of Building Blocks for Children Aged 5–6 Years

The results of the study showed that optimizing the use of building blocks (Lego Duplo) at TK Aisyiyah 1 Kota Bima could be effectively implemented through systematically structured stages of planning, implementation, and evaluation. This success is in line with Jean Piaget's constructivist learning theory, which emphasizes that knowledge is actively constructed by children through interaction with their environment and the objects around them (Magfiroh & Azzahro, 2025).

In the context of this study, Lego Duplo served as a concrete medium that allowed children to explore and manipulate objects directly. Through these activities, children did not merely memorize number symbols but also developed an understanding of number concepts by connecting numerical symbols with the number of blocks they arranged. This aligns with the principle of constructivism, which states that learning occurs when children actively construct knowledge based on the experiences they gain (Hafizah et al., 2025).

This study also reinforces the findings of Yüzbaşıoğlu and Uslu, which showed that the "Six Bricks Duplo Block" program, conducted over 10 weeks with 50 play activities, had a positive effect on preschool children's early mathematics skills and visual perception (Yüzbaşıoğlu & Uslu, 2025). However, the comparison with this study needs to be interpreted critically because there are differences in research design, duration, and focus. Yüzbaşıoğlu and Uslu's study used a quasi-experimental design with a control group and statistical measurements, whereas this study used a classroom-based intervention case study that emphasized understanding the process, children's responses, and descriptive changes in achievement.

Although this study was conducted over a shorter period, namely 5 weeks with 10 activity sessions, the development of children's abilities was still clearly evident because the intervention was specifically designed to develop basic counting skills. The more focused scope allowed each session to concentrate intensively on number recognition, one-to-one correspondence, matching number symbols with quantities, and the introduction of simple arithmetic operations. In addition, game variations such

as Chain Blocks, Finding Pairs, Giant Building, and Number Train were able to maintain children's engagement throughout the learning process, so the relatively short intervention period still produced practically meaningful changes.

Thus, the similarity of findings in both studies can be understood from the characteristics of Lego Duplo as a concrete manipulative medium that provides children with opportunities to learn through direct experience. The difference is that this study shows that when learning objectives are designed more specifically and teachers provide gradual scaffolding, the use of Lego Duplo can still support the development of early numeracy, even within a relatively short period. However, because this study did not involve a control group and did not use inferential statistical tests, the results are more appropriately understood as development observed within the classroom context, rather than as evidence of causal effectiveness that can be widely generalized.

Although the implementation period was relatively shorter, the results of this study still showed meaningful improvement. This was made possible by the higher intensity of learning and the use of more varied games, which helped maintain children's consistent engagement throughout the intervention process. Thus, this study not only confirms the effectiveness of a play-based approach but also shows that optimizing learning strategies can produce significant results even within a more limited period.

**2. Improving Children's Counting Ability through Lego Duplo Play**

The improvement in children's counting ability found in this study is consistent with various previous research findings that highlight the effectiveness of using play-based learning media in developing early childhood numeracy skills. Various studies reveal that the use of concrete media, such as number sticks and other educational games, can significantly improve children's engagement and understanding of mathematical concepts.

Although the type of media used in this study was different, the pattern of improvement showed a similar tendency. This strengthens the view that concrete and manipulative learning media provide more meaningful learning experiences for children, making it easier for them to understand number concepts. This finding is in line with studies stating that the use of play-based media can improve concept understanding, learning motivation, and children's active engagement in the learning process (Putra, 2025). Thus, the results of this study further emphasize that the use of interactive and play-based learning media is an effective strategy for developing early childhood counting skills.

Nevertheless, this study provides a new contribution compared to previous studies because it utilizes Lego Duplo, which has more advantages than media such as number sticks or flashcards. Lego Duplo not only functions as a counting aid but

also develops various aspects of children's development simultaneously, such as fine motor skills through block-building activities, creativity through the freedom to construct various forms, and social skills through interaction and cooperation in group play. This multidimensional advantage is not found in conventional learning media such as flashcards or number sticks, which tend to be one-way and limited to certain cognitive aspects. Studies in Indonesia show that Lego play can stimulate children's cognitive development, creativity, thinking skills, and imagination more comprehensively (Maulida, 2022). In addition, the use of constructive games such as Lego has also been proven to improve children's problem-solving abilities and thinking skills through meaningful manipulative activities (Nursaadah et al., 2025).

Thus, the use of Lego Duplo not only contributes to improving mathematical ability but also has a broader impact on children's overall development. This shows that investing in constructive play-based learning media such as Lego Duplo offers greater added value compared to conventional learning media.

The most prominent improvement in children's counting ability was seen in their ability to recognize number symbols and recite number sequences. This can be understood through the characteristics of Lego Duplo media, particularly the Number Train type, which provides numbered blocks that can be arranged sequentially to resemble a train. This activity naturally encouraged children to repeatedly practice ordering numbers without feeling that they were engaged in formal learning. This condition shows that learning through engaging play media can create enjoyable and meaningful learning experiences. Children not only recognized number symbols but also connected them with the concrete activities they performed. This finding is in line with studies stating that Lego play can help children recognize and arrange number symbols, as well as develop logical thinking skills through manipulative activities (Sumyati, 2025).

In addition, the learning process reflected the principle of learning by doing, in which children gain understanding through direct experience. This approach has been proven effective in improving children's engagement, conceptual understanding, and memory because they learn through contextual and meaningful activities (Maknuni, 2025). Thus, the use of Lego Duplo not only facilitates mastery of numeracy concepts but also strengthens children's learning process naturally through play activities.

### 3. Supporting and Inhibiting Factors in Optimizing the Use of Building Blocks

The supporting factors identified in this study are in line with Malone's theory of learning motivation, which identifies three key elements in games that motivate children: challenge, fantasy, and curiosity. Lego Duplo fulfills these three elements. The challenge element appears in the form of targets for building structures using a certain number of blocks; the fantasy element emerges because children can build anything according to their imagination; and curiosity is stimulated by the colorful

blocks, attractive shapes, and the children's desire to see the final results of their constructions. The combination of these three elements explains why children's enthusiasm for Lego Duplo was very high and sustained over time.

In the context of this study, the use of Lego Duplo was able to fulfill these three elements simultaneously. The challenge element was reflected in specific targets that children had to achieve, such as building a structure with a predetermined number of blocks. The fantasy element emerged through children's freedom to create various forms according to their imagination. Meanwhile, children's curiosity was stimulated by the attractive colors, the variety of block shapes, and their desire to see the final outcome of the constructions they built. The combination of these three elements played an important role in increasing children's intrinsic motivation, enabling them to be actively involved in learning activities. This explains why the children's enthusiasm toward the use of Lego Duplo was very high and could be maintained for a relatively long period throughout the intervention process.

Support from teachers and the principal is a very important supporting factor, yet it often receives limited attention in previous studies. The successful implementation of learning media is basically strongly influenced by educators' readiness, competence, and commitment in managing the learning process. Various studies show that teachers have a strategic role as facilitators, motivators, guides, and role models in creating effective and meaningful learning experiences (Safitri & Nst, 2025).

In this study, the teacher not only served as a provider of learning media but was also actively involved in assisting the children, providing scaffolding according to their needs, and creating a positive and enjoyable learning atmosphere. This active role became the key to helping children understand concepts gradually. Without optimal teacher support and involvement, the use of learning media, no matter how advanced, would not be able to produce maximum results in children's learning process.

Inhibiting factors related to limited learning time and differences in children's learning pace are common challenges in the implementation of early childhood education, particularly in the context of inclusive learning. Differences in children's individual abilities and characteristics often become obstacles in the learning process, as each child has different needs and learning tempos (Damanik & Setiyatna, 2025). In addition, limited learning time can also affect the effectiveness of learning activities, especially when teachers have to adjust learning strategies to meet the needs of all children equally.

To address these problems, it is necessary to develop a differentiated learning model by providing activities that are adjusted to each child's level of ability without physically separating them. This approach allows children to continue learning in the same environment, but with different challenges according to their readiness. For

example, children with higher abilities can be given more complex tasks, such as simple addition, while children who are still at the initial stage can focus on counting concrete objects. Thus, the implementation of play-based differentiated learning using Lego Duplo can be an effective solution for accommodating the diversity of children's abilities while improving the quality of inclusive learning.

The limited number of Lego Duplo blocks became one of the practical obstacles that may be experienced by many early childhood education institutions in Indonesia, especially because the price of the media is relatively high. However, the results of this study show that this limitation does not become a major obstacle when managed with appropriate strategies. Although the available media were limited, the learning process could still be optimized through turn-taking arrangements and the implementation of varied activities that allowed children to remain actively involved, such as observing, giving ideas, and helping their peers. This finding is in line with studies stating that limited learning facilities remain a common problem in early childhood education institutions in Indonesia, which can affect the quality of learning if not managed effectively (Azizah, 2022).

Thus, teachers' creativity in utilizing limited resources becomes a more determining factor than the quantity of media available. As an alternative, early childhood education institutions can use more affordable local building blocks with simple modifications, such as adding number stickers, or gradually procure learning media through parental involvement. This approach can serve as a practical solution for providing meaningful and interactive learning even under limited facility conditions.

Teachers' limited experience in the initial stage of the intervention emphasizes the importance of training and mentoring before implementing new learning media. Various studies show that improving educators' capacity is an important factor in supporting the success of the learning process, especially in the use of innovative media and methods. Planned and continuous training has been proven to improve teachers' pedagogical competence, enrich the variety of learning media, and encourage the creation of more meaningful learning experiences for children (Paramitha & Apriza, 2026). In the context of this study, the brief training provided before the intervention proved helpful in enabling teachers to understand the potential of Lego Duplo as a medium for counting instruction. Teachers became more confident in designing activities, managing the classroom, and integrating play into learning. To ensure the sustainability of implementation, a continuing professional development program is needed for early childhood education teachers. This program is important to ensure that teachers continue to develop their competencies, are able to adapt to various learning innovations, and can optimize the use of constructive play media in early mathematics learning effectively and consistently.

## Conclusion

Based on the research findings, the optimization of building blocks in the form of Lego Duplo at TK Aisyiyah 1 Kota Bima was carried out in a planned manner through three main stages: planning, implementation, and evaluation. In the planning stage, the teacher and researcher prepared the Daily Lesson Plan (RPPH) and game designs based on the indicators of counting ability for children aged 5–6 years. Furthermore, in the implementation stage, the learning activities were conducted gradually, beginning with free exploration, number recognition, matching number symbols with quantities of objects, and practicing simple arithmetic operations. The results of the study showed that children's counting ability developed clearly, particularly in recognizing numbers 1–10, counting blocks, understanding number concepts, and solving simple addition and subtraction problems with the help of concrete media.

The factors supporting the optimization of Lego Duplo use included the children's high enthusiasm, support from teachers and the principal, the characteristics of the media that were attractive, safe, and appropriate for the children's age, and game variations that maintained children's engagement during the learning process. Meanwhile, the inhibiting factors included limited time allocation, differences in children's learning pace, an insufficient number of media for all children to use simultaneously, and teachers' limited initial experience in integrating Lego Duplo with counting activities. These obstacles can be overcome through more flexible time management, the implementation of differentiated learning, turn-taking in media use, and teacher mentoring to optimize the use of Lego Duplo in numeracy learning.

The practical implication of this study indicates that early childhood education teachers can use Lego Duplo or similar types of building blocks as concrete, interactive, and enjoyable numeracy learning media for children. In addition, early childhood education institutions need to provide support through the availability of manipulative media and teacher training, so that counting learning does not depend solely on worksheets but is more aligned with the learning characteristics of young children. For future research, it is recommended to involve a larger number of participants, a longer intervention period, and a comparative or quasi-experimental design so that findings regarding the use of Lego Duplo in numeracy learning can be tested more strongly and have broader generalizability.

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