# The Impact of STEAM Learning with Loose Parts on the Cognitive and Artistic Development of Children Aged 5-6 Years

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| Article info | Abstract |
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| | *This study aims to analyze the effect of STEAM learning using Loose Parts on the cognitive and artistic abilities of children aged 5-6 years. The research employs a quantitative approach with a Quasi-Experimental Design. The subjects consist of 48 children divided into experimental and control groups. Hypothesis testing was conducted using the Mann-Whitney U Test, yielding a p-value of < 0.001 (α = 0.05), indicating a significant difference between the two groups. The findings confirm that STEAM learning with Loose Parts has a positive impact on enhancing young children's cognitive and artistic abilities. This approach not only stimulates creativity and problem-solving skills but also improves logical thinking and artistic expression. Therefore, integrating Loose Parts into STEAM learning can be an effective strategy for optimizing early childhood development.*<br><br>***Keywords:*** *STEAM, Loose Parts, Cognitive Ability, Artistic Ability.* |

**Abstrak**

Penelitian ini bertujuan untuk menganalisis pengaruh pembelajaran STEAM berbahan Loose Parts terhadap kemampuan kognitif dan seni anak usia 5-6 tahun. Penelitian ini menggunakan pendekatan kuantitatif dengan desain Quasi-Experimental Design. Subjek penelitian terdiri dari 48 anak yang dibagi ke dalam kelompok eksperimen dan kontrol. Pengujian hipotesis dilakukan dengan Mann-Whitney U Test, menghasilkan nilai p < 0,001 (α = 0,05), yang menunjukkan adanya perbedaan signifikan antara kedua kelompok. Hasil penelitian mengonfirmasi bahwa pembelajaran STEAM berbahan Loose Parts berdampak positif terhadap peningkatan kemampuan kognitif dan seni anak usia dini. Pendekatan ini tidak hanya merangsang kreativitas dan pemecahan masalah, tetapi juga meningkatkan keterampilan berpikir logis dan ekspresi artistik. Oleh karena itu, integrasi Loose Parts dalam pembelajaran STEAM dapat menjadi strategi efektif dalam mengoptimalkan perkembangan anak usia dini.

**Kata Kunci:** STEAM, Loose Parts, Kemampuan Kognitif, Kemampuan Seni.

## PENDAHULUAN

Cognitive and artistic abilities are essential for early childhood development. Cognitive skills encompass logical thinking, problem-solving, and conceptual understanding, which lay the foundation for future learning (Hanifa et al., 2024; Lestari,

2019; Warmansyah, Utami, et al., 2023). Meanwhile, artistic abilities foster creativity, imagination, and fine motor coordination (Nursalsabila, 2023; Wasilah, 2022; Yusman & Indrayuda, 2019). Research indicates that early and appropriate stimulation significantly enhances both aspects (Diamond, 2013). Children with strong cognitive skills grasp academic concepts more easily, adapt better to learning environments, and develop critical thinking. Similarly, artistic abilities support individual expression while also contributing to social-emotional growth through exploration and creative experimentation.

Early childhood cognitive development is shaped by the environment and learning methods applied. Exploratory and problem-solving activities enhance children's ability to think flexibly and apply new concepts in daily life (Piaget, 1964). Likewise, engaging with art—such as drawing, painting, and building with manipulatives—develops motor skills, hand-eye coordination, and imagination (Winner & Cooper, 2000). Integrating cognitive and artistic development creates a richer, more holistic learning experience.

Research shows that children exposed to educational games develop better memory and analytical skills than those in conventional learning settings (Ardhi & Warmansyah, 2023; Hart et al., 2003). Additionally, art-based learning enhances communication, confidence, and divergent thinking, fostering creative problem-solving (Playto, 2024). Artistic expression thus serves not only as a creative outlet but also as a foundation for complex and adaptive thinking (Alghufali, 2024). Given its importance, early childhood education must adopt interactive and flexible approaches that encourage exploration, independent problem-solving, and creative expression (Gao & Hall, 2024). Effective learning strategies should simultaneously nurture cognitive growth and artistic abilities, making research in this area essential for advancing early childhood education.

Early childhood stimulation is crucial as it lays the foundation for cognitive, emotional, moral, artistic, and social development (Imara et al., 2024; Maromi & Pamuji, 2024; Warmansyah, Suzanne, et al., 2023). Providing appropriate stimulation at an early age maximizes children's potential, fostering their growth into successful and well-rounded individuals (Heckman et al., 2006). Young children possess unique creativity, allowing them to learn through environmental interactions (Aisy et al., 2024; Erma & Yaswinda, 2023; Sitorus et al., 2024). However, limited opportunities for exploration and innovation often hinder their creative development (Hutami et al., 2023; Sinaga, 2022). Thus, a stimulating learning environment is essential for holistic child development.

Initial observations at DWP Tawangsari 2 Kindergarten, Sidoarjo, revealed that the center learning model was used, with cognitive learning in the preparation center and art activities in the creativity center. However, both relied heavily on worksheets (LKA), with minimal integration of STEAM content and loose parts. Cognitive learning focused on basic concepts like counting and grouping without active child involvement, while art activities were limited to drawing and coloring with crayons. The lack of

interaction and hands-on engagement hindered children's cognitive and artistic development. This issue stemmed from teachers' limited understanding of STEAM-based learning with loose parts, resulting in passive, worksheet-driven instruction. To address this, researchers examined the impact of STEAM learning with loose parts on the cognitive and artistic abilities of children aged 5-6 years, aiming to enhance teachers' knowledge and instructional practices.

This study utilizes loose parts media as a learning tool. Loose parts are classified as natural materials as they originate from the surrounding environment. This media allows children to play freely without teacher guidance, enhancing their creativity. Loose parts are open-ended, can be assembled and disassembled, and combined with other materials. They can be sourced naturally, such as stones, gravel, dry leaves, twigs, shells, and seeds, or synthetically, like plastic bottles, bottle caps, fabric scraps, and ribbons. Loose parts also support STEAM learning due to their flexibility and ability to encourage exploration (Hasibuan, 2024; Siskawati & Herawati, 2021; Utami et al., 2023).

STEAM learning is recognized as an innovative 21st-century learning approach. It was introduced for its ability to adapt to rapid educational changes, particularly in exploring and developing relevant skills (Fadillah & Yusuf, 2022; Reswari, 2021). Children naturally have a high curiosity, allowing them to learn and explore their surroundings based on their interests. Early childhood is a phase where play dominates daily activities (Purnamasari et al., 2020; Wulandani et al., 2022). Engaging children in active learning helps them solve problems in their own way. Their innate curiosity further drives them to explore (Kurnia & Nasrudin, 2022). Therefore, integrating STEAM learning into early childhood education provides an effective approach to fostering creativity, problem-solving skills, and independent exploration.

STEAM is an instructional approach integrating science, technology, engineering, art, and mathematics to enhance academic learning, problem-solving, critical thinking, collaboration, and creativity (Shalehah, 2023). Science in STEAM involves exploration through experiments and observations, helping children understand natural phenomena scientifically (Rahardjo & Melita, 2019; Warmansyah, Komalasari, et al., 2023; Zubaidah, 2019). Teachers can design science learning by integrating it with social, cognitive, and physical development. Technology in STEAM includes simple tools like scissors and crayons to advanced gadgets, requiring supervision while allowing children to explore independently (Motimona & Maryatun, 2023). Engineering focuses on building tools and structures to solve problems, starting with identifying issues and developing solutions. Art fosters imagination and creativity, enabling children to express emotions through drawing, painting, and sculpting, influenced by their developmental stage (Fitriyah et al., 2023). Mathematics in STEAM covers classification, geometry, measurement, and arithmetic, designed to support physical, social, and cognitive growth through well-planned activities integrated into the curriculum.

Previous studies have shown that STEAM learning based on loose parts has the potential to enhance creativity and cognitive abilities in early childhood. Salma Fadillah & Yusuf, (2022) found that incorporating loose parts in STEAM activities helps children better understand instructions, while teacher creativity in designing engaging play experiences plays a crucial role in fostering children's interest in learning. Similarly, Kulsum (2022) highlighted that loose parts media positively impact cognitive development, reinforcing its role as an effective learning tool. Additionally, research by Hadinugrahaningsih et al., (2016) emphasized that STEAM learning provides a holistic educational experience, integrating multiple disciplines to enhance conceptual understanding and creativity. Priyanti & Warmansyah, (2021) further noted that exploration-based STEAM improves children's critical thinking, problem-solving, and artistic skills.

Despite these findings, limited studies have specifically examined how loose parts-based STEAM simultaneously supports cognitive and artistic development in early childhood, particularly in the Indonesian context. While existing research explores the benefits of loose parts in early childhood learning, there remains a gap in understanding their integration within the STEAM framework. This study aims to address that gap by investigating how loose parts-based STEAM learning can foster both cognitive and artistic skills in young children. Beyond strengthening conceptual understanding, this approach encourages contextual creative exploration, providing practical insights for educators to implement more interactive and effective STEAM-based learning in early childhood education.

## METHODS
### Research Design

This study employed a quantitative approach with a quasi-experimental design using a one-group pretest-posttest model. The research design involved an experimental group that received an intervention using loose parts-based learning and a control group that followed conventional teaching methods. The study design is illustrated as follows:

Table 1. One-Group Pretest-Posttest Design

| Group | Pretest | Treatment | Posttest |
|---|---|---|---|
| **Experiment** | $O^1$ | X | $O^2$ |
| **Control** | $O^3$ | - | $O^4$ |

Explanation:

O1: Pretest for the experimental group before the loose parts-based learning intervention

O2: Posttest for the experimental group after the intervention

O3: Pretest for the control group before conventional learning

O4: Posttest for the control group after conventional learning

X: Loose parts-based learning intervention
–: Conventional learning without intervention

## Population and Sample

The population in this study consisted of all students in Group B at TK Dharma Wanita Persatuan Tawangasari 2, Sidoarjo. The sample included 48 students, divided into two learning groups: Group B1 as the experimental group, which received the loose parts-based learning intervention, and Group B2 as the control group, which followed conventional teaching methods. The sampling technique used was total sampling, as all students in the targeted population were included in the study.

## Data Collection Techniques

Data were collected through systematic observation, focusing on children's logical thinking development based on predefined indicators. The observations were conducted directly by the researchers, ensuring objective assessment throughout the learning process. The research instrument underwent expert validation, where early childhood education experts reviewed and confirmed its suitability with the research objectives.

## Data Analysis Techniques

The data analysis aimed to evaluate the effectiveness of loose parts-based learning in improving children's logical thinking skills. The n-gain score method was used to measure cognitive improvement by comparing pretest and posttest scores.

## RESULTS AND DISCUSSION
## Results

This study analyzed the effectiveness of STEAM learning using loose parts in enhancing cognitive and artistic abilities in children aged 5-6 years. Descriptive statistical analysis was conducted using JASP 0.19.10 to summarize the findings.

## Descriptive Statistical Analysis

The descriptive statistical results are presented in Table 2.

**Table 2. Descriptive Statistics**

| Variable | Pretest Mean | Posttest Mean | Gain Score Mean | Min | Max | Std. Deviation |
|---|---|---|---|---|---|---|
| **Cognitive Ability (K)** | 5.833 | 10.000 | 4.167 | 5 | 12 | 1.155 |
| **Artistic Ability (S)** | 7.313 | 10.167 | 2.854 | 5 | 12 | 0.618 |

The results indicate that all 48 participants were included in the analysis, with no missing data. The mean pretest score for cognitive ability was 5.833, with a minimum of 5 and a maximum of 7, while the posttest mean score increased to 10.000, with a

minimum of 8 and a maximum of 12. The mean gain score was 4.167, with a standard deviation of 1.155. Similarly, for artistic ability, the mean pretest score was 7.313, increasing to 10.167 in the posttest. The gain score for artistic ability was 2.854, with a standard deviation of 0.618.

## Hypothesis Testing

As some data did not meet normality and homogeneity assumptions, non-parametric statistical analysis was conducted using the Mann-Whitney U test.

**Table 3. Hypothesis Testing Results**

| Variable | Mann-Whitney U | p-value | Interpretation |
|---|---|---|---|
| **Cognitive Ability Gain (GAIN-K)** | 72.000 | < .001 | Significant Difference |
| **Artistic Ability Gain (GAIN-S)** | 179.000 | .007 | Significant Difference |

The results for cognitive ability (p < 0.001) indicate a statistically significant difference between the experimental and control groups. This suggests that the intervention did not significantly enhance cognitive ability in children aged 5-6 years. On the other hand, the results for artistic ability (p = 0.007) confirm a significant effect of the intervention, indicating that STEAM learning using loose parts positively influenced children's artistic development.

## Discussion

The findings highlight the differential impact of STEAM-based loose parts learning on cognitive and artistic abilities. While the intervention did not significantly affect cognitive abilities, it had a positive effect on artistic development.

## The Impact of STEAM Learning on Cognitive Abilities

The statistical analysis revealed that the increase in cognitive abilities was not significantly different between the experimental and control groups. These findings align with previous studies suggesting that cognitive development in early childhood is influenced by multiple factors, including prior knowledge, environmental support, and teaching strategies (Piaget, 1964). Although STEAM learning integrates science, technology, engineering, art, and mathematics, its direct impact on cognitive abilities may require a more extended intervention period. Similar findings were reported by Chun & Park, 2020 (2020). , who argued that cognitive improvements through STEAM learning tend to be gradual and dependent on the depth of concept exploration.

## The Effect of STEAM Learning on Artistic Development

Conversely, artistic ability showed a significant improvement in the experimental group. Activities such as collage-making, creating animal figures from

natural materials, and designing artworks using loose parts encouraged creativity and aesthetic expression. These findings align with Perignat & Katz-Buonincontro (2019), who emphasized that the integration of art in STEAM learning fosters children's imagination, problem-solving skills, and artistic appreciation. Additionally, Wulandari, (2017) highlighted that artistic expression in early childhood education enhances visual perception, which contributes to the overall development of creativity and aesthetic sensitivity.

**Challenges and Observations During the Intervention**

Beyond the primary research indicators, other aspects of child development were observed, such as creativity and critical thinking. Some children exhibited difficulties in following structured activities, particularly in waiting their turn during material distribution. This finding resonates with research by Bodrova & Leong (2019), which suggests that young children require structured guidance to develop patience and collaborative skills in group learning environments. To address these challenges, collaboration with classroom teachers was essential to ensure a well-managed learning process. These results contribute to the growing body of research on STEAM learning in early childhood education. They emphasize the need for continuous exploration of interdisciplinary approaches to optimize cognitive and artistic development in young learners.

**CONCLUSION**

The implementation of STEAM learning using loose parts has a significant impact on both cognitive and artistic abilities in children aged 5-6 years. This finding aligns with the research objectives and problem formulation outlined in Chapter I. The results indicate that children exposed to STEAM-based learning with loose parts demonstrate notable improvements in their cognitive and artistic skills compared to those in the control group. These findings highlight the potential of STEAM education as an interdisciplinary approach that integrates science, technology, engineering, art, and mathematics to enhance early childhood development. However, challenges remain, particularly in the availability of educators who fully understand and effectively implement this approach. Strengthening teacher training and resource availability is crucial to maximizing the benefits of STEAM learning with loose parts in early childhood education.

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