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# Implementation of STEAM Learning in Developing Cognitive Development Aspects in Children Aged 5–6 Years at Al Ihsan Cikande Kindergarten

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**ABSTRACT**

This research is motivated by the fact that the learning implemented in schools is still conventional and monotonous, namely in the form of giving assignments such as tracing letters, drawing, and coloring, so that it does not stimulate children's thinking skills. This study aims to describe the implementation of STEAM learning in developing aspects of cognitive development in children aged 5–6 years at Al Ihsan Cikande Kindergarten. The subjects of this study were 8 children. This study employed a descriptive qualitative method with data collection techniques through observation, interviews, and documentation. The data were analyzed using the Miles and Huberman model, which includes data reduction, data display, and conclusion drawing/verification. The research findings indicate that the application of STEAM learning through project-based play and the use of loose parts provides learning experiences that encourage children to think critically, logically, and symbolically, as well as to explore various ways of solving

problems. This study concludes that STEAM learning provides meaningful learning experiences that are necessary to support the cognitive development of early childhood through active and exploratory learning processes.

## Introduction

At the age of 5 to 6 years, children must receive appropriate stimulation in all aspects of their development. One of the aspects that must be stimulated is the cognitive aspect, because children experience significant development at this age (Haeriyah et al., 2024; Suminah et al., 2024). The age of 5 to 6 years is referred to as the golden age, a period when the child's brain develops rapidly. At this stage, the child's brain is like a sponge, meaning that everything they see, hear, and feel can be absorbed well (Mulyawan et al., 2024). According to Piaget, children are in the preoperational stage, where they learn using symbols or signs around them and begin to develop basic logic, symbolic thinking, and imagination (Adistiarachma et al., 2024). Therefore, the importance of early childhood education during this golden age is undeniable, as appropriate and directed stimulation is highly needed to optimize children's cognitive potential.

Early Childhood Education is organized for children from birth to 6 years old and is not a prerequisite for entering basic education (Nafal, 2024). This emphasizes that the state has the responsibility to ensure that early childhood receives quality education that supports their overall

development, as well as the importance of providing education from an early age as an effort to educate the nation's life.

One of the essential developmental aspects for children is the cognitive aspect, because cognitive development in early childhood is one of the important aspects that greatly determines the success of the learning process at the next educational level (Juita et al., 2019).

Cognitive development must be possessed by children at an early age because of its crucial role as both an ability and a learning outcome (Erviana et al., 2024). This development helps children think logically and critically, provide clear reasoning in solving problems, and discover cause-and-effect relationships when facing challenges (Victoranto Amseke et al., 2025). However, data show that cognitive development among children in Indonesia still faces challenges. The Indonesian Ministry of Health (2023) reported that 5–25% of preschool children experience delays in cognitive development (Kolomboy & Syamsu, 2025). Furthermore, the UNICEF report (2023) on children aged 24–59 months globally indicates that the proportion of children who are "on track" in development across health, learning, and psychosocial well-being domains is around 75%, meaning that approximately 25% of children are not on track. These findings emphasize the need for optimal efforts in providing cognitive stimulation in Early Childhood Education. Based on school data, Al Ihsan Cikande Kindergarten has 14 students in Group B. This study focuses on 8 children as the main subjects. The

results of preliminary observations conducted in April–May 2025 showed that among the 8 children in Group B, 5 children were not yet able to solve simple problems, and 3 children were still confused when asked to group objects based on color or shape. Most children had not shown creative attitudes, tended to imitate the examples given, and experienced difficulties in logical and symbolic thinking. Many children aged 5–6 years still experience difficulties in connecting concepts, classifying objects based on certain characteristics, organizing information logically, and solving simple problems. Some children also showed inconsistent memory and easily distracted attention. This condition indicates that cognitive stimulation has not been provided optimally, resulting in limited development of critical thinking, logical thinking, and problem-solving abilities.

Learning innovation is needed to provide optimal cognitive stimulation that is relevant to the needs of early childhood. Along with the development of science and technology, the education sector must continuously innovate in creating learning methods that are relevant to the needs of the times. One of the approaches currently being widely developed and aligned with the characteristics of children in the era of the Industrial Revolution 4.0 towards Society 5.0 is the STEAM learning approach. As an alternative, STEAM learning—Science, Technology, Engineering, Art, and Mathematics—is considered relevant to 21st-century needs. STEAM learning should begin in early childhood

because the core concept of STEAM lies in curiosity, creativity, collaboration, and critical thinking, which are highly engaging for children (Rini et al., 2022).

In the context of early childhood, learning can be integrated through play activities, as children's world is the world of play. Therefore, the concept of STEAM in early childhood can be implemented through play-based learning, and STEAM serves as an integrated learning approach aimed at broadening children's insights and ways of thinking. Thus, the STEAM learning method can be applied in education for children aged 5 to 6 years using the concept of loose parts, as loose parts media can help improve children's cognitive abilities (Nuraeni, 2023). To support cognitive development, early childhood needs to be equipped with learning experiences that are designed according to their developmental abilities by using methods that can develop cognitive aspects. This makes learning child-centered, thereby encouraging the development of their cognitive abilities (Karyadi & Rosa, 2023).

This study aims to elaborate on the implementation of STEAM learning in the school environment, which is still limited, and only a few studies specifically focus on the STEAM learning process, while many other studies mainly discuss STEAM activities. Therefore, this research aims to improve children's cognitive development through STEAM-based learning activities.

## Methods

This study is a descriptive qualitative research. According to Salam (2023), descriptive qualitative research aims to provide an in-depth description of the implementation of STEAM learning in developing the cognitive development aspects of children aged 5–6 years at Al Ihsan Cikande Kindergarten. A qualitative approach was used because the researcher intended to understand the phenomenon naturally and contextually, namely how STEAM learning is applied in children's daily activities within the school environment and how it influences their cognitive development.

This research was conducted at an early childhood education institution located in Serang Regency, namely Al Ihsan Cikande Kindergarten, which is situated at Puri Teratai Housing, Block H1 No. 27, Situterate Village, Cikande District, Serang Regency, Banten Province. The data were obtained directly from Group B students or children aged 5 to 6 years, totaling 14 students at Al Ihsan Cikande Kindergarten. Eight students were selected as the main informants and research subjects for data analysis, along with the classroom teacher who provided information related to the learning process. In this study, the data analysis technique used was the Miles and Huberman model, which consists of data reduction, data display, and conclusion drawing/verification.

## Result and Discussions

This study aims to describe the implementation of STEAM learning in developing the cognitive abilities of children aged 5–6 years at Al Ihsan Cikande Kindergarten. Data were obtained through interviews with teachers and the principal, observations of learning activities, and documentation. The presentation of the research findings refers to three main aspects in accordance with the research instruments, namely: (1) STEAM learning planning, (2) the implementation of STEAM learning and children's cognitive development, and (3) the evaluation of STEAM learning.

**STEAM Learning Planning**

The results of interviews and observations indicate that the teachers at Al Ihsan Cikande Kindergarten have systematically prepared STEAM-based learning plans through the development of the Annual Program, Semester Program, teaching modules, and Daily Lesson Plans (RPPH). The planning was carried out by integrating STEAM elements (Science, Technology, Engineering, Arts, Mathematics) into learning themes and subthemes.

The teachers and the principal stated that planning was conducted to ensure that activities run in a directed, contextual manner and are appropriate to children's developmental stages. Teachers prepared the Daily Lesson Plans (RPPH) based on the Merdeka Curriculum teaching modules and explicitly included project-based activities using loose parts media (recycled materials). The planning also covered theme

selection, learning resources, preparation of learning media, and supporting videos or stories.

The use of loose parts media (recycled materials such as bottles, bottle caps, blocks, and Lego) was proven in this study to support children's exploration and creativity. This is consistent with the study by Cankaya et al. (2023), which found that loose parts encourage constructive play, divergent thinking, and problem-solving skills in preschool children. Flexible media provide opportunities for children to innovate, revise plans, and experiment—mechanisms that were strongly observed in activities such as making toy cars and constructing structures using blocks or Lego. These findings strengthen empirical studies and literature reviews regarding the positive influence of loose parts on children's cognitive development.

**Implementation of STEAM Learning and Children's Cognitive Development**

The implementation of STEAM learning was carried out through experimental activities, projects, exploration, and constructive play using loose parts media. Activities began with morning routines, followed by core learning activities integrated with digital media such as video presentations.

Children were given the opportunity to be actively involved in the entire activity process: planning, implementing, trying, modifying, and

evaluating their work results. STEAM elements were clearly visible in several learning activities.

Children actively participated in all STEAM learning processes, including planning, experimenting, modifying, and evaluating their work outcomes. In the project of making toy cars from used bottles, children learned to understand concepts of motion and cause-and-effect relationships, used simple tools, designed car structures, and decorated their creations. This activity fostered logical thinking skills, problem-solving abilities when the wheels did not function properly, and the ability to classify materials according to needs.

In the activity of making banana satay, children observed changes in the shape and color of ingredients, used kitchen tools as technology, followed cooking steps, and decorated the final product. This learning experience trained creativity, accuracy, and basic mathematical understanding through counting banana pieces.

The walking rainbow water experiment helped children observe color changes, recognize experimental tools, and arrange experimental configurations. Children demonstrated the ability to explain cause-and-effect relationships and correct mistakes when the experiment results were not as expected.

The rice planting activity provided direct experience regarding plant growth processes, natural element requirements, and counting the

number of seeds and planting distances. Understanding was reinforced through video presentations as supporting technological media.

Meanwhile, block and Lego construction games developed classification skills, symbolic thinking, structural planning, and problem-solving when buildings collapsed. Children learned to group blocks based on color and size while building shapes according to their imagination. Overall, all these STEAM activities provided rich, contextual learning experiences oriented toward the development of early childhood thinking abilities.

This finding is in line with the research of Supianti et al. (2025), which states that project-based activities such as making toy cars, cooking banana satay, and conducting rainbow water experiments facilitate cycles of planning, implementation, reflection, and revision. This pattern aligns with the Project-Based Learning (PjBL) model, which has been reported to be effective in fostering critical thinking skills, creativity, and problem-solving abilities in early childhood. Several applied studies in the STEAM context show that PjBL increases student engagement and cognitive outcomes; therefore, these field findings fall within the framework of international and local evidence regarding the effectiveness of STEAM-PjBL.

**The Impact of STEAM Implementation on Children's Cognitive Development**

Observation results indicate that the implementation of STEAM learning had a significant impact on children's cognitive development. During activities, children demonstrated various higher-order thinking skills, especially in aspects of problem-solving, logical thinking, object classification, symbolic representation, as well as initiative and exploration. Through activities such as making toy cars from recycled bottles, cooking banana satay, and conducting the walking rainbow water experiment, children had opportunities to reason, make decisions, and assess cause-and-effect relationships from the processes they carried out.

These project-based activities provided space for children to experiment, correct mistakes, and try new strategies, thereby allowing critical and creative thinking skills to develop naturally. These findings are consistent with theories stating that the STEAM approach can stimulate children to understand simple scientific concepts through direct and meaningful exploration experiences. Alibek & Akhmetova (2025) found that children's ability to explain cause-and-effect relationships in experimental activities can enhance observation skills and basic science concepts through structured experimental activities in early childhood education. Therefore, the integration of simple experiments in the Daily Lesson Plan (RPPH) supports the achievement of cognitive indicators regulated in the STPPA.

**Evaluation of STEAM Learning**

The evaluation of STEAM learning at Al Ihsan Cikande Kindergarten was conducted in stages to ensure that children's development was monitored comprehensively. At the daily level, teachers carried out assessments through anecdotal records and direct observations during activities. Every behavior, response, and development of the child was recorded as part of continuous monitoring.

Weekly evaluations were conducted through briefing sessions every Friday. In this forum, teachers discussed children's developmental achievements, obstacles encountered during learning, and improvement strategies for the following week. The principal also provided supervision to ensure that the quality of learning implementation was maintained.

Semester evaluations were conducted every six months using a checklist instrument guided by STPPA, with assessment categories of "not yet developed," "beginning to develop," and "well developed." In addition to the checklist, teachers added brief narrative descriptions to portray each child's development more comprehensively. Documentation of STEAM activities, such as photographs and children's work, was also included in development reports provided to parents as a form of transparency in the learning process. Through this gradual and continuous evaluation mechanism, assessment did not

only focus on final results but also on children's thinking processes, engagement, and learning experiences during STEAM activities.

The daily anecdotal evaluation model, weekly briefings, and semester STPPA checklists demonstrate good formative assessment practices oriented toward the learning process. However, research by Fahimah et al. (2024) suggests strengthening assessment practices through more standardized rubrics, systematic documentation portfolios, and teacher training to improve inter-rater reliability. The implementation of these practices would enhance the validity and reliability of children's developmental data for reporting and instructional improvement purposes.

## Conclusion

This study concludes that the digital media needs of early childhood learners at Al Azhar Kindergarten 58 Balikpapan for introducing Balikpapan tourism include: (1) local content that introduces Balikpapan's culture and tourist destinations, (2) parental control features for safety and supervision, (3) a balanced integration of digital experiences and real-world activities, and (4) child-friendly visual design. These findings serve as an important foundation for the subsequent stages of designing interactive educational media based on local wisdom.

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