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Analysis of STEAM Learning in Developing the Creativity of Children Aged 4–5 Years

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ABSTRACT

This study aims to describe the process of STEAM-based learning in developing the creativity of children aged 4–5 years at PAUD Sekar Nagari. This study employed a descriptive qualitative approach using a case study method. The research participants consisted of 20 children, 2 classroom teachers, and the school principal. Data were collected through observations, interviews, and documentation. The findings indicate that STEAM learning was implemented through play-based activities integrating the elements of science, technology, engineering, arts, and mathematics into thematic learning activities. The learning process consisted of the stages of apperception, stimulation, exploration, and reflection. Teachers acted as facilitators by providing children with opportunities to explore, experiment, and freely express their ideas. STEAM learning was able to develop children's creativity, as reflected in their ability to generate diverse ideas, solve problems using various approaches, and create unique and imaginative works. Although several challenges were encountered, such as limited time and

learning media, the learning process remained effective through the utilization of simple materials available in the surrounding environment.

Introduction

Early Childhood Education (ECE) is an educational service provided for children from birth to six years of age. Early childhood is a period during which children experience continuous growth and development (Lestari & Handayani, 2024). According to Slamet Suyanto (2005), this stage is known as the golden age, a period characterized by rapid physical, cognitive, social, and emotional development (Devianti et al., 2020). Early childhood education plays an important role in providing stimulation for various aspects of children's development, including physical development such as fine and gross motor coordination, intellectual development such as thinking skills, creativity, emotional intelligence, and spiritual intelligence, as well as social-emotional development, which encompasses attitudes, behaviors, and religious values. In addition, early childhood education supports the development of language and communication skills according to each child's characteristics and developmental stages (Fitriani, 2023). Therefore, the learning process in kindergarten should be designed to be meaningful, enjoyable, and provide broad opportunities for children to express themselves and develop their creativity according to their developmental stages.

One of the developmental aspects that should be stimulated from

an early age is creativity. Creativity can be fostered through a supportive learning environment in which children feel encouraged to think independently, explore and play freely, conduct observations and reflections, and confidently ask unique or unconventional questions (Arsy et al., 2021). Creativity is one of the most important aspects of early childhood development. According to J. P. Guilford, creativity is closely related to divergent thinking, namely the ability to generate various alternative solutions when facing a particular situation. Children who are accustomed to divergent thinking do not rely on a single answer but are capable of discovering various creative and innovative possibilities. Theoretically, creativity in early childhood can develop through meaningful, active, and child-centered learning experiences. Torrance (1974) explained that creativity is characterized by divergent thinking, which includes fluency, flexibility, originality, and elaboration of ideas (Devianti et al., 2020). This perspective is consistent with Lev Vygotsky's theory, which emphasizes the importance of the social environment and interaction in stimulating children's creativity. Children become more creative when they are given opportunities to explore, experiment, ask questions, and freely express their ideas without pressure regarding the final outcome. Every individual is born with creative potential that can be developed and nurtured. Therefore, no one is completely devoid of creativity; the real challenge lies in how this potential can be managed and developed optimally so that it does not diminish over time (Jumroh & Istiarini,

2018). Thus, creativity does not emerge spontaneously but must be developed through appropriate and contextual learning processes.

In the educational context, creativity is not only related to the final product but also to the process of thinking and acting in expressing oneself and solving problems. Creativity is an individual's thinking ability to produce original ideas that can develop through various activities supporting creative thinking patterns (Barkah & Dewi, 2018). Creativity emerges when individuals are given opportunities to explore, experiment, and develop ideas based on their experiences and surrounding environment. According to Torrance's theory, creativity can be measured through several indicators, including fluency in generating ideas, flexibility in using different approaches or perspectives, originality in producing unique ideas, and elaboration, namely the ability to develop and expand existing ideas (Afni, 2019). Furthermore, creativity is reflected in a high level of imagination, strong curiosity, and the courage to try new things without fear of making mistakes.

Early childhood is a critical period during which the foundation of creativity begins to develop. Creativity in early childhood is not merely the ability to produce artistic works but also includes divergent thinking, independence in problem-solving, and the courage to explore the surrounding environment. Therefore, creativity should become an essential component of early childhood education. Creative learning enables children to actively develop both their creativity and

independence (Fitriani, 2023). However, in practice, learning activities in kindergartens are still frequently dominated by one-way instruction, outcome-oriented activities, and an emphasis on early academic skills such as reading, writing, and arithmetic. As a result, children's opportunities to explore and think creatively remain limited. This condition indicates a gap between the expectations of creative education and the realities encountered in educational practice. To address this issue, a comprehensive learning approach that integrates multiple disciplines is required. Such an approach should not only focus on children's cognitive abilities but also provide opportunities for them to learn directly and develop creativity through authentic experiences (Agustina & Mugara, 2020).

Along with the advancement of the times and the demands of the twenty-first century, the field of education is expected to prepare a generation that is not only academically competent but also creative, innovative, and capable of solving problems (Novita Ananda & dan Sitti Nurhidayah Ilyas, 2023). One learning approach that is highly relevant to the demands of the twenty-first century is the STEAM approach. STEAM is a learning approach that integrates five interconnected disciplines—Science, Technology, Engineering, Arts, and Mathematics—as an effort to solve problems (Nurlaela & Mardian, 2025). STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning is an instructional approach that combines the fields of science, technology, engineering, arts, and mathematics into a

single integrated learning framework implemented holistically within school learning activities (Agustina & Mugara, 2020). Yakman (2008) states that STEAM emphasizes the interaction among these disciplines to develop learners' critical, creative, and innovative thinking skills through exploration and problem-solving activities. In early childhood education, the STEAM approach is implemented through play-based activities involving observation, simple experiments, construction activities, drawing, and counting, all of which are carried out in meaningful and contextual learning situations.

Through STEAM learning, children become more active and self-confident. This approach also enhances problem-solving skills, broadens children's knowledge, and develops independent thinking, initiative, and communication skills (Ratna et al., 2023). STEAM learning helps foster children's creativity because they are actively involved in the learning process. The arts component provides opportunities for children to express their feelings and ideas, while science, technology, engineering, and mathematics help them understand their surrounding environment through hands-on experiences. Through STEAM activities, children become accustomed to trying different approaches, combining simple ideas, and producing creations based on their own imagination and understanding. Such learning experiences create a more natural learning atmosphere and effectively support the development of children's creativity.

The STEAM approach requires teachers to design learning activities

that encourage children to explore, ask questions, try new things, and express their ideas through tangible creations. Learning through play is an enjoyable instructional method because it integrates play with the learning process. In early childhood education, play is a natural activity that enables children to explore and understand the world around them (Hasanah et al., 2025). For example, when children are invited to make "fruit satay," they not only learn scientific concepts such as the taste and texture of different fruits, but also gain an understanding of technology by learning how to arrange the fruit pieces so that they do not fall apart. At the same time, they express their creativity by combining different colors and shapes of fruit. In addition, children learn to count the fruit pieces, create patterns, and make comparisons.

Based on the results of preliminary observations conducted in one kindergarten, the implementation of STEAM learning continues to face various challenges. Learning activities are still dominated by the use of worksheets and imitation-based tasks in which children are expected to replicate predetermined examples. Opportunities for children to explore freely, develop their own ideas, and experiment with different approaches to solving problems remain limited. Furthermore, inadequate facilities and infrastructure, limited learning media, and the continued reliance on conventional teaching practices also affect the quality of STEAM implementation in schools. Limited instructional time is another major obstacle because STEAM activities require sufficient time for children to explore and engage in learning

experiences optimally (Athfal & Ageng, 2024).

Several previous studies have demonstrated that STEAM learning positively influences the development of creativity in early childhood. However, most studies have focused on learning outcomes or quantitative improvements in children's creativity. For example, Lestari and Handayani (2024) emphasized the improvement of creativity scores and creative thinking abilities after the implementation of STEAM learning through a pretest-posttest experimental design. Similarly, Pitaloka and Sinaga (2023) employed a Nonequivalent Control Group design to measure children's creative thinking abilities following the implementation of STEAM learning without examining in depth how the STEAM learning process was actually carried out in kindergarten settings. In contrast, understanding how STEAM learning is designed and implemented is essential for identifying the contribution of each learning stage to stimulating children's creativity. Previous studies have also paid limited attention to the challenges encountered by teachers during the implementation of STEAM learning in real classroom settings. Prahartiwi et al. (2025) examined the implementation of STEAM in early childhood education using a qualitative approach; however, their study focused primarily on the general implementation of STEAM without analyzing each stage of the learning process in detail. Likewise, another study by Prahartiwi et al. (2025) highlighted the implementation of environment-based STEAM activities to enhance children's creativity and collaboration but provided only limited

discussion regarding the challenges faced by teachers in daily classroom practice. Therefore, the present study is important because it investigates the STEAM learning process qualitatively in the context of developing the creativity of children aged 4–5 years.

This study aims to provide an in-depth description of how the STEAM learning process is implemented to develop creativity in early childhood. A qualitative approach is considered appropriate because it enables researchers to understand the processes, interactions, experiences, and meanings associated with STEAM learning from the teachers' perspectives. By examining the STEAM learning process directly in the classroom setting, this study is expected to provide a comprehensive description of STEAM instructional practices and their contribution to fostering creativity among young children.

Methods

This study employed a descriptive qualitative approach using a case study method because it aimed to obtain an in-depth understanding of the STEAM learning process in developing the creativity of children aged 4–5 years. Rather than focusing on measuring children's creativity using numerical data, this study sought to provide a detailed description of the implementation of STEAM learning, children's engagement in learning activities, teachers' efforts to stimulate children's creativity, and the challenges encountered during the STEAM learning process. A descriptive qualitative approach was selected because it enables researchers to describe phenomena that

occur naturally in accordance with real conditions in the field. Meanwhile, the case study method was adopted because the research focused on a specific case, namely the implementation of STEAM learning at PAUD Sekar Nagari. Through the case study method, the researcher was able to examine the phenomenon comprehensively and in depth within its real-life context.

The data in this study were collected through research instruments consisting of observations, interviews, and documentation, providing a comprehensive description of the STEAM learning process in developing the creativity of children aged 4–5 years. The research participants consisted of 20 children from Kindergarten A1 and A2 at PAUD Sekar Nagari, two classroom teachers, and the school principal. This research site was selected because it aligned with the focus of the study, namely the STEAM learning process in developing the creativity of children aged 4–5 years in Group A classrooms. The study was conducted over a two-month period, from February to March 2026. The data collection techniques employed in this study included observations, interviews, and documentation. The data obtained from these methods were analyzed using the Miles and Huberman data analysis model, which consists of three stages: data reduction, data display, and conclusion drawing. During the data reduction stage, the researcher selected and focused on data relevant to the objectives of the study. Subsequently, the data were presented in the form of a narrative description to facilitate interpretation and analysis. The final stage

involved drawing conclusions based on the findings obtained throughout the research process. Through this analytical process, the researcher gained a comprehensive understanding of the STEAM learning process, the development of children's creativity, and the challenges encountered by teachers during its implementation.

Result and Discussions

The implementation of STEAM learning at PAUD Sekar Nagari has been carried out since 2020, the year the school was established. STEAM-based learning at PAUD Sekar Nagari is implemented through meaningful play activities. In practice, teachers integrate the elements of Science, Technology, Engineering, Arts, and Mathematics (STEAM) into learning activities according to the selected learning theme. STEAM is a learning approach that provides students with opportunities to develop knowledge in both science and the humanities simultaneously (Huda et al., 2024). Teachers design engaging learning experiences based on the learning theme and further develop them into meaningful activities by utilizing various learning media, such as loose parts, building blocks, natural materials, and simple tools and materials.

The learning activities generally begin with an introduction or apperception stage. For example, the teacher presents a video about different types of weather and explains the day's weather conditions, such as sunny, rainy, or cloudy. This is followed by stimulating questions or simple problems designed to arouse children's curiosity, such as, "Why is it raining today?" or "What happens when the sun

shines?" Afterward, children are given opportunities to explore through activities such as drawing clouds or engaging in role-play related to rainy or sunny weather. Throughout the learning process, children are free to experiment, create, and express their ideas according to their imagination while remaining connected to the learning theme. At the end of the lesson, the children participate in a discussion and present their work by explaining the drawings or projects they have created, after which the teacher conducts a brief reflection on the learning activities

Teachers serve as facilitators, guides, and motivators by providing children with the freedom to choose materials, explore ideas, and express their creativity. The STEAM elements do not necessarily appear simultaneously in every activity but are integrated according to the children's needs and developmental abilities. Learning is also implemented through various learning centers, during which the children demonstrate positive responses, such as enthusiasm, active participation, and enjoyment throughout the learning process.

The implementation of STEAM learning at PAUD Sekar Nagari is not without challenges. The findings indicate that limited instructional time is one of the primary obstacles to implementing STEAM learning. STEAM activities require a considerable amount of time because children need opportunities to explore ideas, experiment with different approaches, and complete the projects they undertake. In addition to time constraints, limited tools and learning materials also pose

challenges to the implementation of STEAM learning. To address these limitations, teachers utilize various simple materials available in the surrounding environment, such as natural materials, recycled items, and loose parts as learning media. This strategy enables teachers to continue implementing STEAM learning according to the selected learning themes despite the limited availability of educational resources.

The findings also reveal that STEAM learning effectively promotes the development of children's creativity. The creativity demonstrated by the children during STEAM learning is reflected in the originality of their ideas and solutions. The children show the confidence to try new things and solve problems in ways that differ from those of their peers. This is often observed when children discover unexpected solutions while constructing building structures or conducting simple science experiments. The children are also able to express their imagination in various forms. For example, in a weather-themed activity, the children not only imitate the cloud drawings demonstrated by the teacher but also add unique elements such as rainbows or lightning. During block-play activities, some children build a school complete with a roof so that "we will not get wet when it rains." Likewise, when creating artwork using loose parts, the children do not merely replicate examples provided by the teacher; instead, they enrich their creations with imaginative elements surrounding the main object, such as making clouds from cotton and dried leaves. These observations indicate that the children's creativity is developing progressively. They are able to

generate numerous ideas, experiment with different approaches, and create unique products. This finding is consistent with the view of E. Paul Torrance, who argues that children's creativity can be identified through their ability to generate multiple ideas, employ various methods to express their thoughts, and produce creations that are original and different from those of others.

Furthermore, the children also demonstrate their ability to solve problems using different strategies from those employed by their peers, indicating the development of creative and critical thinking skills. The children show confidence in trying new ideas, modifying their strategies when encountering difficulties, and generating various alternatives for completing assigned tasks. These findings indicate that STEAM learning provides children with opportunities to explore, imagine, and develop creative thinking skills through meaningful learning experiences.

Conclusion

STEAM-based learning at PAUD Sekar Nagari is implemented through meaningful play activities by contextually integrating the elements of Science, Technology, Engineering, Arts, and Mathematics according to the learning theme. The learning process consists of the stages of apperception, stimulation, exploration, and reflection, with teachers serving as facilitators who provide children with the freedom to explore and express their ideas. The implementation of STEAM learning has been shown to effectively develop the creativity of children

aged 4–5 years, as reflected in their ability to generate diverse ideas, think flexibly, solve problems using different approaches, and produce unique and imaginative creations. Although challenges such as limited instructional time and learning facilities remain, teachers continue to address these constraints by utilizing simple materials available in the surrounding environment. Through this approach, learning activities can continue to be implemented effectively and meaningfully for children. STEAM learning makes a positive contribution to stimulating creativity in early childhood and deserves to be continuously developed and implemented in kindergarten learning practices.

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