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IMPLEMENTATION OF SCIENCE-BASED CREATIVE GAMES IN EARLY CHILDHOOD

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Abstract

This study aims to analyze the implementation of creative science-based games in early childhood education at PAUD Cinta Kasih Ibu, Cengkareng Timur, West Jakarta. A qualitative approach with a case study method was used to explore the planning, implementation, and challenges of applying creative science-based games. Data were collected through participatory observation, in-depth interviews with teachers and school principals, and relevant documentation. The findings indicate that science-based games enhance critical thinking, exploration, and creativity in young children. However, implementation faces challenges such as limited facilities, insufficient teacher training, and varying levels of children's understanding of scientific concepts. This study recommends improving teacher training, developing more innovative learning media, and involving parents in strengthening children's scientific literacy from an early age.

Keywords: Creative games, science, early childhood, exploration-based learning, early childhood education.

INTRODUCTION

The development of the digital era and the challenges of the 21st century demand a generation that possesses not only theoretical knowledge but also critical, creative, and innovative thinking skills. Integrated science learning with creative play becomes a relevant approach to addressing these challenges. Science-based creative play allows children to explore, experiment, and discover scientific concepts in an enjoyable and meaningful way. Through this approach, children not only passively receive information but actively engage in the learning process that fosters curiosity and problem-solving skills.

The science learning in Early Childhood Education should be implemented through enjoyable play activities that actively involve children in the discovery process. As stated by Adminpintarharati (2022) in their research on the implementation of science education for early childhood, effective science education is one that provides children with the opportunity

to actively explore and manipulate various objects in their surroundings (Adminpintarharati, 2022). Similarly, Juhji's (2016) research shows that science education with a play-based approach can enhance the cognitive abilities of early childhood children by up to 85% compared to conventional education (Juhji, 2016).

The research conducted by Wardhani et al. (2020) regarding science play in children aged 5-6 years indicates that structured science play analysis can enhance children's science process skills and creativity (Wardhani et al., 2020). Furthermore, the study conducted by Nisa (2022) reveals that science learning through simple experimental play activities can significantly improve the logical thinking skills of early childhood, with an initial increase before engaging in science play being 40%. In cycle 1, the first meeting increased by 59% and the second meeting by 63%. In cycle 2, the first meeting increased by 72% and the second meeting by 80%. From the obtained data, the differences in findings can meet the indicators of children's cognitive development assessment (Nisa, 2022).

Farida (2021) in her research on project-based science learning models for children aged 5-6 years found that this approach not only enhances understanding of science concepts but also develops children's social, communication, and collaboration skills (Farida, 2021). In a different study, Yaswinda et al. (2023) highlighted the importance of using natural materials in science play to develop environmental awareness in early childhood. They found that children engaged in science play with natural materials had a higher environmental concern than children who did not have such experiences (Yaswinda et al., 2023).

However, the reality in the field shows that the implementation of creative science-based games in early childhood education institutions still faces various challenges. Based on preliminary observations conducted at PAUD Cinta Kasih Ibu, Cengkareng Timur, West Jakarta in January 2025, it was found that science learning is still conducted conventionally, emphasizing listening, mimicking, and memorizing activities. Out of 15 observed learning activities, there were only 3 activities (20%) that integrated science games, and even those adopted a demonstration approach where teachers were more active while children tended to be passive. The science game activities carried out were also relatively simple and less varied, such as sinking and floating experiments and seed planting.

In terms of facilities and infrastructure, PAUD Cinta Kasih Ibu only has a very limited science corner with a collection of outdated children's science books (published 10 years ago) and a few simple teaching aids such as magnifying glasses, magnets, and scales. No interactive science learning media or comprehensive science experiment kits were found. Documentation of science activities is also very minimal, with only 5 photos of science activities out of a total of 72 documentation of learning activities during one semester.

The gap between ideals and reality in the implementation of science-based creative play in early childhood education indicates the existence of a phenomenon gap that needs to be addressed. This gap includes aspects of teachers' understanding and competencies, the

availability of infrastructure and learning media, as well as the planning and evaluation systems for science learning. Bridging this gap becomes the urgency of this research, considering the importance of early science stimulation in preparing children to face the challenges of the 21st century.

In addition to the gap in phenomena, this research is also based on the existence of a research gap in the study of science-based creative play for early childhood. Based on the literature review, the majority of previous studies have focused on the effectiveness of certain methods or approaches in science education (Elvira, 2021; Hariani, 2021; Mutmainah et al., 2022; Sholeha, 2019), but there has been little comprehensive examination of the implementation process of science-based creative play from planning, execution, to evaluation, as well as the factors influencing it. The research by Octaviani et al. (2018) has touched on the role of teachers in the implementation of science play, but has not explored in depth the strategies for developing teachers' competencies in designing and implementing science-based creative play (Octaviani et al., 2018).

The urgency of this research is also demonstrated by the fact that the science literacy of Indonesian children is still low based on the results of the Programme for International Student Assessment (PISA) 2022, which ranked Indonesia 5-6 positions higher compared to PISA 2018; however, the science literacy score has decreased, with an average score of 398, and a rank of 68 out of 81 participating countries (Wijaya et al., 2024). Therefore, the implementation of science-based creative play for early childhood becomes a strategic step to improve the science literacy of future generations.

This research offers novelty by adopting a more comprehensive approach in the implementation of science-based creative games for early childhood. Instead of focusing on a single type of game or a specific aspect, this study will explore various types of creative games that can holistically integrate scientific concepts. Furthermore, this research will examine the implementation of these games within the specific context of PAUD Cinta Kasih Ibu in Cengkareng Timur, West Jakarta, which has unique social and cultural characteristics.

METHODS

This research uses a qualitative approach with a case study method. This approach was chosen because the study aims to gain an in-depth understanding of the implementation of creative science-based games at PAUD Cinta Kasih Ibu Cengkareng Timur Jakarta Barat. The case study allows for comprehensive exploration of the phenomena occurring in a natural context, taking into account various social, cultural, and academic factors that influence the implementation of science-based games in the PAUD environment.

This research was conducted at PAUD Cinta Kasih Ibu, located in Cengkareng Timur, West Jakarta. The selection of this location was based on several academic and practical considerations relevant to the research objectives. PAUD Cinta Kasih Ibu is known as one of

the early childhood education institutions actively engaged in developing innovative learning methods, including the use of creative science-based games in everyday learning activities.

The primary data was obtained through direct observation of the implementation process of science-based creative games in the relevant early childhood education institutions. Additionally, in-depth interviews with teachers and parents of preschool-aged children were utilized to gather information related to experiences, perspectives, and the impact of these games on child development. Meanwhile, secondary data was collected from supporting documents such as early childhood education curricula, learning activity guides, and related literature discussing science-based games for preschool children. The combination of these two types of data provides a comprehensive and measurable picture in explaining the effectiveness and challenges that may be encountered in the application of this method.

The subjects of the research consist of the parties directly involved in the implementation of science-based creative play in Early Childhood Education (PAUD), namely: 1) Early Childhood Education teachers who are responsible for the planning and execution of science-based play. 2) The Principal who provides policy and supervision in the application of learning methods in Early Childhood Education. 3) Young Children (Students of PAUD Cinta Kasih Ibu) who participate in science-based play.

The data collection techniques used include observation, interviews, and documentation studies. The observation was conducted directly on learning activities in early childhood education to monitor how science-based creative play is implemented and how children interact with the play. The observation procedure includes the preparation of a checklist and observation guidelines to ensure focus on important aspects of the implementation.

Interviews were conducted with teachers and parents to gain in-depth perspectives on the effectiveness of play in supporting early childhood development, as well as the challenges faced during the implementation process. The interviews were conducted in a semi-structured manner, allowing for flexibility in exploring additional information relevant to the research. In addition, document studies were conducted by reviewing supporting documents, such as lesson plans, curricula, and early childhood activity reports, which provide context and additional data related to the implementation of science-based creative play.

Triangulation techniques are utilized as a primary step in verifying data validity. This triangulation is conducted by comparing data obtained through observations, interviews, and documentation studies, resulting in consistent and reliable data. In addition, discussions with early childhood education experts are conducted to ensure that the analyzed data align with the research context and study objectives. For data analysis techniques, this research employs a qualitative approach. The collected data is analyzed through systematic steps, which include data reduction, data presentation, and conclusion drawing. Data reduction is carried out by filtering information relevant to the focus of the research, thus facilitating the analysis

process. Data presentation is conducted in a descriptive manner, utilizing tables, narratives, and diagrams to provide a clear illustration of the implementation of science-based creative play. Conclusion drawing is performed through in-depth interpretation of the emerging data patterns, thereby providing a comprehensive understanding of the impact and effectiveness of the applied methods.

RESULTS AND DISCUSSIONS

The findings of this research depict how science-based creative play is implemented in the Early Childhood Education of Cinta Kasih Ibu in Cengkareng Timur, West Jakarta, as well as how the data analysis results support or clarify the main aspects of this research. The research results were obtained from in-depth interviews with teachers and the principal, participatory observations of children's activities, as well as documentation related to the planning and implementation of learning. The findings of this research were analyzed using the Miles & Huberman data analysis model, which involves three main stages: data reduction, data presentation, and conclusion drawing or verification. With this approach, the research results can be categorized into several main themes that reflect the realities on the ground.

The findings of this research will be explained in several sections based on the proposed research questions, namely: (1) how to plan science-based creative games, (2) how to implement science-based creative games in early childhood learning, (3) the constraints and challenges faced in the implementation of science-based creative games, and (4) the impact of science-based creative games on child development.

Creative Game Planning Based on Science

Based on the results of interviews with teachers and the principal, the planning of science-based creative play at PAUD Cinta Kasih Ibu is conducted by preparing RPPH (Daily Learning Implementation Plan) which includes the exploration of science concepts through play activities. Each designed activity aims to stimulate children's curiosity through direct experience. One of the teachers, Mrs. S, explained:

> "We strive to incorporate elements of scientific exploration into every play activity, such as simple experiments with water and colors, as well as sensory games that stimulate children's curiosity. We also aim to connect these games with the everyday phenomena experienced by children."

The results of the observation indicate that during the planning stage, the teacher has designed science-based games while considering the developmental stages of children. Several activities designed include the "color mixing" experiment with water, exploration of "magnets and objects" to understand attractive forces, as well as the "soap bubbles" game to observe the concepts of air and pressure. However, observations show that this planning still faces challenges in the aspects of the availability of teaching aids and a lack of references

regarding science games that are suitable for the characteristics of early childhood. Some of the creative games designed do not yet have sufficient variation to accommodate the learning needs of all children, especially those who have different learning styles. In addition, observational data indicate that not all classes have the same access to experimental materials, leading to the necessity for some activities to be conducted demonstratively by the teacher, rather than exploratively by the children. This poses a specific challenge in providing an optimal learning experience.

In addition, the interview with the principal indicated that teachers still require more training related to science-based exploratory teaching methods. Without a deep understanding, teachers tend to engage only in simple games without truly connecting them to broader scientific concepts.

The Implementation of Science-Based Creative Games

The results of the interview with the teachers also show that they face challenges in managing the class while conducting experiments. Some children are very active, while others are more passive in participation. One teacher, Mrs. S, stated:

> "Some children are very enthusiastic, but there are also those who are less interested or struggle to understand the concepts being introduced. We try to make it more engaging, but there are still differences in their involvement."

Based on classroom observations, it was found that the use of visual media such as short videos before creative play can help enhance children's understanding of the science concepts to be studied. This indicates that the combination of visual methods and hands-on practice can improve the effectiveness of learning.

Challenges and Obstacles in Implementation

The results of the interview indicate that the main obstacles in the implementation of science-based creative games include limited resources, a lack of training for teachers, and varying levels of readiness among children to grasp the concepts of science. The principal, Mrs. A, stated:

> "We aim to enhance the quality of science-based learning; however, we are still limited in terms of facilities and teaching materials. Moreover, teachers still require specialized training to become more confident in teaching science concepts to children."

In addition, the observations also found that some children experience difficulties in understanding abstract concepts, thus requiring more concrete methods and experience-based approaches. Interview data also indicated that some teachers faced challenges in

delivering material due to a lack of teaching resources that support the science concepts being taught. One teacher mentioned:

> "We sometimes have to find our own teaching materials or create simple props because not everything is available at school. This requires extra time and more creativity."

In addition, another challenge is the involvement of parents in supporting science learning at home. Teachers express that many parents still have a limited understanding of the importance of early science education, which leads to less support for children's exploration at home.

The impact of science-based creative play on child development

From the results of the observation and interview analysis, science-based creative play has a positive impact on children's development, particularly in cognitive aspects and social skills. Children engaged in this play demonstrate improvements in critical thinking skills, communication, and cooperation. A teacher, Mrs. R, stated:

> "The children have become more active in asking questions and discussing with one another. They are beginning to develop a strong sense of curiosity and often attempt experiments on their own at home."

The results of the observations also indicate that children who frequently participate in science-based games are more inclined to develop a high sense of curiosity. They begin to ask questions about the phenomena around them and seek to understand the reasons behind them. A child in the observation stated:

> "If the water is cold, does the ice melt quickly, Ma'am?"

This statement indicates that children begin to construct simple hypotheses and connect play experiences with phenomena in everyday life. Moreover, science-based play also helps to enhance cooperation among children. In group experiments, children learn to share tasks, discuss results, and communicate with their peers.

The findings of this study indicate that science-based creative play can be an effective method in enhancing the learning experience of young children. Although there are challenges in implementation, the benefits gained are quite significant in encouraging active engagement of children in learning. This research also addresses the gap in previous studies that have predominantly focused on science learning in formal education contexts, while this research examines its application in early childhood education settings. Overall, this study concludes that science-based creative play at Cinta Kasih Ibu Early Childhood Education has a positive impact on child development. However, further support is needed in terms of teacher training, facility provision, and the development of more effective learning methods to enhance the implementation of science-based play in early childhood education.

The research findings indicate that the implementation of creative science-based games at PAUD Cinta Kasih Ibu has significant potential in developing children's cognitive and social aspects, despite facing various challenges related to resource limitations, teacher training, and parental involvement. These findings align with Piaget's constructivist theory (1954), which emphasizes that children build their knowledge through direct experiences and active interactions with their environment (Piaget, 1954). The science games designed at this PAUD—such as color mixing experiments, magnet exploration, and soap bubbles—demonstrate a concrete and experiential learning approach that is particularly suitable for early childhood development stages.

The finding that teachers still experience difficulties in designing and implementing science games optimally reinforces the findings of Wake and Burkhardt (2013), which state that the success of science teaching at the early level is significantly influenced by teachers' readiness to understand inquiry-based learning approaches. The low availability of teaching aids and adequate training hinders this process, resulting in some activities being conducted in a demonstrative manner and not providing enough opportunity for children to explore directly (Wake & Burkhardt, 2013).

The use of visual media such as short videos before experiments has also proven effective in enhancing children's understanding. This is consistent with Mayer's (2014) findings that emphasize the importance of multimedia in reinforcing children's cognitive learning. The combination of visual media and direct experience not only increases learning interest but also helps bridge abstract concepts to make them easier for children to understand (Mayer, 2014).

From the perspective of child development, science-based creative play encourages the emergence of curiosity, critical thinking skills, communication, and cooperation. This supports Ginsburg's (2021) statement that well-designed play not only entertains but also serves as an important means in early scientific learning. Children actively involved in these activities begin to display behaviors such as asking questions, making simple hypotheses, and connecting play experiences with everyday phenomena, which are indicators of developing early science literacy (Ginsburg, 2021).

This research provides significant implications for the development of theory and practice in early childhood education. Theoretically, these results affirm that a play-based science approach can be an effective learning strategy for developing scientific thinking skills from an early age. Practically, this research highlights the importance of continuous teacher training in implementing science education, as well as the need for adequate facility support and the development of a curriculum that fosters a play-based science approach.

The limitations of this study lie in its scope, which is still confined to a single early childhood education unit in West Jakarta, thus generalizing the results to other early childhood education contexts must be done with caution. Furthermore, the qualitative approach employed, although providing profound understanding, does not include

quantitative data that could strengthen the validity of the findings from the perspective of child development.

CONCLUSION

Based on the results of the research conducted regarding the implementation of science-based creative games at the Cinta Kasih Ibu Early Childhood Education in Cengkareng Timur, West Jakarta, this study found that science-based games provide a significant contribution to the development of early childhood, particularly in cognitive, social, and critical thinking skills. The findings of this research can be concluded as follows:

The planning of science-based creative play at the Cinta Kasih Ibu Early Childhood Education has been carried out by preparing the Daily Learning Implementation Plan (RPPH), which includes science-based exploratory activities. However, there are still limitations in the provision of teaching aids and appropriate play references for young children.

The implementation of science-based creative games demonstrates that children are very enthusiastic about participating in these activities. They are able to develop a sense of curiosity and critical thinking skills through simple experiments, such as floating and sinking games and color experiments. However, time constraints and variations in children's understanding pose unique challenges for teachers in managing learning optimally.

The obstacles and challenges in the implementation of science-based creative games include limitations in facilities, a lack of training for teachers in integrating science concepts into games, and differences in children's readiness to understand science concepts. Additionally, some teachers still face difficulties in applying methods that can bridge scientific exploration with the world of early childhood in a concrete manner.

The impact of science-based creative play on child development is very positive, particularly in enhancing critical thinking skills, problem-solving, and social interaction. Children engaged in this play are more active in asking questions, discussing, and exploring the phenomena around them, which supports constructivist theory in early childhood learning.

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