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Exploring the Labyrinth Of Thought: Teachers' Perceptions of the Importance of Science Learning in Early Childhood Education

Sri Sukatmi [1]✉, Tedy Andrian[2]
[1]Early Childhood Education Teacher Education, Universitas Terbuka, Banten, Indonesia
[2]Early Childhood Education Education, Universitas Panca Sakti Bekasi, Bekasi, Indonesia

ABSTRACT:
This research aims to explore the understanding, planning, implementation, and evaluation of science learning carried out by early childhood education teachers, as well as identify the challenges faced and the solutions implemented. Using a qualitative approach, data was obtained through in-depth interviews with six teachers from various early childhood education institutions. Data analysis was carried out thematically by linking the research results to pedagogic theory and empirical context. The results of the study show that teachers have a diverse understanding of the concept of science, which is generally seen as a science to foster curiosity and critical thinking skills in children. In lesson planning, teachers use themes relevant to children's lives and develop exploration-based activities using simple tools and materials. The implementation of learning is carried out through hands-on experiments, demonstrations, and exploration-based projects designed to make science learning fun and meaningful. Evaluation of learning success focuses on children's enthusiasm, active participation, and understanding of science concepts. However, teachers face a variety of challenges, including limited tools and materials, limited learning time, and a variety of children's abilities. Creative solutions such as the use of local resources and additional motivation to children are often applied to overcome these obstacles. This research emphasizes the importance of science learning in early childhood education in supporting children's cognitive, social, and emotional development, as well as the need for institutional support in the form of training and the provision of resources to improve teaching effectiveness

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CONTACT Corresponding; Sri Sukatmi, Univeritas Terbuka, Indonesia
Email: srisukatmi@ecampus.ut.ac.id

1. Introduction

Science learning for early childhood has an important role in building a foundation of knowledge and skills that are useful throughout their lives. At an early age, children have a natural curiosity about their surroundings (Hickam & MP; Nursari, 2020). By studying science, they can explore, observe, and ask questions about the world, so that this curiosity is directed and honed (Eliza et al., 2022; Qonita et al., 2022). This helps children develop critical thinking skills early on, which is an important skill in dealing with future challenges. In addition, science learning helps children understand basic concepts that are relevant to everyday life. For example, through activities such as observing plants growing or mixing colors, they begin to recognize cause-and-effect relationships and build a basic understanding of natural phenomena (Risnawati, 2020). This process is not only educational but also entertaining, as it involves practical activities that are fun and interactive. Children naturally learn through play (Hasibuan & Suryana, 2022), so that science taught through simple games and experiments provides a meaningful and effective learning

experience (Husin & Yaswinda, 2021). Furthermore, science learning develops children's cognitive and motor abilities. Science activities such as simple experiments, touching the texture of objects, or recording changes in a process encourage coordination between mind and body (Mirawati & Nugraha, 2017). Children learn to pay attention to detail, make hypotheses, and test results, all of which help improve their analytical abilities. In addition, this learning also stimulates creativity, as children are encouraged to find innovative solutions to problems encountered during activities (Nurhafizah, 2017). Science also shapes positive attitudes towards learning as a whole. By finding answers to their questions, children feel satisfaction and confidence in the learning process. This inspires them to continue to explore and learn later in life. In addition, they learn important values such as cooperation, patience, and perseverance when doing group activities in science learning. These values are important for their social and emotional development (Saepudin, 2011).

Early childhood science learning has a long-term impact in creating a more environmentally conscious and responsible generation (Wahyuni, 2022). Children who understand natural processes from an early age are more likely to appreciate and care for their environment. Thus, learning science not only assists individuals in understanding their world, but also contributes to the formation of a better society in the future (Saregar & Yuberti, n.d.). Ideally, teachers teach science to early childhood through a fun, exploratory, and hands-on, experience-based approach. At this age, children learn through play and interaction with the surrounding environment (Syaodih et al., 2021). Therefore, teachers need to provide a variety of practical activities such as simple experiments, nature observations, or games involving science phenomena (Firda & Suharni, 2022). For example, teachers can invite children to observe the growth of plants from seeds, play with water to understand the concepts of floating and sinking, or mix colors to learn color mixing. This activity makes it easier for children to understand science concepts because they learn through hands-on experience (Budiyono et al., 2019).

Furthermore, teachers need to encourage children's curiosity by asking questions that stimulate thinking and encourage exploration (ZR & Eliza, 2020). The teacher not only provides answers, but also guides the child to find his own answers through observation and experimentation. This approach trains children's critical thinking skills and helps them develop problem-solving skills (Ebony & Yabash, 2023). For example, when conducting an experiment, the teacher might ask, "What would happen if we added water to the ground?" or "Why would this balloon float?" That way, children are encouraged to actively think and formulate their own hypotheses. In addition, teachers ideally create a supportive, inclusive, and flexible learning environment, so that children feel comfortable experimenting and making mistakes. Teachers should provide emotional support by praising the child's efforts, not just the results. This positive attitude makes children feel valued and more confident in learning. In addition, it is important for teachers to tailor learning to each child's needs, interests, and abilities, so that each child can learn science according to their own pace and learning style (Shahali et al., 2016). With a flexible, exploratory and supportive approach, teachers can help early childhood develop a love of science and lifelong learning.

Research shows that science learning at an early age has a significant impact on shaping children's basic skills. According to research (Kuenzi, 2008) In early childhood learning not only stimulates their understanding of the natural world, but also enhances their critical thinking, collaboration, and creativity skills. With a practical activity-based approach, children are more motivated to learn through exploration, improving cognitive and emotional skills simultaneously. Other studies by (Bui et al., 1970) Highlights that the introduction of technology and robotics to early childhood improves learning outcomes, including mastery of logic concepts and problem-solving. The study also shows that an eight-week robotics curriculum can broaden children's understanding of technology while integrating science learning, ultimately enriching their literacy skills in a technological context. This discovery confirms the importance of introducing modern technology as part of early science learning. Moreover (Sofariah et al., 2020) states that STEM learning in early childhood should be supported by a curriculum that is flexible and involves various aspects of daily life. Their research highlights that learning that involves experimentation, observation, and discussion with teachers can provide a more meaningful experience for children. Thus, this study emphasizes the importance of an interactive, experiential, and culturally relevant approach to maximize science learning outcomes in early childhood.

Science learning is rooted in the theory of constructivism, put forward by Piaget (Karaahmetoğlu & Korkmaz, 2019) dan Vygotsky (Preston, 2021) , which states that knowledge is built through active interaction

between individuals and their environment. In this context, science learning facilitates children to observe, experiment, and understand natural phenomena through hands-on experience. This approach emphasizes the importance of discovery-based learning (Simoncini & Lasen, 2018), where students not only receive information but also actively engage in the process of observation and analysis, thus creating a deeper and more continuous understanding. In addition, science learning theory also refers to the inquiry-based learning model (Papadakis & Kalogiannakis, 2022), where the learning process centers on questions, exploration, and investigation conducted by students. This method encourages students to ask critical questions, create hypotheses, and test their ideas through experiments. In this way, science learning is not only about memorizing facts, but also developing scientific thinking skills such as analysis, synthesis, and evaluation. This model supports the development of critical and creative thinking skills that are essential in solving complex problems. Connectivism theory (Promkatkeaw et al., 2022) In science learning, it also emphasizes the importance of collaboration and the use of technology to support the understanding of science. Children are invited to share ideas (Rodrigues-Silva & Alsina, 2023), discuss the results of their observations, and use digital tools for further exploration. This theory highlights that science learning is a social process that involves interaction with others and the use of resources available in their environment. By blending practical exploration and social interaction, science learning helps students relate scientific concepts to the real world, strengthen understanding, and build higher motivation to learn (Johnston et al., 2022).

The purpose of this research is to explore the understanding, planning, implementation, and evaluation of science learning carried out by teachers in early childhood education and identify the challenges they face in the process. This research also aims to analyze the contribution of science learning to children's cognitive, social, and emotional development, as well as explore creative solutions implemented by teachers to overcome resource limitations and other obstacles in science teaching.

2. Method

This study uses a qualitative approach with an in-depth interview method. The research informants were six teachers from various early childhood education institutions who were selected purposively. Interviews were conducted from November to December 2023. The researcher used a semi-structured interview guide to explore teachers' experiences, views, and practices in science learning. Each interview lasts 30-60 minutes and is recorded with the respondent's consent. The researchers also recorded non-verbal observations during the interviews to complete the data. The collected data is then transcribed verbatim and analyzed.

Table 1 Research participants

No.	Name	Name of the Institution	Final Education	Long Teaching Time
1	AIS	TK Al Muttaqin	S1	6 Years
2	LSI	PAUD Cendrawasih	SMA	5 Years
3	SqI	Harapan Kindergarten	S1	13 Years
4	PNI	Not mentioned	S1	10 years
5	RSS	Al Khaeriyah Kresek Kindergarten	S1	2 Years
6	TAX	Not mentioned	S1	9 years

2.1 Interview Questions

1. What does mom have in mind about science?
2. Is science important for early childhood?
3. What is the purpose of learning science according to your mother?
4. How do you plan science learning in the classroom?
5. Tell us what media you use in learning science?
6. Tell us what learning methods you use in science learning?
7. Tell us how you got started in science learning?

8. What science materials do you teach in learning science?
9. Tell us how you teach science?
10. Tell us how you manage your class during science learning?
11. Tell us how you guide your child to a discussion while learning science?
12. Tell us how you explain science learning to your child?
13. Tell us about what experiments have you taught your child about science?
14. How do you know if your child is happy with science or not?
15. Tell us how the mother digging her child to know about the science being taught?
16. Tell us what are the indicators of science learning?
17. How does a child feel when learning science?
18. Have you ever been trained in science learning? If so, where and when? Who is the organizer?
19. What are the difficulties or problems that are often encountered when teaching science?

2.2 Data Analysis

The analysis of research data was carried out using typological analysis techniques. This process begins with reading the interview transcript in depth to identify key themes. The themes that emerged were then categorized according to five main aspects: teacher understanding, planning, implementation, evaluation, and challenges and experiences Each category is further analyzed by linking it to empirical data, pedagogical theory, and research context. For example, teachers' understanding of science is analyzed with reference to Piaget's and Dewey's theories, while the challenges teachers face are compared to previous findings in empirical studies. The results of this analysis produce thematic patterns that show how teachers view, design, and implement science learning. This analysis technique also reveals the relationship between the practical challenges faced by teachers and the creative solutions applied in learning.

3. Result

3.1 Teachers' Understanding and Views on Science

Teachers have a diverse understanding of science concepts and their benefits for early childhood. Most teachers understand that science is the science that studies the universe through scientific approaches such as observation and experimentation. Teachers emphasize that learning science at an early age is important to foster children's curiosity about the world around them.

> *"Science is the study of the universe, the objects in it, as well as phenomena that occur through the scientific method." (AIS, December 1, 2023)*
> *"Science is an activity that fosters critical attitudes, curiosity, and exploration." (LSI 29, 2023)*

Science is also considered a way to develop critical thinking skills in children. Through exploration, children can learn to understand simple natural phenomena, such as how water flows or how colors change when mixed. These concepts help children not only understand facts, but also build logical thinking. In addition, teachers note that learning science at an early age can help children develop social skills. In some cases, science activities allow children to work together in groups, ask questions, and share the results of their observations. This enriches the child's learning experience holistically. This view shows that science is not only about science but also about an enjoyable learning experience. By tapping into children's natural curiosity, learning science can be an important foundation for their cognitive and emotional development.

3.2 Science Learning Planning and Strategy

Teachers design science learning with a flexible and engaging approach, tailored to the child's interests and needs. The first step is to choose a theme that is relevant and easy for children to understand, such as themes about colors, plants, or objects around them.

> *"We choose a theme according to the child's interests, prepare tools and materials, and then do a simple experiment." (SqI, November 29, 2023)*

"The RPPH is prepared by introducing tools and materials first before evaluating the activities." (RSS, November 29, 2023)

This planning involves the preparation of a Daily Learning Implementation Plan (RPPH) that includes the tools and materials needed for the experiment. Teachers usually prepare simple media, such as food coloring, balloons, or small plants, to ensure children can be directly involved in the experiment activities. The planned learning strategy also emphasizes on the early introduction to the child of the tools and materials to be used. The teacher gives a brief explanation of the learning objectives before starting the core activity. This way, children will have an easier time understanding the context of the experiment they will be doing. Overall, careful and flexible planning helps create a conducive learning environment for children. This shows that science learning can be integrated with a variety of creative approaches, allowing children to learn through hands-on experience.

3.3 Implementation and Approach in Science Learning

Teachers use a variety of approaches in the implementation of science learning, including hands-on experiments, demonstrations, and exploration-based projects. This approach is designed to make science learning exciting and enjoyable for early childhood.

"Simple experiments like mixing baking soda and vinegar help the child understand chemical reactions." (AIS, December 1, 2023)
"Using project methods such as planting and observing plant growth." (RSS , November 26, 2023)

Simple experiments such as mixing baking soda and vinegar became one of the favorite activities. This activity not only shows chemical reactions but also triggers the child's curiosity about how the ingredients react. Teachers also often use experiments such as making balloons inflate or mixing colors to teach basic science concepts. The demonstration approach is also often used to explain more complex scientific phenomena. Using simple props, teachers can show concepts such as changes in the shape of objects or the movement of objects. The teacher noted that these demonstrations helped children understand abstract concepts in a more concrete way.

3.4 Evaluation and Indicators of Science Learning Success

Science learning evaluation is carried out by observing children's behavior and responses during and after activities. The teacher noted that the expression of children's enthusiasm is an early indicator of learning success. When children look happy and curious, it shows that they enjoy learning.

"We see the children's enthusiasm during learning and the results of the questions and answers." (LSI, November 29, 2023)
"Children can demonstrate an understanding of simple natural phenomena, such as air in a balloon or simple chemical reactions." (SqI, November 27, 2023)

Teachers also use open-ended questions to evaluate children's understanding. For example, teachers might ask, "What happens when baking soda and vinegar are mixed?" or "Why do balloons get inflated?" These questions encourage children to think critically and express their understanding.

3.5 Teachers' Experiences and Challenges in Science Learning

Teachers face various challenges in teaching science to early childhood. One of the main challenges is the limited tools and materials available at the school. Teachers often have to use creativity to make use of the simple materials that are around them.

"The biggest difficulty is the limitations of tools and materials and the variety of children's abilities." (AIS, November 26, 2023)
"Some children are afraid of getting dirty when doing experiments, so they need to be given extra motivation." (TAX, November 26, 2023)

Children's fear of dirt is also an obstacle in certain experiments. For example, some children are reluctant to touch materials such as soil or colored water. Teachers address this by providing motivation and ensuring that the experimental environment is safe and fun. Teachers also noted that time constraints are often an obstacle. With

limited learning time, teachers must design activities that are effective but still engaging for children. Despite facing many challenges, teachers feel that learning science provides its own satisfaction. Seeing children enthusiastic and involved in science activities is the main motivation for teachers to continue to innovate in their teaching methods.

4. Discussion

Science learning in early childhood has been recognized as an important foundation for developing children's cognitive, social, and emotional skills. Based on Jean Piaget's theory of cognitive development, early childhood is in the preoperational stage, where they learn through hands-on exploration and concrete experiences. This is in line with research findings that show that teachers use experimental and demonstration methods to explain science phenomena in concrete terms.

According to Vygotsky's theory (Johnsen, 1995) About social learning, interaction with peers and teachers can help children reach their proximal development zone. In the context of science learning, group discussions and collaborations in simple experiments such as mixing colors or observing plants help children expand their understanding. These findings are also relevant to pedagogic practices that emphasize the importance of scaffolding, where teachers provide initial support to then allow children to explore independently. Empirical studies support the importance of simple media and aids in science learning. Study by (Luft & Taylor, 2014) shows that the use of relevant props can increase children's attention to scientific concepts. Teachers in the study reported using balloons, food coloring, and other simple materials to help children understand basic concepts of science (Quinn et al., 2023). This shows consistency between theory and practice. In addition, the project-based learning approach applied by teachers in this study is in line with the principles of constructivism put forward by John Dewey. Projects such as growing plants allow children to learn through hands-on experience and connect learning with real life. This approach not only improves children's understanding but also instills the values of responsibility towards the environment.

However, the challenges teachers face, such as limitations in tools and materials, point to the need for additional support in the form of training and resource provision. Study by (Komis et al., 2021) highlighting that teacher training in science learning can improve teaching effectiveness, especially in overcoming practical limitations in the field. The findings of this study also show that children's enthusiasm is an important indicator of the success of science learning. This is supported by Deci & Ryan's intrinsic motivation theory, which states that children are more motivated to learn when they feel happy and engaged in activities. Thus, this research makes a practical and theoretical contribution to the development of science learning in early childhood education. The combination of cognitive developmental theory, pedagogic theory, and empirical evidence reinforces the argument that well-designed science learning can provide long-term benefits to children.

5. Conclusion

This study shows that science learning in early childhood has a significant impact on children's cognitive, social, and emotional development. Teachers understand science as an important tool to foster children's curiosity about the world around them. In addition, science learning is seen as a way to teach critical and logical thinking skills from an early age. Careful learning planning is the key to success in science learning. Teachers design activities that are flexible, relevant to children's interests, and use simple tools and materials, teachers also ensure that the learning process creates a positive experience for children. By utilizing hands-on experimentation and a play approach, children not only understand scientific concepts but also enjoy their learning process. This supports an experiential learning theory that places children as active subjects in learning. In addition, evaluations conducted by teachers help ensure that each child gets the maximum benefit from learning. Success indicators such as children's enthusiasm, ability to explain experimental results, and active participation in activities are important tools in assessing learning effectiveness. This approach demonstrates the importance of continuous reflection and adjustment in teaching methods. However, the study also found that challenges such as limited tools and materials, limited time, and different levels of children's abilities require more attention. Creative solutions such as utilizing local resources and providing additional motivation to children are important steps implemented by teachers to overcome these barriers. Overall, this study reinforces the importance of science learning in early childhood education. With a creative, flexible, and experience-based approach, teachers can help children develop foundational skills that are essential for their future success. Support from the school environment and further teacher training will further strengthen the effectiveness of science learning at the PAUD level.

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