

An Analysis of Teacher Competence in Science

Literacy Activities: "Why Does a Rainbow Appear

After the Rain?"

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ABSTRACT

This study aims to analyze the ability of early childhood education (ECE) teachers to implement science literacy activities through the natural phenomenon topic "Why does a rainbow appear after rain?". Science literacy in early childhood is essential to foster curiosity, critical thinking, and observation and experimentation skills, yet in practice it is often overlooked. This research employed a descriptive qualitative approach, with data collected through classroom observations and in-depth interviews with ECE teachers. Data were analyzed through reduction, display, and conclusion drawing. The findings indicate that most teachers possess a basic understanding of the concept of rainbows but face difficulties in simplifying scientific explanations to match children's developmental levels. Furthermore, limited teaching media, lack of training, and the dominance of language and numeracy literacy over science literacy are the main challenges. Nevertheless, teachers attempt to use storytelling, simple experiments, and

demonstrations to explain the rainbow phenomenon. This study highlights the importance of strengthening ECE teachers' competencies in science literacy through practical training and the provision of simple experimental media so that children are better facilitated in understanding natural phenomena around them.

Introduction

Early childhood education (ECE) forms a critical foundation in developing children's thinking abilities, attitudes, and skills (Retnaningsih et al., 2024). At an early age, children have a strong curiosity about various phenomena in their surroundings. As educators, we must facilitate them with activities that help them find answers that are easily understandable. One activity that facilitates children's curiosity is through science literacy activities (Febriandani et al., 2025).

Science literacy in early childhood is not intended for children to master complex scientific theories but to build scientific attitudes such as curiosity, critical thinking, and skills in observation and experimentation. According to EDC Foundations of Science Literacy (EDC, 2025), children are naturally driven to investigate and observe the world around them, ask questions based on curiosity, and explore phenomena as an essential part of early cognitive development.

Moreover, science literacy in early childhood is closely linked to the development of 21st-century competencies, such as critical thinking, creativity, collaboration, and communication skills (Pareira et al., 2020).

Through science literacy activities, children are not only trained to recognize simple scientific concepts but are also encouraged to express ideas, work with friends, and develop problem-solving skills (Choiriyah et al., 2021). Therefore, science literacy can serve as an essential foundation to prepare children to face future challenges in an ever-evolving world of science and technology.

The topic of the phenomenon "Why does a rainbow appear after rain?" was chosen as a relevant, engaging, and easily encountered entry point in children's daily lives (Pratiwi & Yaswinda, 2024). This topic not only sparks children's curiosity but also provides an effective medium to train observation, questioning, and simple experimentation skills (Delsah, 2021). The phenomenon of the rainbow after rain is a tangible example that captures children's interest and serves as an excellent opportunity for teachers to integrate science literacy into their lessons (Murniati, 2024). Through this phenomenon, children can learn about the process of rainbow formation, the colors in the rainbow, and experiment with light and water.

However, the success of this activity depends heavily on the teacher's ability to understand the scientific concepts and present them through creative, enjoyable, and contextual methods (Widayati et al., 2020). Teachers with a strong understanding of science are better equipped to design activities that encourage children to explore, ask questions, and discover new knowledge. However, the reality in the field shows that many ECE teachers lack confidence in teaching science

(Sholeha et al., 2021). Teachers focus more on developing language and numeracy literacy, while science literacy receives less attention. This issue is exacerbated by teachers' limited understanding of basic science concepts (Sholeha et al., 2021). For example, when children ask about natural phenomena they often observe, such as "Why does a rainbow appear after rain?", not all teachers can provide simple, accurate explanations suited to children's developmental levels.

This challenge stems from limited training, teaching materials, and learning media that support the introduction of science in a simple and enjoyable way (Sativa & Eliza, 2023). These limitations highlight the need for research into ECE teachers' abilities to implement science literacy activities. By understanding the extent of teachers' knowledge and skills in explaining simple scientific phenomena, strategies for improving teacher competence can be identified. This study also aims to provide practical recommendations for ECE teachers in developing contextual and child-appropriate science literacy activities.

Previous studies have shown that many ECE teachers struggle to design science literacy activities that meet children's needs (Atika et al., 2019; Firda & Suharni, 2022; Noviandari et al., 2025; Suharni et al., 2025; Winarni, 2017). This poses a challenge in efforts to improve the quality of science education in ECE. Therefore, it is essential to analyze the ability of ECE teachers in science literacy activities, particularly on the topic "Why does a rainbow appear after rain?"

Based on the above explanation, this study was conducted to

determine how ECE teachers implement science literacy activities, the challenges they face, and the strategies used in explaining natural phenomena to young children.

Methods

This study uses a qualitative approach with a descriptive type. This approach was chosen because the research aims to provide an in-depth description (Lexy, 2018) of ECE teachers' abilities to implement science literacy activities, particularly in explaining the phenomenon "Why does a rainbow appear after rain?". The focus of this study is not to measure with numbers but to understand the process, ability, and challenges teachers face in detail.

The subjects of this study were six teachers from three ECE institutions located in Rukoh Village, Banda Aceh. To maintain confidentiality, each teacher was given a code, namely G1-G6. Participants were selected using purposive sampling, which involved choosing teachers who met the criteria of actively teaching in the classroom, having experience with environmental/nature-related lessons, and being willing to participate in the study. This study was conducted over 2 months, starting from the preparation phase, data collection, to analysis (Tahir, 2023).

Data were collected using several techniques: observation to directly monitor how teachers explain the rainbow phenomenon in science literacy activities. Observed aspects included the teacher's understanding of the rainbow concept, teaching strategies/methods,

media usage, child involvement, and child responses (Anggreni et al., 2022). In-depth interviews were conducted with teachers to assess their understanding of the scientific concept of rainbows, their experience teaching it, and the challenges they face. Semi-structured interviews were used to allow the researcher to freely explore information (Haryono, 2024).

Data analysis was performed using the Miles & Huberman interactive model, involving data reduction, data display, and conclusion drawing/verification stages. Data validity was ensured through triangulation of techniques, sources, and member checks (Rofiah, 2024).

Result and Discussions

Teacher's Understanding of the Rainbow Concept

Based on observations, most ECE teachers demonstrated a basic understanding of the rainbow formation process. Teachers could explain that a rainbow appears after rain due to water droplets and sunlight, but the explanation did not delve into the fundamental scientific concept of light refraction. Interview results supported this finding. Teacher (G1) stated:

"When children ask, I usually explain that a rainbow appears because of rain and sunlight. As for light refraction, I know it, but I am unsure how to explain it to children."

This indicates that teachers possess foundational knowledge but struggle to simplify scientific concepts to a child's level.

Method and Teaching Strategy

From the observations, it was seen that teachers mostly used storytelling or simple Q&A methods to explain the rainbow phenomenon. Only a few teachers attempted simple experiments, such as using a discarded CD or a glass of water to create a simulated rainbow light. Interviews confirmed this finding. Teachers admitted that they rarely conducted experiments due to limited ideas, tools, and time. Teachers G2 and G5 mentioned that they had tried to demonstrate a rainbow using a water spray in the schoolyard, but it did not always succeed. Therefore, they typically resorted to storytelling or showing pictures.

Use of Learning Media

The observations revealed that the media used by teachers were limited to pictures or posters of rainbows. Only a few teachers took the initiative to use concrete media to visualize the rainbow formation process. Teacher G6 mentioned this limitation during the interview:

"We actually want to use experimental media, but we don't know which tools are suitable for children."

The lack of concrete media use is a limiting factor for children's learning experience. Teachers tend to use static visual media such as pictures, even though science literacy requires multi-sensory engagement for children.

Child Involvement and Response

Children showed enthusiasm when teachers told stories or showed

pictures of rainbows. They actively asked questions such as: "Why does a rainbow have so many colors?" or "Can a rainbow be touched?" However, when the teacher's explanation was too long or abstract, some children began to lose focus. Teacher G4 mentioned:

"Children quickly get bored if it's just a story. But if there are pictures or practices, they're more interested."

This shows that children's enthusiasm in activities involving the rainbow phenomenon is high. However, their attention diminishes when passive methods are used.

Teacher Creativity

The observations revealed variations in creativity among teachers. Some teachers only explained verbally, while others tried to connect the rainbow phenomenon to everyday experiences, such as when rain stops or when children see dew exposed to light. Creative teachers often used songs or color games to link the rainbow phenomenon with scientific concepts.

Challenges Faced by Teachers

The interview results revealed several key challenges:

1. **Limited scientific understanding** – Teachers knew the basic concept but struggled to explain it scientifically in child-friendly language.
2. **Lack of media and resources** – Not all teachers were able to design simple experiments.
3. **Limited teaching time** – Often, themes were not enough for in-

depth exploration of science.

These issues align with research showing that most ECE teachers in Indonesia still need training in basic science competencies and innovations in media to improve the quality of children's science literacy (Atika et al., 2019).

ECE teachers have a basic understanding of the rainbow phenomenon but face difficulties simplifying the explanation to children's level. The dominant teaching strategies are storytelling and Q&A, while simple experiments and concrete media are still rarely used. Children show high enthusiasm, but their involvement depends largely on the teacher's creativity and the use of media. The research findings indicate that ECE teachers' competence in science literacy activities, particularly on the topic "Why does a rainbow appear after the rain?", is still at a basic level.

This situation shows that the development of early childhood science literacy is greatly influenced by the teachers' capacities as facilitators of learning. Teachers with limited science knowledge tend to rely on conventional methods, such as lectures or Q&A, thereby limiting children's opportunities for exploration. According to Piaget's constructivist theory, children build their understanding through active experiences, not just listening. The lack of learning media and the limited time allocation further strengthen this challenge because exploratory activities require adequate resources and proportional time planning. Therefore, continuous professional development programs

for teachers are needed, both in basic science competencies and workshops for creating simple media suited to the ECE context. In this way, children's science literacy can be nurtured through concrete, enjoyable, and meaningful experiences.

Discussion

Based on the findings, the study shows that most ECE teachers have a basic understanding of the rainbow phenomenon but still struggle to simplify scientific concepts for children. This finding is consistent with the research of Atika et al. (2019) and Noviandari et al. (2025), which states that teachers' limited scientific knowledge affects their ability to develop meaningful science literacy activities. Moreover, the dominance of storytelling and Q&A methods found in this study is consistent with findings from Santi M. J. Wahid et al. (2024) that most ECE teachers in Indonesia tend to use conventional methods due to limited media and simple experimental training. However, this study also supports Karakaş's (2024) view that children's involvement increases significantly when the learning process is active and based on direct experience (experiential learning).

From a theoretical standpoint, the results of this study confirm Piaget's constructivist theory, which emphasizes that children build their knowledge through direct experience. Teachers who can provide exploratory experiences through simple experiments can help children understand scientific concepts in a concrete and enjoyable way.

Thus, this study underscores the need to strengthen early childhood

science literacy by enhancing teachers' competencies, particularly in understanding basic scientific concepts and translating them into contextual play-based activities.

Implications of the Research

Based on the findings, it can be understood that improving teachers' ability in science literacy should not only focus on mastering scientific concepts but also on pedagogical skills to present natural phenomena in a simple, creative, and enjoyable way. Implementing simple experimental methods, using concrete media, and providing teacher training are essential steps to improve the quality of science education in ECE.

Based on the research findings, science literacy activities concerning the rainbow phenomenon should be designed with an experiential, contextual, and play-based approach.

1. Teachers need to relate the rainbow phenomenon to children's real experiences. For instance, when the rain stops and the sun appears, teachers can invite children to observe the sky together. This activity not only introduces a natural phenomenon but also fosters a sense of awe and gratitude for God's creation.
2. Teachers should use simple experiments to visualize the rainbow formation process. Experiments such as spraying water under sunlight, making soap bubble balloons to observe rainbow colors, using prisms, or old CDs can help children see light dispersed into rainbow colors. In this way, children gain concrete experiences, not

- just verbal explanations.
3. Science literacy activities should be integrated with play and art activities. Children can be invited to sing a song about rainbows, perform a color experiment using rainbow-colored tissue paper, or engage in a fingerprint activity using rainbow colors. These activities support cognitive skills while also fostering creativity and fine motor skills.
 4. Teachers need to use simple and imaginative language when explaining. Instead of explaining "light refraction," teachers could say, "When sunlight meets rain, the light breaks into many beautiful colors." This makes it easier for children to grasp basic scientific concepts without using abstract technical terms.

By applying these strategies, science literacy activities about rainbows can enrich children's knowledge of natural phenomena while also shaping scientific attitudes such as curiosity, the ability to observe, and a passion for experimentation. This aligns with the goals of science literacy in early childhood education, which is to foster the basics of scientific thinking in a fun and meaningful way.

Conclusion

This study shows that ECE teachers' ability in science literacy activities, particularly regarding the topic "Why does a rainbow appear after rain?", remains at a basic level. While teachers have a general understanding of rainbow formation, they struggle to simplify scientific explanations to match children's developmental levels. Dominant

teaching methods include storytelling and Q&A, while simple experiments and concrete media are rarely used.

Despite this, children show high enthusiasm when the rainbow phenomenon is introduced, especially when visual media or creative activities are used. This demonstrates the potential for developing science literacy in early childhood education, but it requires enhancing teachers' pedagogical competencies.

Therefore, science literacy in early childhood should be conducted through contextual, experiential, and enjoyable activities, such as connecting natural phenomena with children's real experiences, conducting simple experiments, and incorporating play and art activities.

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