

Science Learning in Environmental Care Education at Teladan Kindergarten, Sukoharjo

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Abstract

Science learning in environmental education for early childhood at Teladan Kindergarten Sukoharjo. The purpose of this study was to determine how science learning is implemented to instill environmental attitudes and behaviors in kindergarten children. This study explored the implementation process, the learning methods used, their effectiveness, and the support from the principal, teachers, and parents in developing children's science process skills and scientific literacy based on environmental education. This study also examined the challenges faced and strategies to overcome them in the context of science learning and environmental education for early childhood. This research method used a qualitative approach with a phenomenological design on the subjects of children, teachers, principals, and parents. Data were collected through observation, interviews, and documentation during the period of July to September 2025. The results of the study indicate that science learning based on simple experiments and hands-on practice is effective in improving children's knowledge, attitudes, and behaviors of environmental concern. Principal support, teacher creativity, and parental involvement are important factors in the success of this learning. Obstacles encountered include limited learning media and time; however, various strategies such as the use of simple tools and improved teacher training can overcome these. This study provides conceptual and practical contributions to the development of environmentally-based science learning for early childhood and recommends improvements in learning media, parental involvement, and collaboration with environmental communities.

Keywords: *Education, Environmental Care, Learning, Science*

Introduction

Early childhood is known to possess a strong sense of curiosity and enthusiasm for exploring their surroundings (Khaerani & Syairahma, 2022). This natural potential can be nurtured through science learning activities. Science itself is closely related to everyday life and can provide meaningful, real-world experiences for children. Through direct involvement in science activities, children have the opportunity to understand early scientific concepts and develop basic process skills that will provide them with the necessary skills for subsequent levels of education (Fitriah et al., 2024). In early life, a sense of wonder and a drive to learn new things are rapidly developing, making science learning particularly appropriate at this age (Arum Sekar Sari, 2021). The focus of science learning in early childhood lies in mastering process skills such as observing, comparing, asking questions, making predictions, grouping, measuring, analyzing facts, drawing conclusions, and communicating findings (Harlistyarintica & Muryani, 2024). However, providing meaningful science experiences is not always easy (Khoerun Nisa Nur Baety, 2022). Some teachers still rarely provide challenges that encourage children to explore independently. Learning practices often don't fully enable children to use their ideas and concepts. Therefore, teachers need to design learning that is close to children's experiences and remains play-based (Adnyani, 2021).

The guided inquiry approach is a relevant alternative for young children who are not yet accustomed to scientific investigations. If learning experiences are tailored to children's developmental stage, they can begin to understand simple scientific phenomena and develop a foundation in basic scientific concepts. Experts recommend using guided inquiry because this approach allows children to receive systematic guidance from teachers in answering scientific questions (Howitt et al., 2011; Ismail et al., 2024). At the kindergarten level, strong teacher support during the inquiry process helps children acquire new information and understand their environment scientifically (Yuniarti et al., 2024). Simple questions presented in stages can serve as scaffolding to stimulate critical thinking skills. The environment referred to in this context includes physical elements such as water, soil, air, and living things, as well as non-physical elements such as culture and social interactions. All of these components play a vital role as a place to live, a source of necessities, and a space for activities for living things. Previous research has shown that citizen science contributes to environmental management, protection, and responsibility through collaboration between the community and scientists in collecting and analyzing environmental data (Aminudin, 2020). Another perspective states that humans have a responsibility to preserve the environment because both are part of God's creation (Tanjung et al., 2021).

Initial observations at the Sukoharjo Teladan Kindergarten indicate that learning about science skills and environmental care and responsibility has not been optimal. Children are given limited opportunities to experiment, think critically, and understand the concepts of physical changes or growth. Learning is still dominated by teacher explanations and limited media use, resulting in less enjoyable science activities for children. This situation is interesting to study further because learning methods significantly influence the development of science process skills and scientific literacy in early childhood. Early Childhood Education (PAUD) is an effort to stimulate the growth and development of children from birth to six years of age so they are ready to enter the next level of education (Fitri & Nur Khasanah, 2021). This period is a golden period that plays a strategic role in children's cognitive, language, socio-emotional, and spiritual development (Ihda Aisyah Chamamah & Amal, 2021). PAUD aims to facilitate the holistic development of children, in line with the differences in abilities, interests, creativity, and unique character of each child (Ramadani, 2021). Research on brain development also shows that early stimulation can optimize a child's potential.

Kindergarten (TK) is a form of Early Childhood Education (PAUD) service mandated to comprehensively develop the potential of children aged 4–6 years (Nurhamdayani, 2021). This mandate is affirmed in Law Number 20 of 2003, which positions TK as an institution that functions to facilitate personality, cognitive, socio-emotional, and language development according to the child's developmental stages. In this context, the learning process cannot be separated from the principle of play as the primary approach to learning. Through play activities, children have the opportunity to choose, plan, and complete their activities independently. These activities allow various abilities to develop in an integrated and natural manner without instructional pressure (Ririen & Saharullah, 2022). Therefore, the role of adults needs to be directed at providing proportional support, rather than excessive intervention, so that children can complete their play experiences independently (Siti Nur Hayati & Putro, 2021). International research findings further reinforce the importance of play for early childhood development. Colliver et al. (2022) reported that free play experiences during preschool contribute to increased self-regulation skills when children enter school age.

Environmental aspects also significantly influence the quality of children's play experiences. Prins et al. (2022) found that nature-based outdoor spaces provide diverse opportunities for children to explore, imagine, and build richer social interactions than more structured classroom environments. Similarly, a play-based learning approach allows teachers to integrate cognitive, motor, social, and emotional aspects more naturally (Haoyue & Oyam, 2024). In this approach, teachers act as facilitators, providing support as needed without diminishing children's initiative and autonomy in learning (Pyle, 2022).

Based on this description, learning in kindergartens must provide sufficient space for children to engage in meaningful play activities. A play-based approach not only reflects children's developmental characteristics but also draws strong support from contemporary research emphasizing the importance of hands-on play experiences for holistic development. By implementing learning that fosters exploration, creativity, and independence, kindergartens can play an optimal role in laying the foundation for children's development for subsequent levels of education.

Method

This study used a qualitative approach with a phenomenological design to examine how environmental education-based science learning is implemented and interpreted by the school community at Teladan Kindergarten, Sukoharjo. The phenomenological approach was chosen because it allows researchers to capture the subjects' experiences and perceptions in depth and as they are (Moustakas, 1994; Creswell & Poth, 2018). The research object included science learning practices integrated with environmental education, while the research subjects consisted of principals, teachers, parents, and students. To gain a comprehensive understanding, data collection techniques included direct observation of learning activities, in-depth interviews with informants, and documentation in the form of photographs, activity notes, and learning tools used. The use of multiple techniques simultaneously helped enrich the data and capture the dynamics of learning more fully (Creswell, 2013). The collected data was then analyzed systematically. Data analysis techniques included data reduction, thematic organization, and drawing meaning through interpretation of emerging patterns, following the analysis model of Miles, Huberman, and Saldaña (2014). Data validity was strengthened through triangulation of sources and techniques, as well as confirmation with informants to ensure that the researcher's interpretations aligned with the subjects' authentic experiences.

Table 1 Environmental Attitude Indicator Table (Based on Research Findings of Sukoharjo Exemplary Kindergarten)

No	Environmental Attitude Indicators	Description of Observed Behavior (based on observation & interviews)	Rating scale	Notes
1	Demonstrate the habit of maintaining cleanliness of the school environment	Children are actively involved in Clean Friday activities, picking up trash without being asked.	1-4	4 = Very Good (behavior is consistent and occurs spontaneously)
2	Participate in caring for plants and seedling planting activities	Children water plants regularly, observe the process of sprout growth, and are able to explain	1-4	3 = Good (often involved, sometimes needs direction)

		what they observe (according to the children's activities and teacher observations).		
3	Using recycled materials for science and environmental activities	Children utilize used glasses and plastic bottles for plant experiments; understanding the function of used items as planting media (based on the teacher's findings regarding the limitations of the tools).	1-4	2 = Sufficient (seen when guided by teacher)
4	Demonstrate curiosity about natural phenomena and the environment	Children actively ask about plant growth, garbage, water, sunlight,	1-4	3 = Good (often asks spontaneous questions during science activities)
5	Put forward simple ideas/solutions to protect the environment	Children gave suggestions such as watering plants together, or reducing plastic waste (found from interviews with teachers and the principal).	1-4	2 = Sufficient (occasionally appears, requires a lot of stimulation)
6	Collaborate on science activities and cleaning activities	Children are able to share tasks during the experiment of planting sprouts, work in groups and demonstrate a cooperative attitude.	1-4	3 = Good (good cooperation, sometimes needs to be reminded)
7	Demonstrate empathy and responsibility towards living things	Children treat plants with care, do not damage plants, and understand that plants need to be cared for (according to parent and teacher interviews).	1-4	2 = Sufficient (not all children are consistent)
8	Implementing environmentally friendly behavior at home (result of school-parent collaboration)	Children start to throw rubbish in the right place at home, remind their parents, and are willing to water the plants at home (according to the parents' statement about changes in the child's behaviour).	1-4	3 = Good (seen in most children)
9	Understand and practice simple science concepts about the environment	Children can explain changes in plants, understand the basic needs of plants, and are able to draw simple conclusions from experimental results (a reflection of the results of learning evaluations).	1-4	3 = Good (good understanding, delivered in child language)
10	Able to maintain concentration during science activities and environmental exploration	Children focus on planting, observing, and experimenting activities, although some have short attention spans (according to the principal's findings).	1-4	2 = Sufficient (increased concentration on interesting activities)

Research Results and Discussion

Research result

This research was conducted at TK Teladan Sukoharjo with 14 children as subjects. Related to science learning in environmental education at TK Teladan Sukoharjo. Data were obtained through observations and interviews with the principal, teachers, and parents as well as direct observation of children's behavior at school. The results of observations at TK Teladan Sukoharjo showed that: the principal was actively involved in various environmental activities, allocated sufficient resources, and provided full support to teachers and students, so it can be concluded that the principal has a high commitment to science learning in environmental education. The principal's ability to motivate teachers and staff is a key factor in the success of the science learning program in environmental education. By creating a conducive environment, providing adequate support, and being a good role model, the principal can inspire teachers and staff to work together to create a greener and more sustainable school. The principal provides training tailored to the needs of teachers and staff. The training methods used are varied and engaging, such as group discussions, case studies, or role-playing. A variety of methods will make the training more effective. Schools provide various communication channels that are easily accessible to parents, such as the school website, WhatsApp groups, and regular meetings. Schools openly communicate information about environmental programs, their goals, and progress to parents. Schools often hold joint activities between the school and parents, such as community service cleanups or environmental education workshops. Parents are involved in decision-making regarding environmental programs, for example through surveys or meetings.

Science learning can be an effective activity in environmental education. Various activities in science learning can make a significant contribution to changing individual behavior and attitudes toward the environment. Real-world, hands-on learning methods make it easier for children to understand concepts and apply them in everyday life. The principal assesses the outcomes of science learning in environmental education. This assessment determines the extent to which the program has successfully changed children's attitudes and behaviors toward the environment. Furthermore, the assessment results can be used as evaluation material to improve future programs. According to the principal, the assessment results are crucial for improving the quality of science learning programs in environmental education. These assessment results should indicate the program's success, areas for improvement, and potential for future development.

Based on the results of an interview with the principal of TK Teladan Sukoharjo, it was conveyed that science learning is developed in PAUD themes and is directed to form a character of environmental care from an early age. School programs such as "Clean Friday" and "Class Garden" are part of the implementation of these values. The principal understands that science learning in environmental education for early childhood is an effective approach to instill environmental care from an early age. Through science learning, children can understand basic environmental concepts and develop critical thinking skills creatively. According to the principal, the benefits of science learning in environmental education for early childhood are numerous, especially since we learn directly and directly practice so it can develop children's curiosity, develop an attitude of environmental care, and foster an attitude of responsibility towards the environment. A challenge often encountered at TK Teladan Sukoharjo is the short attention span of children. So some children at the beginning of learning can still concentrate and follow well, but their attention span is only short. The beginning of Sukoharjo's Teladan Kindergarten's implementation of science-based environmental awareness stems from a concern about children's lack of awareness of their surroundings. The school then integrated environmental values into teaching and learning activities through a simple science approach. Planting activities introduce children to the concept of living things growing. Children are introduced to seeds, growing media, and the basic needs of plants through hands-on activities. The planting process is carried out in stages, from selecting seeds, adding soil to pots, to regular watering. Through these activities, children learn about the changes that occur in plants over time. They observe the growth of seedlings, changes in stem size, and leaf development. This activity not only introduces basic biological concepts but also fosters responsibility and a sense of caring for living things. Within the context of thematic learning, this activity is integrated into the themes "Plants" or "My Environment."

"We want children to not only memorize or understand concepts, but also develop a habit of caring for the environment and practicing responsibility. That's why we encourage teachers to conduct experiments and activities outside the classroom." (Principal)



Figure 1. Clean Friday Activities at School

The science learning used at TK Teladan Sukoharjo for environmental education is based on simple experiments and direct exploration. The process of implementing science learning in environmental education at TK Teladan Sukoharjo is carried out in stages and contextually. With this method, learning becomes fun and meaningful and instills the values of environmental care and responsibility in children's lives. The effectiveness of science learning in environmental education at TK Teladan Sukoharjo is considered quite good and has a positive impact on the development of children's attitudes and behavior. Overall, science learning is considered effective because it is able to develop children's knowledge, attitudes, and skills in protecting and loving the environment from an early age. The obstacles include limited media and tools used, limited learning time, minimal teacher training in science learning, weather and environmental conditions. To improve the effectiveness of science learning in environmental care education at Teladan Sukoharjo Kindergarten, among others: adding supporting facilities and infrastructure, improving teacher competency, integrating school programs with the surrounding environment, strengthening habits in daily routines, providing sufficient exploration time. Teachers stated that

the science approach is used to build children's curiosity. Through activities such as planting sprouts, learning about the sprout growth cycle, and clean Friday activities, children are trained to observe and draw simple conclusions and protect the environment. The challenges are limited teaching aids and limited time.

"Experiments like growing sprouts are the easiest way to help children understand science concepts while also teaching them environmental care and responsibility." (Teacher)

"Children used to run away when they saw trash. Now they fight over picking up small pieces of trash to throw away and diligently clean the garden." (Teacher)



Figure 2. Simple Student Science Activities.

Environmental education for early childhood is an effort to instill awareness from an early age to protect and preserve the surrounding environment through fun and developmentally appropriate learning. Teachers stated that science learning serves as a medium to introduce children to basic environmental concepts, such as the life cycle, natural cycles, and the importance of maintaining cleanliness, so that children can understand and practice environmentally conscious behavior. Teachers mentioned the types of learning used include exploration-based learning, simple experiments, observations of the surrounding environment, and practical activities such as planting seedlings and caring for the garden. Science learning is integrated through routine activities such as observing plants in the school garden, conducting simple experiments, and giving tasks to maintain the cleanliness of the classroom and surrounding environment. The benefits are that children more easily understand environmental concepts, increase their sense of responsibility for the environment, and foster attitudes of love and care for the environment in a practical way. Challenges faced include limited

facilities and infrastructure, limited learning time, and varying levels of understanding among children and parents.

"Simple experimental equipment is sometimes lacking. We use old mineral water glasses or other discarded items as pots for sprouting plants." (Teacher)

"Learning time is limited. Experiments sometimes take longer." (Principal)

"Not all parents are willing and able to implement environmentally conscious behavior habits at home." (Parent)

Effectiveness is measured through observations of changes in children's behavior, assignment evaluation results, and feedback from parents regarding environmentally conscious habits that are starting to emerge at home. My suggestion is to increase practical activities and direct exploration of the natural environment, involve parents in the learning process, and provide engaging and child-friendly teaching aids to increase children's interest and understanding of the concept of environmental stewardship. For example, when children are invited to plant bean seedlings at school, they learn about the growth of bean seedlings, the importance of water and sunlight, and how to maintain a clean environment so that plants can grow well. This activity makes children much more environmentally conscious and responsible. Teachers hope that schools can hold more workshops or training for teachers on innovative and child-friendly science learning methods, as well as foster collaboration with environmental communities to broaden the knowledge of both children and teachers. Most parents welcome science activities that build children's character. Some parents notice changes in their children's behavior at home, such as starting to reprimand them for scattered trash and wanting to water plants. However, they hope there will be regular communication about environmental activities that can be continued at home.

"Now my son often reminds us at home, 'Mom, don't litter.' He also asks us to water the plants every afternoon." (Parent)

"I also get my child used to protecting the environment by taking care of plants" (Parent)

Parents try to regularly talk about the importance of protecting the environment to their children at home, especially when there are relevant moments, such as when throwing out trash: parents explain the importance of throwing trash in its place, when watering plants: parents invite children to join in and tell the benefits of caring for plants, when using water or electricity: Parents remind them to save and not waste. So that children get used to and understand the value of protecting the environment through direct examples. Parents often invite my child to plant plants such as vegetables and ornamental plants at home, getting my child used to throwing trash in its place. Activities that parents find interesting and effective in teaching children about the environment are environmental cleaning activities because at that time children are invited to get directly involved in cleaning the surrounding environment, getting to know various types of plants, knowing whether the environment is dirty or clean. And practicing responsibility for living things, especially plants.

Discussion

Science learning within environmental education implemented at Teladan Kindergarten Sukoharjo demonstrates a well-planned implementation oriented toward developing ecological awareness in early childhood. Research findings indicate that the learning process not only targets the achievement of scientific concepts but also guides children in developing environmental habits through a series of practical activities. This approach aligns with the view of Asmar and Lestari (2021), who stated that the integration of science learning and environmental education will be more effective when packaged in direct experiences relevant to children's lives. Furthermore, the principal's managerial support is evident in the program's implementation process through the provision of learning resources, teacher training, and the establishment of a school culture that supports environmental awareness. This confirms the findings of Wahyuni and Nugroho (2022) that principal leadership has a significant influence on the success of environmental education programs, particularly in the planning and empowerment of educators as implementers.

Teachers play a crucial role in guiding activities to ensure they are meaningful and connect scientific concepts to children's daily activities. Teachers at Teladan Kindergarten in Sukoharjo implement learning methods such as simple experiments, environmental exploration, and direct observation activities, enabling children to connect scientific processes with concrete experiences. These methods have been shown to support the development of children's critical thinking skills, curiosity, and an increased understanding that protecting the environment is a shared responsibility. This aligns with the findings of Kurniawati and Pratiwi (2023), who explain that simple science experiments in early childhood education can stimulate inquiry while instilling environmental values. Collaboration with parents is also a crucial element in strengthening ecological behavior habits at home through regular communication and mentoring activities. These findings support the research of Rahmawati and Maulida (2024), who emphasized that the success of environmental education is strongly influenced by the continuity of habits between home and school, so that the values acquired by children are more durable. Although the program's implementation went well, this study identified several challenges that still require attention. These include limited science experiment facilities, a lack of varied, environmentally-based learning media, and limited learning duration. Furthermore, variations in children's abilities and the level of parental

involvement are also factors influencing the program's effectiveness. This finding aligns with the findings of Hernawati and Nurhafifah (2022), who revealed that implementing environmentally-based learning at the early childhood education (PAUD) level requires teacher creativity to utilize the surrounding environment as an alternative learning resource to address limited facilities.

Therefore, adaptive strategies and educator flexibility are needed in managing learning so that all children can receive equal learning opportunities according to their developmental stage.

Routine evaluations conducted by the school indicate that the implementation of science learning within an environmental context has a positive impact on changing children's behavior. Indicators of success are seen in children's increased awareness of maintaining environmental cleanliness, involvement in plant care activities, and the habit of sorting and disposing of waste properly. This reinforces the findings of Sari and Yanti (2025), who stated that the effectiveness of science learning is determined by the variety of media, frequency of practice, and opportunities for practice provided to children. Based on this analysis, it can be concluded that science learning at Teladan Sukoharjo Kindergarten has been effective in developing knowledge, scientific skills, and environmental attitudes. The success of this program is built on the combined roles of the principal, teachers, and parental support as part of the children's learning environment. These research findings align with Prasetyo's (2021) view that environmental education in Early Childhood Education (PAUD) will be optimal if implemented holistically, sustainably, and involving various parties.

In addition to its impact on shaping children's behavior, the implementation of environmentally conscious science learning has also successfully created a more ecological school culture. Children not only adopt environmentally conscious habits for themselves but also become agents of change for their friends and family. This phenomenon aligns with Bronfenbrenner's view that changes in children's behavior can resonate with their social environment through repeated interactions that form new systems. The use of an exploration-based learning approach and emotional experiences makes children more connected to the learning process. When children can witness plant growth or see the impact of unmanaged waste, learning becomes more meaningful because they not only understand it cognitively but also feel it emotionally. This condition supports Wilson's (2020) finding that sensory and emotional experiences are important foundations in the process of forming ecological character in early childhood.

The program's sustainability depends heavily on consistent habits and a supportive learning environment, both at school and at home. If learning activities are not implemented consistently, children's behavior can potentially revert to pre-program behavior. Therefore, strengthening internal school policies, allocating adequate time, and further training for educators are necessary to ensure the program's sustainability. In this context, the teacher's role extends beyond delivering material to ensure that children's learning experiences are enjoyable, routine, and relevant to their daily lives. Accessible learning media and family involvement help children maintain the habit of caring for and being responsible for their environment. When schools and families are able to build a harmonious ecosystem of support, the values of caring for and being responsible for the environment that have been instilled become more than just a fleeting activity, but develop into a long-term part of the child's character.

Conclusion

Conclusion

Based on the research results and discussion, it can be concluded that the implementation of science learning in environmental education at Teladan Sukoharjo Kindergarten was effective and significantly contributed to the development of ecological behavior in early childhood. The applied science learning not only focused on understanding basic natural concepts but also aimed to build meaningful learning experiences through exploratory activities. This approach aligns with Burhanudin's view, which emphasizes that environmental education for early childhood needs to integrate cognitive, affective, and psychomotor aspects so that ecological values can be fully internalized. The principal's involvement in providing policy support and facilities also strengthened the program's sustainability. Teachers also played a central role in presenting simple experiment-based activities that fostered children's curiosity and awareness of the relationship between actions and their impact on the environment. Through activities such as planting plants, sorting waste, and direct observation of natural phenomena, children demonstrated emotional involvement and a growing sense of responsibility. This was reinforced by the finding that parents observed changes in children's behavior at home, particularly related to habits of maintaining cleanliness and using materials more wisely.

Furthermore, contextually designed science learning activities enable children to be more active in constructing their understanding of the environment. The learning process, which takes place through direct experience, provides space for children to ask questions, experiment, and reflect on the results of experiments. This pattern suggests that science learning not only enhances factual knowledge but also serves as an important tool for developing environmentally conscious character from an early age. However, this study also uncovered several challenges that require further attention. Limited teaching aids limit the variety of activities, necessitating the provision of more adequate learning media. Furthermore, not all parents are actively involved in supporting environmental awareness activities at home, thus preventing the continuity of children's habits from being fully optimal. Collaboration between schools and families needs to be strengthened so that habits developed at school can be integrated with the home environment. Overall, science learning within environmental education at Teladan Kindergarten Sukoharjo shows great potential as a strategy for developing ecological character in early childhood. With the support of school policies, teacher creativity, and parental

involvement, this program can become a sustainable and relevant learning model for implementation in other early childhood education institutions. These findings also confirm that environmental education is not merely an additional activity, but a crucial part of developing environmentally friendly school values and culture.

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