

Teacher Strategies for Introducing Life Science Concepts to Early Childhood Learners through the Green School Program

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ABSTRACT

Purpose – Existing literature on green school in early childhood education mainly concentrates on the way it encourages environmental values among children. Few studies have examined how teachers use green school activities to introduce life science concepts to children aged 5–6 years. The current study examines how teachers combine both objectives in their teaching practice.

Methods – Qualitative case study method was used in this study in TK Islam Al Azhar 13, East Jakarta. Participants were seven teachers, one school principal, and three Group B classes (ages 5–6) observed over about 1.5 months. Data were collected through interviews, observations and documentations. Credibility was supported through source and technique triangulation and member checking.

Findings – Two major strategies were used by teachers to teach life science. One emphasizes outdoor activities like planting seeds, measuring the growth of plants, watering, feeding fish, and maintaining the environment. The other emphasizes activities in the Learning Resource Center, where children observe the leaves using a microscope, read storybooks and share experiences. Both strategies integrate direct observation and active participation in learning. Teachers showed good practical knowledge and communicated ideas well. Teachers used guiding questions during several activities; these can be planned more systematically across activities.

Research Implications – These activities can be enriched by preparing guiding questions, including relevant concepts in lesson plans, documenting children's performance, and sequencing the activities in an organized way. Even though "green school" is an opportunity for children to learn about life science, its success depends on the involvement of teachers to guide them. Since this research study was carried out in one school without evaluating children's comprehension of life science, the scope of this study is limited.

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Introduction

Education in early childhood becomes vital for human resource development since it takes place in the early years, also known as the “golden age.” This stage influences all processes of child development, including cognitive development, and lays the basis for future development (Shonkoff & Phillips, 2000). Children at this stage naturally have a strong curiosity about their surroundings; therefore, appropriate early stimulation is essential because it encourages exploration, shapes how they understand the world, and helps them develop an initial grasp of simple scientific concepts. Early stimulation supports their development (Harlistyarintica & Suyanto, 2022; Kastriti et al., 2022).

The learning process in early childhood is theoretically explained, in part, through constructivist theory, specifically the ideas of Jean Piaget and Lev Vygotsky. Together, these perspectives show that young children learn best through direct experience, active exploration, and social support. Jean Piaget argued that children construct their own knowledge through direct experience and active exploration, which supports inquiry-based learning (Piaget, 1952). Complementing this view, Lev Vygotsky emphasized that a child's knowledge develops through the role of adults in their environment, such as teachers acting as a bridge to help the child achieve a level of understanding beyond what they could attain on their own (Vygotsky, 1978). Science learning for young children should be concrete, actively facilitated by teachers, and centered on inquiry rather than conveyed verbally and abstractly (Havu-Nuutinen et al., 2022).

One science area that can be introduced early is life science, the branch of science concerned with living organisms. In early childhood, introducing life science concepts involves helping children recognize the characteristics of living things, ask questions about them, and gain a basic understanding of how they grow and develop (Inagaki & Hatano, 2006). This early introduction can build a foundation for children to understand better the interconnectedness among humans, the environment, and other living beings around them, while fostering scientific attitudes from an early age, such as environmental awareness (Puspita et al., 2024).

Introducing life science concepts to young children should go hand in hand with fostering early scientific literacy. For young children, scientific literacy is not about memorizing scientific concepts; rather, it is a process of learning to understand and care for their surroundings through proper scientific inquiry (Choiriyah, 2021), such as observing, comparing, classifying, and communicating (Charlesworth, 2016; Harlistyarintica & Muryani, 2024a, 2024b). Linking life science instruction with these scientific inquiry processes helps ensure that, as they develop, children can care for their environment and help solve the problems they encounter. Science instruction should emphasize scientific inquiry, processes, and attitudes rather than focusing solely on conceptual mastery.

However, many kindergarten institutions have not yet fully implemented science learning environments that emphasize scientific processes, attitudes, and inquiry. Although systematic reviews of early childhood science teaching strategies in various scholarly journals show that hands-on experience, active participation, environmental engagement, and STEM or STEAM approaches have been widely studied (Kastriti et al., 2022; Leung, 2023), implementation still varies and depends on teachers' understanding of the nature of early childhood science (Choiriyah, 2021; Leung, 2023). In practice, this means that these widely studied approaches are not always linked in kindergarten classrooms. Some kindergartens still introduce concepts such as life science mainly through images, flashcards, or verbal instruction, limiting children's opportunities to gain direct familiarity with living things and their surrounding environment (Hadijah et al., 2026).

One emerging approach to addressing this gap is the Green School program. In Indonesia, this concept is known as the Adiwiyata movement, launched in 2006 to encourage schools to participate in environmental conservation and sustainable development. Although it was initially conceived for primary and secondary education, kindergartens are also considered important to play a role (Herlina, 2022). Green School initiatives in kindergartens have been documented, for instance, at Jogja Green School (Mukaromah, 2019) and at a kindergarten in Palembang (Puspita et al., 2024). Together, these examples show that the Green School program involves the entire school community teachers, children, and parents alike in fostering environmental consciousness. This study focuses on how teachers use Green School activities to introduce life science concepts, with the natural environment serving as a primary learning resource rather than merely a supplement to classroom activities.

Schools that implement a nature-based approach give students many opportunities to inquire directly into their surroundings, engaging with nature, teachers, and peers alike (Prins et al., 2022). Activities such as planting, gardening, feeding animals, and properly disposing of waste directly support inquiry-based learning in school gardens and help children grasp life science concepts in a tangible, contextual way. School gardens, for instance, have been studied as settings for inquiry-based science learning across various educational levels (Eugenio-Gozalbo et al., 2020).

Previous research on Green Schools has largely focused on fostering environmentally conscious character through gardening, planting activities, and nature-based learning models (Mukaromah, 2019; Oktamarina, 2021; Puspita et al., 2024). These studies show that Green School programs can cultivate environmental awareness from an early age, but few have examined how teacher strategies use Green School activities to introduce life science concepts to children aged 5–6, the final stage of kindergarten education.

This is important because children ages 5-6 start to have knowledge of cause and effect relationships, including the functioning of living beings (Inagaki & Hatano, 2006). This research focuses on the process of teaching life science concepts through Green School activities like planting and animal observations.

This research is unique because it focuses on the strategies employed by teachers in different Green School activities. Using a qualitative case study approach, this research investigates the strategies employed by teachers in life science teaching. Three questions guide the study: (1) what role do Green School activities play in the learning process; (2) what role does the Learning Resource Center play; and (3) how can teachers use their strategies to help children move from observation to understanding.

Methods

This study adopts a qualitative case study approach that analyzes the introduction of life science concepts by teachers among 5-to 6-year-old children enrolled in the Green School Program in TK Islam Al Azhar 13, East Jakarta. The study mainly concentrates on the approaches used by teachers in introducing the concepts. Purposeful sampling was adopted in selecting the teachers working directly with the 5-to 6-year-old children, the principal of the school for policy analysis, and the children as observation subjects. Data were collected through observation, semi-structured interviews, and documentation (Table 1). Fieldwork lasted about 1.5 months

Table 1. Data Collection Guidelines

Technique	Focus of the Data Extracted	Data source	Scope
Observation	Green school activities, teacher strategies, media used, and children's responses	Teachers, children, school environment	Three group B classes
Semi-structured interview	Activity planning, teacher strategies for introducing life science concepts, rationale for media selection, children's responses, as well as challenges and solutions	Teacher, school principal	Seven teachers, and one principal
Documentation	Teaching modules, activity photos/videos, children's work	School documents	Children's work from Groups B1, B2, and B3

Analysis of the data was done by using the interactive analysis model of Miles et al. (2014) whose components are data collection, data condensation, data display, and drawing and verifying conclusions. This process helped in analyzing the strategies used by teachers in teaching life science concepts through inquiry and important findings. Data condensation was carried out through summarization, selection of essential aspects, and

noting important details about strategies used by the teachers. The condensed data were then displayed in descriptive form in relation to activities done in Green Schools. Data accuracy was guaranteed through the use of both source and technique triangulation. Source triangulation entailed checking the validity of data from different sources such as the teachers, the school principal and observation of the children. Technique triangulation entailed the checking of data from different techniques on the same issue including observation, interviews and documentation. The researcher also made use of member checking.

Result

At TK Islam Al Azhar 13 located in East Jakarta, the Green School is one of the subjects in the curriculum that is taught regularly at school. There are two elements in the Green School. During Mondays to Wednesdays, the students get their learning process in the Islamic Green School (IGS), where they learn through observing the living things around them and questioning them. On Thursdays, the students go to the Learning Resource Center to conduct their study more deeply using other media such as books. Table 2 outlines the teachers' strategies for each activity.

Table 2. Teacher Strategies through the Green School Program

Activity	Teacher Strategies	Life Science Concept
Planting and measuring water spinach	Children are involved from the stage of planting the seeds, plant height is measured periodically, and the measurement results serve as a basis for observing change	The growth and transformation of living things
Caring for and watering plants	As a routine practice before children enter the classroom, the teacher provides guidance by offering examples and using questions to spark engagement	Plants need water to live
Feeding the fish	The child is given direct responsibility for caring for the animals and observing the fish while they eat	Animals need food and care
Disposing of waste	Cultivating habits and setting an example in maintaining the cleanliness of the planting area and the pond	A clean environment supports the lives of living organisms
Observing a leaf under a microscope	Magnified observations of objects familiar to the children in the school's green area	Parts of the plant not visible to the naked eye
Reading a storybook	Stories are used to reinforce and expand children's experiences	Characteristics and life of living things in children's language

1. Teacher Strategies for Activities in the School's Green Area

1.1. Planting and measuring plant growth

Water spinach was chosen because it grows quickly, allowing children to see changes quickly. Seeds are planted, and plant height is measured regularly, giving children chances to practice science processes such as observing, measuring, comparing, and communicating what they find out. Children's work collected as documents shows how plant height was recorded. In Group B3, children's drawings of their water spinach (Figure 1a) were displayed under the title "Pertumbuhan Tanamanku" (My Plant's Growth), and many drawings carry a handwritten label giving the plant's height in centimeters. In Group B2, a class diagram (Figure 1b) titled "Diagram Pohon Kangkung" (Water Spinach Tree Diagram) shows each child's plant as a popsicle stick labeled with the child's name, with sticks of different lengths set side by side so that heights can be compared.



Figure 1. (a) Group B3: children's drawings of water spinach with handwritten plant heights, displayed as "Pertumbuhan Tanamanku"; (b) Group B2: "Diagram Pohon Kangkung," a class diagram of plant height using labeled popsicle sticks

Interviews indicate that teachers see this activity as a way for children to learn about living things by observing plants. Teachers assess learning by connecting children's behavior and language with notes, observations, and portfolios. Teachers described measuring the plants with a ruler to see them grow taller.

1.2. Caring for and watering plants

Watering and tending to the plants are part of the children's daily routine and are done before the class begins. Supervision and constant reminding from teachers contribute to maintaining this habit. Moreover, teachers ask questions such as "Why do we need to water plants?", which helps children think about how and why plants need to be watered. Such questions contribute to focusing on inquiry and connecting the habit formation technique with the theory of scaffolding (Wood et al., 1976), which is rooted in Vygotsky's sociocultural theory.

According to interviews, this activity helps teachers to instill care for living creatures in children, gratitude to God's creation and independence. Moreover, watering plants becomes more significant when children understand that they should care about plants. Teachers consider asking such questions a best practice and state that this contributes to reflection on the significance of this habit and taking notes in writing.

1.3. Feeding Animals

Feeding animals such as fish provides children with a distinct animal care experience compared to plant care. The animals require food and depend on the children to fulfill their requirements. In this process, children realize that all living beings have requirements and their fulfillment is a duty.

The interviews revealed that teachers employ this exercise to inculcate the values of responsibility and thankfulness in the children. The school, especially the pond, is seen by teachers as an ideal place for the children to learn. The evaluation of children's understanding depends on their ability to recognize the body parts of animals.

1.4. Disposing of waste and maintaining environmental cleanliness

The promotion of proper waste management and cleanliness of planting zones and ponds is an integral part of the Green School Program. Teachers themselves act as role models and always remind the students to behave this way. Students come to realize through practice that plants and animals need to be nurtured in a clean environment. They realize that cleanliness is the prerequisite for survival, not just a necessity of the school.

Interviews reveal that the teachers see such exercises as a way of teaching environmental responsibility. With scarce resources, teachers utilize their own school ground for studying and ask parents to help their children do the same at home.

2. Teacher Strategies for Activities at the Learning Resource Center

2.1. Observing leaves using a microscope

The children begin by gathering the leaves found in the green areas of the school at the Learning Resource Center. The children then observe the leaves through a magnifying glass before using a microscope for closer observation. This gradual process links practical experience with discovery and adds meaning to learning. The teacher uses demonstrations on the correct use of equipment and facilitates discussions, stories, questioning, and comparison of results as the children work. Through this method, children can articulate their thoughts and learn language and science skills. The interviews done with teachers reveal that the use of real items enhances engagement and comprehension, according to the teachers, learning through direct experience is more effective than learning by listening.

2.2. Reading storybooks

Storybooks complement rather than replace hands-on experience. After exploring their immediate environment, such as observing the growth of plants in the school garden, children can use stories to name and describe the plant parts and the animal activities they have observed. In this way, children learn to use precise language instead of merely pointing at things.

Through shared reading, teachers can ask questions, elicit predictions, and relate the story to life experiences. For instance, the teacher may ask what will happen if a plant is watered daily or if such events have been observed in schools. Such questions can motivate children to think, reflect, and connect their learning to prior knowledge. Children are taught to offer points of view, hear out other points of view, and understand that events can be viewed differently. Storybooks help relate concrete experiences to more general concepts, so that children can move from concrete experience to broader ideas about living things and their environment.

Discussion

The findings show that learning about life sciences takes place mostly through activities in the green areas of the school and through observations in the Learning Resource Center. This aligns with a review of 66 studies on early childhood environmental education, which is typically conducted in formal settings with adult guidance (including teachers). These studies highlight positive impacts on environmental literacy, cognitive development, and social-emotional growth (Ardoin & Bowers, 2020). The discussion below addresses the three research questions: the role of Green School activities, the role of the Learning Resource Center, and how teachers can help children move from observation to understanding.

Planting and growing the water spinach suggests that active learning may support children's development of scientific thinking skills. It corresponds to Vandermaas-Peeler & McClain (2015) who observed that children in a Reggio Emilia-inspired preschool who had been gardening for one year showed similar development. The authors observed that the children were working on the skills of observing, predicting, evaluating and comparing with teachers' encouragement to compare the results. Such parallels suggest that measuring the growth of fast-growing plants, as done at TK Islam Al Azhar 13, may help develop basic science skills in children. Also, a review of literature on the topic shows that there is evidence about the efficiency of science experiences for children aged 3–6 (O'Connor et al., 2021).

Feeding fish and watering plants may help children become more responsible toward other living beings. Research conducted in a kindergarten in Palembang found that gardening, waste management, and plant growing through "Green School" activities increased the environmental awareness and the sense of responsibility of the children

(Puspita et al., 2024). A study in a kindergarten in Bandung found that bringing animals to the class improved naturalist intelligence in children. This suggests that bringing living beings into the classroom may help children become more sensitive to living things (Suhartini & Laela, 2018). Teachers aim to develop gratitude, caring, independence, and responsibility among their students. This is consistent with research on Jogja Green School (Mukaromah, 2019; Rini & Rigianti, 2023).

Good habits provide children with a strong foundation and can be reinforced by linking daily activities to broader concepts. Vandermaas-Peeler & McClain (2015) found that, with appropriate teacher support, preschool gardens foster scientific thinking in children. For instance, teachers at TK Islam Al Azhar 13 guide students by asking questions such as "Why do plants need to be watered?" However, implementing this approach can be challenging. A study of four preschool teachers found they typically asked closed-ended questions, although science questions were more likely to be open-ended than others (Hamel et al., 2021). These findings indicate that increasing the use of open-ended questions in daily routines may be a valuable focus for teacher development.

The Learning Resource Center offers students a distinct advantage over the Green School area by enabling closer examination of objects. Although the green area allows children to observe whole leaves, microscopes reveal details that cannot be seen with the naked eye. In a study conducted by Chou & Wang (2021) two classes of third-grade students from Taiwan (56 students), who were older than the children in the present study, were observed for five weeks. One class utilized a mobile microscope for viewing plants while another one only utilized tablets. Although the groups differed in their concept maps, their multiple-choice test results did not differ. Based on qualitative data, microscopes stimulated discussion between the children and exchange of their observations. The children had difficulties in focusing the microscopes and needed help from a teacher, which was considered by the authors as a consequence of the novelty of the tool. A similar pattern appears at TK Islam Al Azhar 13, where children use microscopes in the Learning Resource Center to study leaves under teacher supervision.

The use of storybooks enhances children's learning process since they offer context and language of what they experience. According to McLean et al. (2015) the connection between storybook themes and science play has been studied in preschoolers. According to Cruz & Breda (2024) stories and illustrations have been effective in teaching children scientific ideas and encouraging them to conduct inquiries. However, they found that there are some science books that are difficult for children because of their complex language and boring narrative.

The present study found something similar. Reading stories stimulates children to communicate their experience gained in the green environment and talk about leaves, different parts of plants, and small creatures living there. Initially, children notice and feel

all of these things, but thanks to the appropriate vocabulary, they will be able to explain their experience and link it to bigger concepts. In this case, the Learning Resource Center helps by giving children an opportunity to look at the details not visible to the naked eye and teaching them how to speak about it. The two factors work together to make the experience more valuable due to the ability to describe it properly.

Vygotsky (1978) argued that the help of a knowledgeable adult allows children to accomplish more than they could on their own. As the interview showed, teachers have a good practical knowledge about life science topics and they are ready to explain them. It is important because "provocation questions" become more effective when teachers understand the concepts deeply.

It is possible to integrate previously independent activities. For instance, observing leaves in the Learning Resource Center, measuring water spinach in the green space, and discussing the measurements in the classroom are some activities that can form an integrated learning process. Children may measure and compare the length of water spinach regularly, observe leaves closely in the Learning Resource Center, and discuss in class what they have observed. In such cases, where each activity follows another, children can link their learning and do not treat them as separate. Research conducted in preschool gardens has shown that comparing and discussing changes in plants (Vandermaas-Peeler & McClain, 2015), is essential for sustaining learning processes.

The study results imply that quality development could begin with activities that are already successful. The effectiveness of such a strategy can be improved through the following measures: forming guiding questions for each activity, defining concepts within everyday routines, and writing down children's activities systematically, beyond the notes and portfolios teachers already keep, so that they can be reflected on later. The study shows that "green school" programs for young children should be considered not only as character education that leads to environmental awareness but also as an opportunity to introduce life science concepts.

Such programs are effective mainly due to the teachers' assistance. This study is limited by the use of data from one institution and a small number of participants. Children's understanding was not evaluated by the researchers, the teachers' assessments reported in Sections 1.1 and 1.3 are the teachers' own records. Thus, the results are context-bound and do not fully reveal children's understanding. Future research could focus on several institutions or on the role of more "trigger questions" for children's comprehension of life science concepts.

Conclusion

Green School activities in TK Islam Al Azhar 13 East Jakarta enable the teacher to present life science to students who are 5-6 years old. The students take part in activities

in the green area of the school from Monday to Wednesday and in activities at the Learning Resource Center on Thursdays.

At the green area, the teachers facilitate the following activities: planting and measuring water spinach, watering the plants, feeding the fish, and dealing with waste. They develop good habits, model good behavior, and question the students to stimulate curiosity. At the Learning Resource Center, the teachers facilitate leaf observation activities using microscopes and storytelling activities using storybooks with the children. The microscopes allow children to observe what cannot be seen with the naked eye while the storybooks allow children to verbalize what they see. These activities are designed to introduce concepts of growth, the requirements of plants and fish, and the cleanliness of the environment, although children's actual learning outcomes were not assessed in this study. Plants, fish, and leaves are used as concrete material while microscopes and storybooks are used as supplementary materials.

Teachers are recommended to formulate and pose inquiry-based questions regularly; make the key concepts and values for each activity clear; and assist the children in connecting their learning across Green School, the Learning Resource Center, and the classroom. Inquiry-based questions and goals need to be included in the lesson plans. It is recommended that the school provide the training and guidelines that incorporate all three areas and additional life science resources for young children. Future research may focus on how these changes impact the children's learning about life science.

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