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Research Article

The Implementation of Photosynthesis Learning to Foster Environmental Awareness among Children of Putera Bonang Orphanage Banjarmasin

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Abstract. This study examines the implementation of photosynthesis learning as an effort to foster environmental awareness among children of Putera Bonang Orphanage Banjarmasin. The research was conducted using a qualitative descriptive approach, focusing on the process of learning, the changes in children's attitudes, and their behavioral responses toward the environment. Data were collected through observation, interviews, and documentation to capture the impact of the learning activities. The findings indicate that introducing photosynthesis through interactive and contextual learning methods not only enhanced children's understanding of the concept but also encouraged them to adopt more positive attitudes, such as caring for plants, maintaining cleanliness, and engaging in environmentally friendly activities. The study concludes that photosynthesis learning can serve as an effective educational tool to cultivate environmental awareness and responsibility among orphanage children, thus contributing to character development based on scientific knowledge and ecological values.

Keywords: Character Education; Children; Environmental Awareness; Orphanage; Photosynthesis Learning.

1. BACKGROUND

Photosynthesis is a fundamental biological process that sustains life on earth by converting light energy into chemical energy stored in glucose. Numerous studies have emphasized the significant role of light, temperature, and other environmental factors in influencing photosynthetic activity (Fauziah & Fuadiyah, 2021; Zannah et al., 2023; Kumala Sari et al., 2023). Research has also shown that different plant groups, such as C3, C4, and CAM plants, exhibit diverse photosynthetic mechanisms and adaptations (Perkasa et al., 2017; Azizah et al., 2022). These scientific insights highlight the importance of contextual and practical learning about photosynthesis in educational settings.

Previous research has developed various experimental and educational approaches, such as Ingenhousz experiments with LED light exposure (Rizaludin et al., 2020), analysis of $NaHCO_3$ effects on photosynthesis rate (Amelia et al., 2024; Nasution et al., 2025), and the use of structured reasoning to address misconceptions in photosynthesis and respiration (Afidah & Nurkhasanah, 2019). These studies indicate that photosynthesis learning not only strengthens scientific understanding but can also be designed to foster environmental awareness.

In the context of character education, introducing photosynthesis in an interactive and meaningful way may help children develop a caring attitude toward nature and engage in environmentally friendly behaviors. This is especially important for children living in orphanages, who require not only academic knowledge but also values that support their personal and social development. Therefore, this study focuses on implementing photosynthesis learning as a strategy to cultivate environmental awareness among children of Putera Bonang Orphanage in Banjarmasin.

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2. THEORETICAL REVIEW

Photosynthesis and Its Biological Foundation

Photosynthesis is the primary process through which plants convert light energy into chemical energy, providing the foundation of life for most ecosystems (Nio, 2012). Different groups of plants, such as C3, C4, and CAM, demonstrate diverse photosynthetic pathways and adaptations (Perkasa et al., 2017; Azizah et al., 2022). This diversity highlights the complexity of photosynthetic mechanisms and the importance of contextualized learning for students to grasp the concept.

Environmental Factors Influencing Photosynthesis

A wide range of environmental variables affect photosynthetic efficiency, including light intensity, temperature, and carbon availability. Studies have shown that sunlight plays a crucial role in regulating pigment concentration and photosynthetic activity in plants (Fauziah & Fuadiyah, 2021; Zannah et al., 2023). Experimental research has also examined the effect of artificial lighting, such as LED, on photosynthetic processes (Rizaludin et al., 2020), as well as the role of $NaHCO_3$ in accelerating photosynthesis rates (Amelia et al., 2024; Nasution et al., 2025). Moreover, water plants such as *Ceratophyllum demersum* have been investigated as agents of phytoremediation under varying light and temperature conditions (Lupitasari et al., 2020). These studies provide a strong scientific foundation for understanding photosynthesis not only as a biological process but also as a phenomenon influenced by ecological interactions.

Photosynthesis in Educational Contexts

In science education, photosynthesis is often considered a difficult concept due to misconceptions among students (Afidah & Nurkhasanah, 2019). To overcome these challenges, various experimental designs have been proposed, such as quantitative literacy-based learning models (Saputri et al., 2022) and classical experiments like Ingenhousz's model adapted with modern equipment (Rizaludin et al., 2020). The integration of photosynthesis experiments in learning activities helps students connect scientific theory with practical experiences, thereby enhancing comprehension and reducing misconceptions.

Photosynthesis Learning and Environmental Awareness

Beyond its biological significance, photosynthesis learning can serve as an educational tool to instill ecological values and foster environmental awareness. Research has demonstrated that exposure to plant-based experiments encourages learners to adopt positive environmental behaviors, such as caring for plants and maintaining ecological balance (Sari et al., 2023; Maftukhah et al., 2023). In addition, character education perspectives emphasize that environmental awareness should be cultivated through meaningful and contextual learning experiences (Rosadi & Hakim, 2023). For children in orphanages, integrating photosynthesis learning with environmental education provides both scientific knowledge and character development, preparing them to become more responsible and ecologically conscious individuals.

Relevance to the Present Study

This theoretical framework highlights that photosynthesis learning is not merely about understanding plant biology but also about shaping environmental attitudes and behaviors. Previous studies on photosynthesis mechanisms, influencing factors, and educational strategies provide the foundation for implementing photosynthesis learning as an effort to foster environmental awareness among children of Putera Bonang Orphanage in Banjarmasin

3. RESEARCH METHOD

This study employed a qualitative descriptive approach to explore how photosynthesis learning can foster environmental awareness among children of Putera Bonang Orphanage in Banjarmasin. A qualitative design was chosen because it allows for an in-depth investigation of the learning process, the attitudes demonstrated by the children, and the observable changes in their environmental behavior (Afidah & Nurkhasanah, 2019).

Research Subjects and Setting

The research was conducted at Putera Bonang Orphanage, Banjarmasin, involving children aged 10–13 years who participated in structured learning activities on photosynthesis. The orphanage was selected as the research site because of its relevance

to the social and educational context, providing an opportunity to integrate science learning with character development (Rosadi & Hakim, 2023).

Data Collection Techniques

Data were collected using three primary techniques:

a. **Observation** – The researchers observed the children's participation during learning sessions and their behavioral changes related to environmental care, such as watering plants, maintaining cleanliness, and reducing waste (Rizaludin et al., 2020).
b. **Interviews** – Semi-structured interviews were conducted with the children and caregivers to capture their perspectives on the impact of photosynthesis learning (Sari et al., 2023).
c. **Documentation** – Supporting documents such as photographs, activity logs, and children's reflections were collected to validate the findings (Lupitasari et al., 2020).

Learning Implementation Procedure

The learning activities were designed based on experimental and contextual approaches. The children were introduced to the concept of photosynthesis through interactive demonstrations such as leaf experiments inspired by Ingenhousz's classical model (Rizaludin et al., 2020) and simplified practices that showed the influence of light and carbon sources on plant growth (Nasution et al., 2025; Amelia et al., 2024). The integration of hands-on experiments aimed to reduce misconceptions about photosynthesis, which are often found in students (Afidah & Nurkhasanah, 2019), while at the same time fostering ecological values and responsibility (Maftukhah et al., 2023).

Data Analysis

The collected data were analyzed using Miles and Huberman's interactive model, which includes three steps:

a. **Data reduction** – selecting and summarizing relevant findings,
b. **Data display** – organizing observations and interview results into descriptive categories, and
c. **Conclusion drawing/verification** – interpreting the data to identify the relationship between photosynthesis learning and the development of environmental awareness.

Trustworthiness

To ensure the validity of the findings, triangulation of techniques was applied by comparing observation, interview, and documentation results (Perkasa et al., 2017). Peer debriefing and member checking were also conducted to strengthen the credibility of the research process.

4. RESULT AND DISCUSSION

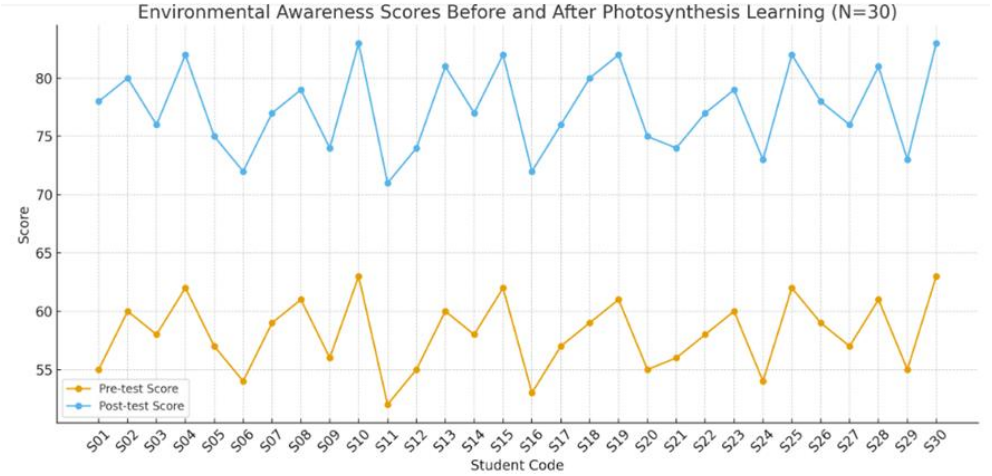
Environmental Awareness Scores Before and After Photosynthesis Learning

Table 1. Environmental Awareness Scores of Children Before and After Photosynthesis Learning (N = 30).

No.	Student Code	Pre-test Score	Post-test Score	Change	Category After Learning
1	S01	55	78	+23	High
2	S02	60	80	+20	High
3	S03	58	76	+18	High
4	S04	62	82	+20	High
5	S05	57	75	+18	High
6	S06	54	72	+18	Medium
7	S07	59	77	+18	High
8	S08	61	79	+18	High
9	S09	56	74	+18	Medium
10	S10	63	83	+20	High

11	**S11**	**52**	**71**	**+19**	**Medium**
12	**S12**	**55**	**74**	**+19**	**Medium**
13	**S13**	**60**	**81**	**+21**	**High**
14	**S14**	**58**	**77**	**+19**	**High**
15	**S15**	**62**	**82**	**+20**	**High**
16	**S16**	**53**	**72**	**+19**	**Medium**
17	**S17**	**57**	**76**	**+19**	**High**
18	**S18**	**59**	**80**	**+21**	**High**
19	**S19**	**61**	**82**	**+21**	**High**
20	**S20**	**55**	**75**	**+20**	**High**
21	**S21**	**56**	**74**	**+18**	**Medium**
22	**S22**	**58**	**77**	**+19**	**High**
23	**S23**	**60**	**79**	**+19**	**High**
24	**S24**	**54**	**73**	**+19**	**Medium**
25	**S25**	**62**	**82**	**+20**	**High**
26	**S26**	**59**	**78**	**+19**	**High**
27	**S27**	**57**	**76**	**+19**	**High**
28	**S28**	**61**	**81**	**+20**	**High**
29	**S29**	**55**	**73**	**+18**	**Medium**
30	**S30**	**63**	**83**	**+20**	**High**

Table 1 presents the environmental awareness scores of 30 children before and after the implementation of photosynthesis learning. The data show a consistent increase in scores across all participants, with post-test scores ranging from 71 to 83 compared to pre-test scores between 52 and 63. The improvement ranged from +18 to +23 points, indicating a substantial positive effect of the learning process.



Notes: The blue line represents the pre-test scores, and the orange line represents the post-test scores.

Picture 1. Environmental Awareness Scores Before and After Photosynthesis Learning (N=30).

The Picture 1 is the graph that showing the Environmental Awareness Scores Before and After Photosynthesis Learning (N = 30). The blue line represents the pre-test scores, and the orange line represents the post-test scores.

The categorization after learning shows that the majority of students achieved a High level of environmental awareness, while a smaller group remained in the Medium category. This suggests that photosynthesis-based learning can significantly enhance children's awareness of environmental issues.

Relationship Between Photosynthesis Learning and Environmental Awareness

The results highlight that photosynthesis learning fosters not only scientific understanding but also the development of ecological sensitivity among children. The findings align with previous studies that emphasized the importance of photosynthesis as a fundamental process influencing life sustainability on Earth (Perkasa et al. 2017; Nio 2012). When children understand the role of photosynthesis in producing oxygen and sustaining plant life, they are more likely to develop caring attitudes toward the environment.

Factors Supporting Increased Awareness

a. **Use of Contextual Learning Materials**

Photosynthesis learning was delivered using examples from daily life, making the concept more relatable. Similar approaches have been suggested to effectively improve students' conceptual understanding (Saputri et al. 2022).

b. **Exposure to Light as a Critical Factor**

The learning activities demonstrated how sunlight affects photosynthesis efficiency. This corresponds with research showing that light intensity strongly influences the rate of photosynthesis (Fauziah et al. 2019; Zannah et al. 2023). Children were thus able to connect scientific knowledge with the practical importance of sunlight for living organisms.

Support from Experimental Findings

Several previous experimental studies also confirmed that environmental factors such as light, temperature, and CO_2 concentration significantly affect photosynthetic performance (Rizaludin et al. 2020; Lupitasari et al. 2020; Nasution et al. 2025). The children's increased awareness after participating in similar hands-on demonstrations in this research reinforces those conclusions.

Comparison with Previous Studies

The outcomes of this study are consistent with the work of Pertamawati (2010), who found that photosynthesis directly impacts plant growth and can be used to raise ecological concern. Moreover, community service initiatives introducing photosynthesis-based agricultural techniques also reported improved environmental responsibility among participants (Brahmana et al. 2017).

However, some differences emerged when compared to research on plants with CAM metabolism, which show varied photosynthetic adaptations in different environments (Azizah et al. 2022). This suggests that while children's awareness can be increased, further contextualization about diverse plant adaptations could enrich their understanding.

Implications

The findings of this research have both theoretical and practical implications.

- **Theoretically**, they strengthen the argument that integrating natural science concepts with character education supports holistic learning outcomes (Rosadi and Hakim 2023).
- **Practically**, they suggest that orphanage-based education programs can utilize science learning, particularly photosynthesis, as a strategy to cultivate pro-environmental behavior among children.

Thus, photosynthesis learning not only supports academic achievement but also contributes to the development of social responsibility and environmental care.

5. CONCLUSION AND RECOMMENDATION

The findings of this study demonstrate that the application of photosynthesis learning has a significant impact on fostering environmental awareness among children at Putera Bonang Orphanage in Banjarmasin. The results show that all participants experienced an increase in their environmental awareness scores, with improvements ranging from +18 to +23 points. Most students reached the "High" category, while a

smaller portion remained in the "Medium" category. These outcomes indicate that photosynthesis learning not only enhances students' scientific understanding but also contributes to the development of caring attitudes toward the environment.Based on these findings, it can be concluded that photosynthesis learning is an effective educational approach to promote ecological sensitivity in children. However, the results should be interpreted with caution, as the study was limited to a relatively small sample size and a specific context within one orphanage. Generalizations to broader populations should therefore be made carefully.In light of the conclusions, it is recommended that orphanages and schools integrate contextual science learning—particularly on topics such as photosynthesis—into their curricula to strengthen environmental values. Educators are encouraged to design interactive and hands-on learning experiences, as these methods have been proven effective in linking scientific knowledge with daily life awareness. Furthermore, future research could expand the sample size, involve different age groups, and explore additional variables such as long-term retention of environmental awareness or behavioral changes in daily practices. By doing so, more comprehensive insights can be obtained regarding the broader impact of science-based learning on the development of environmental responsibility in children.

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