



Integrating Environmental Education into Science Learning to Foster Environmental Awareness: A Case Study of An Adiwiyata Madrasah Ibtidaiyah

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ABSTRACT

This study examines the integration of Environmental Education in Natural Science learning at Madrasah Ibtidaiyah Assunniyyah 45 Paseban, an Adiwiyata-certified Islamic primary school in Jember, East Java, Indonesia. Employing a qualitative case study approach, data were collected through semi-structured interviews with the school principal, science teachers, and the Adiwiyata coordinator, supplemented by classroom observations and document analysis. The study reveals three main findings, encompassing the integration of environmental education in science learning, the role of teachers in integrating environmental education into science instruction, and the enabling and inhibiting factors that shape the integration process. The findings demonstrate that the Adiwiyata school environment functions as a living laboratory that transforms abstract ecological concepts into concrete, value-laden learning experiences. These findings provide empirical evidence regarding the integration of environmental education in Islamic primary education, a context that remains largely absent from the existing international literature.

Keywords: *environmental education, natural science learning, environmental awareness, adiwiyata, madrasah ibtidaiyah*

Submitted	Accepted	Published
02 March 2026	10 April 2026	30 May 2026

Citation	:	Kholidiyah, W.S., & Balqis, R.R. (2026). Integrating Environmental Education Into Science Learning to Foster Environmental Awareness: A Case Study of An Adiwiyata Madrasah Ibtidaiyah. <i>Jurnal PAJAR (Pendidikan dan Pengajaran)</i> , 10(3), 302-310. DOI: http://dx.doi.org/10.33578/pjr.v10i3.1469 .
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INTRODUCTION

A meta-analysis of 169 empirical studies from 43 countries with 176,007 participants shows that Environmental Education (EE) consistently and significantly improves children's and adolescents' environmental understanding and pro-environmental attitudes, making it the most effective evidence-based intervention for increasing environmental awareness from an early age (Wetering et al., 2022). The natural disasters that have recently struck various regions from Aceh to West Sumatra are a real consequence of land degradation and uncontrolled use of the river upstream areas. This situation serves as a stark reminder of the importance of building an environmentally conscious character in the younger generation as a long-term preventive measure (Sumatera, 2026). This fact shows that theory alone is not enough in learning. What is most needed today is a contextual approach that genuinely embeds environmental ethics into daily learning activities across every subject taught.

According to Braus & Wood, as cited in Environmental Education (EE) emphasizes a learning process aimed at developing public awareness, knowledge, skills, and commitment to solving environmental problems and preventing new ones from arising. In the context of learning, this approach encourages active participation and the adoption of environmentally friendly behavior. Experts assert that Environmental Education (EE) consists of three closely interrelated dimensions. First, the cognitive dimension, namely an understanding of ecosystems, the impacts of environmental degradation, and science-based solutions. Second, the affective dimension, namely attitudes of empathy, responsibility towards the environment, as well as empathy towards various aspects of daily life. Third, the conative dimension, namely, behaviors that actively support the environment in everyday activities (Halidah, 2018). These three dimensions are relevant to (Lickona's (2022) character education framework, namely moral knowing, moral feeling, and moral action,

which serves as the analytical foundation for this research. Confirmed by research on a school certification program for girls in Chile: students in schools with more advanced environmental education (EE) integration show measurable pro-environmental behavior changes and significantly stronger sustainable consumption habits (Salazar et al., 2024). Environmental Education (EE) is integrated into national policy through the Adiwiyata Program. This program requires schools to meet four criteria: environment-oriented policy, environment-based curriculum implementation, participatory-based environmental activities, and management of eco-friendly supporting facilities (Jayanti & Sholihah, 2024).

Theoretically, the integration of Environmental Education (EE) in science learning can be understood through two complementary pedagogical frameworks. First, the Contextual Teaching and Learning (CTL) framework (Johnson, 2007), which asserts that meaningful learning occurs when students can relate academic lessons to real life, making the Adiwiyata school environment not just a physical setting but a primary learning resource that makes Science concepts concrete. Second, Experiential Learning theory (Kolb, 1984), which explains why EE (Environmental Education) values are internalized through a cycle of concrete experience, reflection, conceptualization, and active experimentation, is more effectively formed through direct activities such as planting trees, managing waste, and observing ecosystems. The synthesis of these two frameworks is empirically confirmed: A systematic review of 111 articles on Environmental Education (EE) teaching practices (2015–2024) found that hands-on and experiential pedagogy are the most consistent approaches for improving environmental literacy in schools (Zhang et al., 2025). Meanwhile, a review on outdoor learning confirms that direct interaction with nature significantly enhances nature connectedness and pro-environmental attitudes of primary school students in the long term (Hu & Mou, 2025).

Given that science learning is fundamentally linked to natural phenomena and local ecosystems, it is consistently viewed as the most strategic subject for integrating Environmental Education (EE) (Santika et al., 2022). A survey of Indonesian elementary school teachers confirms this: teachers can integrate Environmental Education (PLH) into the learning process, with Science (93%) being identified as the most appropriate subject for instilling environmental themes (Sukma et al., 2020). In this context, teachers do not merely teach; rather, they play an active role in the success of the Adiwiyata program. They hold three main roles: designing contextual learning, facilitating students in environmental action activities, and serving as role models (*Uswah Hasanah*) in shaping an environmentally conscious character grounded in Islamic values. The term *uswah hasanah* here signifies an educational approach based on setting a positive example for students, manifested in both words and deeds (Wahidi & Syahidin, 2024). (Xiong et al., 2025) It emphasizes that the teacher's role as an environmental facilitator and role model is crucial, yet remains the most under-researched aspect of Environmental Education (EE) effectiveness in the classroom.

The Adiwiyata program is a strategic government instrument that significantly shapes students' environmental care attitudes through curriculum integration and school-based habituation programs (Adawiah & Anggraini, 2023). In the context of *Madrasah Ibtidaiyah*, this cultural dimension possesses a unique characteristic as Islamic environmental ethics frames it: the concept of *khalifah fi al-ardh* (QS. Al-Baqarah: 30) transforms environmental conservation into a spiritual obligation (*ibadah*) rather than a mere ecological duty; the prohibition of *la tufsidu fil ardh* (QS. Al-Baqarah: 11) provides a normative foundation for anti-destruction character; and the concept of *mizan* (natural balance) reinforces the learning of ecosystems within Science subjects (Farabi et al., 2025). Although Islamic environmental ethics have been thoroughly examined from a theological perspective, there is a lack of empirical evidence concerning their operationalization in daily Science instruction at Adiwiyata-certified Islamic Elementary Schools.

Previous studies on Environmental Education (EE) and the Adiwiyata program in Indonesia, such as the research conducted by (Hasibuan & Sapri, 2023) indicate that integrated Science learning in Islamic Elementary Schools effectively fosters students' sense of responsibility toward their environment, (Najla et al., 2025) that a green curriculum can enhance students' environmental awareness, as well as (Jayanti & Sholihah, 2024) that the Adiwiyata program effectively instills environmental concern in Islamic Elementary

Schools. Nevertheless, gaps remain in the existing research. First, most studies examine the Adiwiyata program only at the institutional level without exploring how the pedagogical process unfolds in the classroom (Zhang et al., 2025); . Second, research at the elementary school level remains very scarce in the environmental education literature, which is dominated by the junior and senior high school levels (Naila, 2026). Third, the context of Madrasah Ibtidaiyah, grounded in religious values, as examined in this study, has rarely been investigated.

This research directly addresses all three gaps by examining how Environmental Education is integrated into Science learning at Madrasah Ibtidaiyah Assunniyyah 45 Paseban. The objectives of this research are: to identify the pedagogical forms of Environmental Education integration in Science learning, to analyze the role of teachers in integrating Environmental Education, and to identify the supporting and inhibiting factors in the integration process. This research contributes theoretically by expanding the framework of Environmental Education integration in Adiwiyata Madrasah Ibtidaiyah within an Islamic educational context.

METHOD

This study employs a qualitative approach with a case study design to explore in depth the integration of Environmental Education in Science learning at an Adiwiyata Madrasah Ibtidaiyah. The qualitative approach was chosen to understand the processes, meanings, and social dynamics that occur naturally in the field (Rabani et al., 2025). The case study design was selected because this research focuses on a single institution with unique characteristics, an Adiwiyata Madrasah Ibtidaiyah grounded in Islamic values requiring in-depth and contextual exploration (Nuzulia & Suardi, 2025). The study was conducted at Madrasah Ibtidaiyah Assunniyyah 45 Paseban, Kencong District, Jember Regency, East Java, from early January to mid-February 2026. This school was selected because it has integrated environmental education into all subjects, and the material taught is relevant to environmental education, including Natural Science. The research subjects consisted of three informants: the school principal, a subject teacher, and the Adiwiyata coordinator, selected through purposive sampling based on their direct and relevant knowledge of the research focus.

Data collection in this study included observation, semi-structured interviews, and documentation. Observations were conducted directly from the time students arrived at the school until they left, in order to obtain a clear picture of how the school realizes an environmentally cultured Adiwiyata school and how the pedagogical process unfolds during learning, approximately one week prior to the formal study period. Semi-structured interviews were conducted with the subject teacher, school principal, and Adiwiyata coordinator to gather in-depth information regarding Science teaching practices integrated with environmental education and the teacher's role in facilitating students' understanding of the environment. Documentation collected included photographs of morning habituation activities, classroom learning activities, teaching modules used, working-group documents, and other relevant documents.

Data analysis used the Miles & Huberman interactive model (Miles et al., 1992), comprising three stages: data reduction, data display, and conclusion drawing. During the data reduction stage, the researcher selected information relevant to the research focus. The data display stage was structured by describing three main research focuses: the forms of Environmental Education integration in Science learning, the teacher's role, and supporting and inhibiting factors. To ensure data validity, this study employed source triangulation by comparing data from the three informants (school principal, Science teacher, and Adiwiyata coordinator), and technique triangulation by comparing data obtained through interviews, observation, and documentation of the same phenomena (Nuzulia & Suardi, 2025).

RESULTS AND DISCUSSION

Integration of Environmental Education in Science Learning

The integration of environmental education at MI Assunniyyah 45 Paseban is conditional in nature. During an interview with the Adiwiyata coordinator, it was explained that all subjects are integrated with environmental education, including science, as long as the topics studied are aligned. The subject teacher also noted that not all topics can be linked to environmental education. Within the environmentally cultured Adiwiyata program, teachers must first identify the topics to be taught and should not force environmental education into every learning topic. An analysis of the teaching modules integrated with Environmental Education identified 14 Science topics that are well-aligned.



Figure 1. Compost Fertilizer Making from Rice Washing Water and Dry Leaves

In facilitating environmental awareness, the teacher uses the school grounds as a natural laboratory—for example, a project-based learning activity on making liquid compost fertilizer from rice washing water and dry leaves, focused on the topic of decomposition. This session lasted

approximately 60 minutes. In addition, observations revealed that all teachers consistently conduct a classroom cleanliness check before the lesson begins. This is a form of commitment to the Adiwiyata program aimed at building students' empathy toward the environment.

The approach implemented at MI Assunniyyah is consistent with the CTL theoretical framework (Johnson, 2007), which states that learning must be connected to students' real environment, linking learning topics to the context of daily life so that students can apply what they learn outside the school environment. The school environment in this study functions not merely as a physical backdrop, but as an active pedagogical resource, a living laboratory that transforms abstract scientific concepts into concrete environmental experiences. (Kosta et al., 2022) found that students with prior experience in environmental education programs tend to feel more connected to nature and retain acquired knowledge better than other students. This is reinforced by (Sawitri et al., 2024) who found that integrating Science and environmental learning can improve students' conceptual understanding and pro-environmental attitudes. Research by (Tanubrata et al., 2024) also confirms that a pro-environmental school culture increases students' awareness of environmental issues. The findings of (Budiono et al., 2024) show that the validity and practicality of an environmental education learning module using the Discovery Learning model for school students yielded an average validity score of 4.47 (very valid) and an average practicality score of 4.81 (very practical). These findings confirm that integrating environmental education into elementary school learning can be effectively carried out through the development of structured, active-learning-based teaching materials with the potential to cultivate environmental awareness in students from an early age.

The Role of the Teacher in Integrating Environmental Education

As curriculum planners, teachers integrate Environmental Education values into teaching modules before learning begins. The Adiwiyata coordinator stated that teachers must have knowledge of current environmental issues in real life, which are then linked to the Adiwiyata learning modules. As facilitators of experience, teachers also design direct interactions between students and the surrounding natural environment. The subject teacher noted that adapting Science topics to a real environmental context requires creativity so that students can apply what they learn in daily life. As moral role models, the school principal stated that the Adiwiyata program is carried out voluntarily, everything is implemented collectively, and all members of the school community must be involved in the Adiwiyata development process in order to create students who have a caring attitude toward the environment and a character-based culture.

The three teacher roles identified in this study expand on the findings of (Rismayanti, 2022) and (Dwijaya & Rigianti, 2024), which found that teachers who actively plan and implement Environmental Education also increase students' environmental awareness—indicating that the planner and implementer roles are mutually reinforcing. Most distinctive in this study is the concept of Uswah Hasanah within the Islamic madrasah context, where the teacher as khalifah fi al-ardh embodies environmental stewardship as a spiritual obligation. (Adawiah & Anggraini, 2023) confirms that the Adiwiyata program significantly shapes students' pro-environmental attitudes through curriculum integration and school-based habituation programs. This research demonstrates that program effectiveness is further reinforced in an Islamic school context because both the program and Islamic principles simultaneously mandate environmental conservation.

These findings extend the research of (Hidayah et al., 2026) which found that students demonstrate significant environmental awareness, as evidenced by their proactive efforts to maintain

cleanliness and ecological balance in the school environment. Both studies indicate that formal learning, when grounded in a coherent institutional environmental culture, is an effective vehicle for developing environmental awareness in Indonesian students. In the context of Madrasah Ibtidaiyah, environmental awareness is constructed not only ecologically but also spiritually.

Supporting and Inhibiting Factors

Supporting factors include the participatory and voluntary leadership of the school principal in Adiwiyata development, the consistent environmental culture of the school, Adiwiyata environmental facilities, and the commitment of teachers to integrating learning that is relevant to the environmental context. Meanwhile, inhibiting factors include limited learning time for integrating Environmental Education, the relevance of Science topics, the availability of natural objects that depend on the season and environment, and varying levels of student enthusiasm and conceptual understanding.

The participatory leadership style of the school principal in routine environmental care habituation activities reflects a commitment to the Adiwiyata program. The principal does not merely supervise and delegate to a single teacher, but is directly involved. (Karaköse et al., 2023) asserts that school principals occupy a highly strategic position in driving change and progress at school, including in implementing justice- and sustainability-based programs. In the context of environmental education, the principal's support and commitment are determining factors in creating an environmentally conscious school culture, encouraging teachers to integrate environmental issues into learning, and facilitating the provision of resources needed to support environment-based learning. The barriers identified are consistent with challenges noted in the international literature on Environmental Education integration (Zhang et al., 2025) dan (Hu & Mou, 2025), pointing to areas requiring systemic support, particularly curriculum flexibility and time allocation for teacher professional development.

CONCLUSIONS AND RECOMMENDATION

This study demonstrates that the integration of Environmental Education in Science learning at an Adiwiyata Madrasah Ibtidaiyah is a structured and multidimensional process, shaped by pedagogical design, teacher roles, institutional culture, and Islamic environmental ethics. Three main conclusions can be drawn. First, effective Environmental Education integration requires a staged pedagogical approach: selective topic identification, experiential learning methods, and institutionalized environmental habituation routines all operationalized through the CTL and experiential learning frameworks. Second, Science teachers occupy three mutually reinforcing roles: curriculum planner, experience facilitator, and moral role model (Uswah Hasanah), with the third role holding particular theoretical significance in the Islamic educational context, as it embeds environmental stewardship within a framework of spiritual obligation. Third, the institutional infrastructure of the Adiwiyata program is a necessary enabling condition. However, its effectiveness is further strengthened when combined with Islamic ethical principles of *khalifah fi al-ardh* and *mizan*, which transform environmental awareness from an academic objective into a spiritual responsibility.

For schools and educational institutions, these findings recommend embedding Environmental Education values not only in the formal curriculum, but also in daily institutional routines and leadership practices. For Science teachers, this study highlights the importance of designing Environmental Education integration selectively and intentionally based on content relevance, rather than applying it uniformly to all topics. Future research should employ multi-site designs or mixed methods to examine the causal relationships between Environmental Education integration practices and measurable environmental awareness outcomes across various Indonesian school contexts.

Limitation

This study is limited to a single Madrasah Ibtidaiyah in Jember Regency, which constrains direct generalization to other contexts. The research period of approximately six weeks also limits observation of long-term behavioral outcomes. Future research should address these limitations through multi-site comparative designs and longitudinal follow-up assessments.

Credit authorship contribution statement

First Author: Original draft writing, Methodology, Conceptualization, Observation, Visualization, and Investigation. Second Author: Supervision and Validation.

Declaration of competing interest

The authors declare no conflict of interest in the research, writing, or publication of this article.

Ethical Declaration

All informants participated voluntarily with informed consent. The confidentiality of their identities was maintained throughout the research in accordance with the ethical guidelines of Universitas Al-Falah As-Sunniah Jember.

Acknowledgment

The authors express their gratitude to the school principal, Science teacher, and Adiwiyata coordinator of MI Assunniyyah 45 Paseban for their participation and openness throughout the research, as well as to Universitas Al-Falah As-Sunniah Jember for their academic support.

Generative AI Statement

The authors confirm that generative AI tools were used solely for language editing and proofreading purposes during the manuscript revision process. No AI tools were used to generate research data, analysis, conclusions, or any substantive academic content.

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