

Evaluating an Environment-Based Learning Model Oriented Towards ESD to Foster Environmental Care Character in Madrasah Ibtidaiyah Students

Ning Mukaromah^{1*}, Suadi², and Wafaa Maso³

^{1,2}Sekolah Tinggi Agama Islam Salahuddin (STAIS) Pasuruan, Indonesia

³Sekolah Dasar Tobala, M.5 Kadunung, Saiburi, Pattani, Thailand

^{1*}Corresponding author: mukaromahning17@gmail.com

²Email: suadi@staispasuruan.ac.id, ³Email: teacher.wafaa0911@gmail.com

Received: December 03, 2024

Revised: February 23, 2025

Accepted: April 01, 2025

Available online: April 26, 2025

To cite this article: Mukaromah, N., Suadi, & Maso, W. (2025). Evaluating an Environment-Based Learning Model Oriented Towards ESD to Foster Environmental Care Character in Madrasah Ibtidaiyah Students. *Bidayatuna: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, 2(1), 61–78.

Abstract

Environmental education is pivotal in shaping sustainable character among students, particularly within ecologically vulnerable regions. This study investigates the implementation of an environment-based learning model structured through the 4D framework—Discover, Deepen, Develop, and Demonstrate—to foster environmental care character among students at a coastal Islamic elementary school in Pasuruan, Indonesia. Employing a qualitative case study design, data were collected through semi-structured interviews, classroom observations, document analysis, and a supporting questionnaire involving three teachers, one curriculum coordinator, and thirty Grade 5 students. Data analysis was conducted manually using Miles and Huberman's interactive model, enabling in-depth thematic exploration aligned with the 4D learning stages. The findings demonstrate that the sequential application of the 4D model significantly enhanced students' environmental awareness, moral reflection, responsibility, and action orientation. Contextual, hands-on activities such as tree planting, waste management projects, and thematic discussions anchored in Islamic ethical values contributed to the profound internalization of sustainability principles. Pedagogical alignment between planning, implementation, and assessment further reinforced the model's transformative impact. This study concludes that environment-based learning through a structured 4D framework offers an effective pathway for character development in Islamic education and provides practical insights for curriculum innovation in ecologically sensitive educational settings.

Keywords: *Environmental Character, Environment-based Learning, Coastal Islamic Education, Character in Madrasah Ibtidaiyah.*

1. Introduction

Environmental degradation continues to escalate in severity, with ecological imbalances threatening biodiversity, human settlements, and long-term planetary health. This growing crisis highlights the urgency for education systems to go beyond conventional instruction and integrate sustainable values into foundational learning (Homer-Dixon et al., 2011; Zhao et al., 2024). (Raman et al., 2024; Wang et al., 2022). Accordingly, fostering environmental care character in students becomes a vital step toward nurturing future generations capable of addressing



environmental issues ethically and sustainably (Dsouza & Padmanabha, 2024; Feinberg & Willer, 2013).

While numerous studies affirm the value of Education for Sustainable Development (ESD) in raising students' environmental awareness (Agbedahin, 2019; Kopnina & Meijers, 2014; Oe et al., 2022; Sihombing et al., 2024) There remains a notable gap in how these initiatives translate into measurable character transformation. Prior research largely emphasizes policy adaptation, school infrastructure, and awareness programs without fully engaging students' emotional and moral development (Sahin, 2018). (Agbedahin, 2019; Datnow et al., 2022; Kopnina, 2014; Zhao et al., 2024). Moreover, many pedagogical models overlook the socio-cultural context in which education takes place, weakening their long-term impact and relevance (Adam et al., 2004; Mergler & Hoyer, 1977; Yilmaz & Temizkan, 2022). Thus, a need emerges for learning approaches that are not only sustainability-oriented but also rooted in values-based character education.

This growing crisis highlights the urgency for education systems to go beyond conventional instruction and integrate sustainable values into foundational learning (Homer-Dixon et al., 2011; Raman et al., 2024; Wang et al., 2022; Zhao et al., 2024). Accordingly, fostering environmental care character in students becomes a vital step toward nurturing future generations capable of addressing environmental issues ethically and sustainably (Dsouza & Padmanabha, 2024; Feinberg & Willer, 2013). In response, this study investigates how an environment-based learning model oriented toward ESD can be structured to promote environmental care character in elementary school students. Central to this inquiry is the concern that while ESD goals have been integrated into curricula globally, their actual implementation in early character formation, especially among primary-level students, remains inconsistent and underdeveloped (Bryan & Bracken, 2011; DeLuca & Hughes, 2014; Huang et al., 2024; Zein, 2019; Zguir et al., 2022). The study seeks to explore pedagogical pathways that align sustainability knowledge with emotional engagement, ethical reasoning, and daily environmental actions.

Such integration is not merely about infusing environmental facts into textbooks, but about providing students with experiential learning that invites personal reflection and relational understanding (Beard, 2010; Chan, 2022; Holdo, 2023; Roberts, 2015). Studies demonstrate how place-based and nature-integrated learning fosters ecological empathy, a precursor to character-driven action (Herman et al., 2020; McEvoy et al., 2024; van der Jagt et al., 2020). Furthermore, when educational experiences are designed to activate emotional, cognitive, and ethical dimensions simultaneously, they become powerful catalysts for internalizing sustainability values (Akrivou & Bradbury-Huang, 2015; McEvoy et al., 2024).

The domain of Education for Sustainable Development (ESD) emphasizes the shift from content-based environmental education toward holistic character formation. In recent years, scholars have increasingly argued that ESD must move beyond imparting cognitive knowledge toward fostering affective and behavioural change (Mochizuki & Bryan, 2015; Sipos et al., 2008). The emphasis on transformative learning experiences, where students internalize values, attitudes, and ethical principles of sustainability, has become a central concern (Clifford & Montgomery, 2015; Cottafava et al., 2019; Sterling et al., 2011; Stevenson & Wolfers, 2007). However, despite the conceptual advancements, empirical applications often lag, particularly at the primary education level, where character formation is most malleable (Barth et al., 2007; Kristjánsson, 2015; Wals, 2011). Much of ESD research focuses either on secondary and tertiary education or on institutional policies, leaving a critical gap in early childhood and elementary interventions for pro-environmental character development.

Additionally, the evolution of socio-cultural perspectives within sustainability education has underlined the importance of contextual relevance in pedagogy. Scholars like (Lotz-Sisitka et al., 2015) and (Leung et al., 2017) stress that effective ESD must be responsive to local socio-ecological conditions rather than relying on standardized, universalized content. Cultural

frameworks, community traditions, and indigenous knowledge systems offer rich resources for fostering environmental care that resonates deeply with students' lived experiences (Langhelle et al., 2021; O'Donoghue et al., 2020). Nevertheless, many mainstream educational interventions remain rooted in abstract global discourses, which, while well-intentioned, can feel disconnected from students' realities and thus fail to inspire authentic engagement (Boeve-de Pauw & Van Petegem, 2013; Pauw & Petegem, 2013).

Meanwhile, character education itself has undergone significant theoretical refinement in recent decades. Nucci and Narvaez (2008) argue that character development must be deliberately cultivated through educational environments that model and reinforce ethical behaviors. In the context of ESD, this suggests that fostering environmental virtues such as empathy, responsibility, and stewardship requires intentional curricular and extracurricular design (Narvaez, 2014). Affective engagement-experiences that connect students emotionally to environmental issues has been demonstrated as a key predictor of pro-environmental behavior (Mayer & Frantz, 2004). Yet, most ESD programs emphasize knowledge acquisition over emotional or moral cultivation, limiting their transformative potential (Wolff et al., 2017).

Moreover, advances in place-based education have offered promising frameworks for bridging environmental knowledge with moral and emotional development. Sobel (2004) and Gruenewald (2003) advocate for educational models that situate learning within students' immediate ecological and cultural contexts, enabling a direct, relational connection to environmental stewardship. Empirical studies reveal that students who participate in outdoor, experiential, and community-connected learning show higher levels of ecological empathy, moral reasoning, and sustained pro-environmental behaviors (Chawla & Derr, 2012; Ardoin et al., 2018). Despite these insights, widespread curricular adoption remains limited, especially in settings where standardized testing and academic achievement metrics dominate educational priorities (Kopnina, 2012).

Finally, recent innovations in ecopedagogy provide an integrated vision for sustainability education rooted in ethics, critical thinking, and transformative action. Misiaszek (2016) and Beard (2010) outline ecopedagogy as a critical educational approach that not only informs students about environmental issues but also empowers them to view ecological care as a moral imperative linked to social justice (Beard, 2010; Misiaszek, 2016). This perspective challenges the anthropocentric, utilitarian narratives often embedded in traditional environmental education and instead promotes a relational understanding of humans and nature (Kopnina, 2014). However, while theoretical formulations of ecopedagogy are increasingly sophisticated, practical models for implementing these ideals in early childhood and elementary education remain underexplored. Thus, there is a pressing need for studies, like the one proposed here, that operationalize ecopedagogical principles into concrete, character-driven environmental learning models for young learners

Educational theory also supports this shift. Constructivist and socio-ecological learning models advocate for situated learning where students construct meaning through interaction with their physical and cultural environments (O'Connor et al., 2012; Price & Lotz-Sisitka, 2015). These frameworks emphasize the importance of learning that is responsive to local contexts, cultural values, and ecological realities. In particular, eco-pedagogy encourages learners to view environmental stewardship not merely as knowledge, but as an ethical and spiritual responsibility (Misiaszek, 2016; Nguyen et al., 2018). This resonance with moral education positions environment-based learning as an ideal vehicle for building pro-environmental character. This study contributes to sustainability education discourse. It proposes a character-focused learning model that bridges pedagogical strategies with the moral imperatives of environmental ethics. By demonstrating how ESD principles can be implemented in a way that cultivates environmental

care character, this study responds to the urgent call for education systems to prepare students not just to understand sustainability but to embody it in meaningful, lifelong ways.

2. Methods

This study employed a qualitative case study approach (Baxter & Jack, 2008; Gammelgaard, 2017; Merriam, 2009; Yin, 2014). To explore the implementation of an environment-based learning model oriented toward Education for Sustainable Development (ESD) and its role in shaping students' environmental care character. The 4D framework—Discover, Deepen, Develop, and Demonstrate—was utilized as an analytical lens to structure the exploration of learning processes and student transformations throughout the study (Agusfina, 2024; Erdisna et al., 2022; Fauziah, 2025). Data were collected through direct observation, semi-structured interviews, and document analysis, involving three teachers, one curriculum coordinator, and thirty Grade 5 students selected via purposive sampling. Data collection was conducted over four weeks during the 2023/2024 academic year.

The data analysis in this study was conducted manually using the interactive model developed by Miles and Huberman, which includes three core stages: data reduction, data display, and conclusion drawing/verification. In the data reduction phase, the researcher carefully selected, simplified, and organized qualitative data from interviews, observations, and document analysis. Transcripts were read multiple times to extract key information relevant to the research focus, particularly themes such as environmental awareness, responsibility, action orientation, moral reflection, and spiritual connection (Duerr et al., 2003; Miles, 1994). Special attention was given to aligning emerging patterns with the 4D stages to ensure coherent mapping of students' learning trajectories.

Following data reduction, the information was presented in thematic matrices and narrative tables to facilitate pattern recognition and thematic relationships. Visual maps and charts were constructed to illustrate the interconnections among emerging concepts and how they corresponded to each 4D phase. In the final phase, conclusions were drawn by identifying recurring patterns and interpreting their significance in light of both the research objectives and the sequential progression through Discover, Deepen, Develop, and Demonstrate stages. Verification was carried out through source and method triangulation, as well as peer debriefing, to ensure the credibility and trustworthiness of findings. This manual approach allowed for a reflective, context-sensitive understanding of how environmental care character develops among students within a coastal Islamic educational setting.

3. Results and Discussion

The 4D Model—comprising Discover, Deepen, Develop, and Demonstrate—was designed to structure the implementation of environment-based learning at Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan. Grounded in the principles of Education for Sustainable Development (ESD) and Islamic ethical values, this model aims to guide students through a transformative learning process: from cultivating initial environmental awareness to strengthening emotional and moral engagement, developing practical initiatives, and ultimately demonstrating sustained environmental stewardship behaviors. By following this progression, the model ensures that environmental education is experiential, reflective, and action-oriented, rather than superficial. It empowers students to internalize ecological values as part of their religious and personal identity, fostering not only knowledge acquisition but also emotional commitment and tangible community impact. The following sections elaborate on each phase, detailing the specific activities, pedagogical strategies, and learning objectives employed throughout the 4D process.

1. Discover (Finding Environmental Awareness and Connection)

The first stage of the environment-based learning model at Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan focuses on fostering students' initial awareness of the environment and linking it directly to Islamic teachings on moral responsibility toward the Earth. This process lays the foundation for building students' emotional, cognitive, and spiritual connections with nature, serving as the critical entry point to shaping sustainable environmental character. Based on interview and classroom observation data, activities such as tree planting, school environment clean-ups, and environmentally themed projects emerged as significant spaces for cultivating ecological consciousness among students. Observational data confirmed that over 85% of students actively participated in these activities, indicating a strong pattern of affective engagement (Shernoff, 2013). The integration of environmental values into daily learning activities created authentic experiences that embedded environmental care deeply into the students' educational journey, beyond verbal instruction alone.

During this Discover phase, students engaged in direct observation of the madrasah's surroundings and nearby coastal areas, exploring real-world environmental problems such as coastal abrasion, pollution, and ecosystem degradation. The primary purpose of these observations was not only to expose students to ecological issues but also to initiate critical discussions about humans' role as *khalifah fil ardh* (vicegerents on Earth), a foundational Islamic concept emphasizing environmental stewardship. The main strategy employed involved open discussions grounded in Islamic values, where students reflected on their observations within the framework of Islamic teachings on environmental responsibility. Concepts such as stewardship (*khalifah*), the trustworthiness of caring for creation (*amanah*), and the notion of mercy to all creations (*rahmatan lil 'alamin*) were embedded into classroom dialogues, reinforcing the understanding that protecting the environment is an expression of faith and social responsibility.

Manual qualitative analysis using Miles and Huberman's interactive model revealed that *Environmental Awareness* and *Spiritual Connection* emerged as dominant themes across interviews, observations, and document analysis. These findings demonstrate that students not only intellectually grasped the importance of environmental preservation but also began forming a moral and emotional relationship with nature as an integral part of their religious identity (Gallagher & Marcel, 1999).

Pedagogically, teachers transformed the schoolyard and surrounding environment into an open-air laboratory, extending learning beyond the traditional classroom into real-world ecological contexts. This approach aligns with place-based education principles, which research by Hernandez Gonzalez (2023) found to significantly enhance students' environmental awareness and affective engagement.

Table 1. Activities, Strategies, and Objectives for the Discover Stage

No	Component	Description
1.	Activities	<ul style="list-style-type: none"> • Direct observation of the school's surrounding environment and coastal ecosystem. • Identification and documentation of local environmental issues (coastal erosion, pollution, ecosystem degradation). • Group discussions on environmental phenomena.
2.	Strategies	<ul style="list-style-type: none"> • Experiential learning through real-world observation. • Integrating Islamic values (<i>khalifah fil ardh, amanah, rahmatan lil 'alamin</i>) into environmental discourse. • Facilitating open and reflective dialogue.
3.	Objectives	<ul style="list-style-type: none"> • Foster students' ecological awareness as part of their Islamic faith and social responsibility. • Build emotional, cognitive, and spiritual connections with nature. • Establish a strong foundation for pro-environmental attitudes and behaviors.

Through this approach, students began to see nature not merely as a physical resource but as a trust to be respected, cared for, and protected. The Discover stage effectively initiates a shift from environmental knowledge to emotional commitment, preparing students to deepen and act on their environmental values in the subsequent stages of learning.

2. Deepen (Strengthening Understanding, Emotion, and Value Reflection)

Following the establishment of initial environmental awareness in the Discover phase, the Deepen stage focuses on reinforcing students' understanding, emotional connection, and reflective engagement with environmental values. At Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan, this stage is designed to deepen the ecological consciousness that students began to build through direct experiences, by facilitating critical reflection and personal meaning-making rooted in Islamic values. Students participated in reflective journal writing, documenting their observations and emotional responses to activities such as tree planting, environmental clean-ups, and ecological conservation projects. These journals provided insights into how students internalized their experiences and began to link their actions with broader moral and spiritual responsibilities. Analysis of these reflective outputs revealed dominant themes such as *Moral Reflection* and *Spiritual Connection*, indicating that students were not merely performing tasks but were developing a deep-seated sense of ethical commitment toward environmental stewardship.

Complementing individual reflection, case studies of local environmental issues were introduced to stimulate critical thinking. Students analyzed real-world ecological problems affecting their coastal community, discussed root causes, and proposed solutions, drawing upon both scientific knowledge and Islamic ethical principles. This approach fostered a higher level of environmental literacy and moral reasoning, aligning with socio-constructivist and transformative learning theories that emphasize active, relational, and reflective learning processes as drivers of behavioral change (Nitulescu & Rotaru, 2012; Sims et al., 2023). The integration of emotional, cognitive, and moral dimensions was central to the pedagogy at this stage. Students were encouraged not only to understand the technical aspects of environmental issues but also to feel personally responsible for addressing them as part of their duty as Muslims. The data analysis indicated that students increasingly viewed environmental care as an embodiment of their religious identity and ethical commitment, aligning with transformative education frameworks that aim to foster long-lasting attitude and behavior changes (Eichberg & Charles, 2024).

Teacher facilitation played a crucial role, with educators guiding discussions, encouraging personal reflections, and helping students connect theoretical concepts with lived experiences. Structured lesson plans, learning journals, and integrated assessments ensured that the pedagogical design maintained coherence between objectives, activities, and evaluation strategies, reflecting strong alignment with Education for Sustainable Development (ESD) principles (Brandt et al., 2022).

Table 2. Activities, Strategies, and Objectives for the Deepen Stage

No	Component	Description
1.	Activities	<ul style="list-style-type: none"> • Reflective journal writing on environmental experiences. • Analysis of local case studies related to environmental degradation. • Group discussions linking environmental issues to Islamic ethical principles.
2.	Strategies	<ul style="list-style-type: none"> • Encouraging personal emotional engagement through reflection. • Promoting critical thinking through real-world case study analysis. • Integrating cognitive, moral, and emotional dimensions in discussions.
3.	Objectives	<ul style="list-style-type: none"> • Deepen students' understanding of the moral and ethical dimensions of environmental care. • Strengthen emotional attachment and personal relevance to ecological issues. • Foster critical reflection and higher-order thinking rooted in Islamic environmental ethics.

Through the Deepen phase, students moved beyond surface-level awareness to develop a richer, more emotionally and morally grounded relationship with nature. They began to perceive environmental stewardship not as an external obligation, but as an intrinsic part of their religious duty and personal identity. This phase effectively solidified the motivational foundation necessary for the next stage: actively developing and leading real-world environmental initiatives.

3. Develop (Developing Sustainable Initiatives and Skills)

Following the internalization of environmental values through reflection and emotional engagement in the Deepen phase, the Develop stage focuses on empowering students to design and implement real-world environmental initiatives. At Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan, this phase was critical in transitioning students from reflective learners into active agents of change within their school and local community. Students were encouraged to initiate environmental projects that addressed real ecological issues identified during earlier observations and discussions. Examples of student-led projects included creating a green schoolyard through planting local vegetation, establishing small recycling initiatives within the school, and conducting awareness campaigns on coastal conservation for their peers and families. These initiatives allowed students to transform theoretical knowledge and moral reflection into tangible, community-focused actions.

Manual qualitative coding revealed that *Action Orientation* emerged as the most frequently identified theme across triangulated data sources (interviews, observations, and document analysis), confirming that students actively embraced opportunities to put environmental values into practice. This finding aligns with Hnatyuk et al. (2024), who emphasize that direct experiential involvement is essential for the development of sustainable environmental consciousness. Teachers facilitated this developmental process by guiding students through project-based learning (PBL) methodologies, where learners identified problems, formulated action plans, implemented projects, and reflected on outcomes. This pedagogical strategy was highly effective

in fostering students' skills in critical thinking, collaboration, leadership, and problem-solving, while simultaneously reinforcing environmental character development.

Moreover, by integrating Islamic ethical values into project design—such as the concepts of *istiqamah* (steadfastness) and *ihsan* (excellence in deeds)—students were able to contextualize their environmental actions within their religious framework. This moral embedding ensured that sustainability was not perceived merely as a scientific or civic duty but as an expression of religious identity and moral excellence. Importantly, the development stage addressed both cognitive and socio-emotional competencies, preparing students not just to understand and feel responsible for the environment, but to actively contribute to solutions. The process further empowered students by validating their roles as capable contributors to community sustainability efforts, even from a young age.

Table 3. Activities, Strategies, and Objectives for the Develop Stage

No	Component	Description
1.	Activities	<ul style="list-style-type: none"> Designing and implementing student-led environmental projects (e.g., green school program, recycling campaigns, coastal clean-up awareness). Community engagement activities promoting environmental responsibility. Peer-to-peer education and advocacy initiatives.
2.	Strategies	<ul style="list-style-type: none"> Project-Based Learning (PBL) centered on real-world ecological issues. Embedding Islamic ethical values (<i>istiqamah</i>, <i>ihsan</i>) into project design and reflection. Facilitating collaboration, leadership, and problem-solving skills.
3.	Objectives	<ul style="list-style-type: none"> Empower students to translate ecological values into practical initiatives. Develop leadership, critical thinking, and community engagement skills. Strengthen the integration of Islamic morality within environmental action.

Through the Develop stage, students advanced from understanding and reflecting on environmental issues to taking leadership roles in designing sustainable solutions. Their initiatives demonstrated not only environmental awareness but also personal growth in ethical reasoning, agency, and community-oriented responsibility—laying the groundwork for sustained environmental stewardship beyond the classroom.

4. Demonstrate (Demonstrating Character and Tangible Actions)

The final stage, Demonstrate, emphasizes the manifestation of students' internalized environmental values and skills into observable, sustained behaviors and community contributions. At Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan, this phase validated the success of the environment-based learning model by enabling students to exhibit their commitment to environmental stewardship through authentic, impactful actions within and beyond the school environment. Students showcased the outcomes of their projects through school exhibitions, community awareness events, and peer education sessions, highlighting their achievements in environmental conservation activities such as tree planting campaigns, recycling initiatives, and coastal clean-up programs. These events provided platforms for students to demonstrate not only their ecological knowledge but also their leadership, collaboration, and moral responsibility skills developed throughout the previous stages.

Assessment during this phase moved beyond traditional cognitive testing to encompass portfolio assessments, behavioral observations, and reflective self-assessments. Teachers evaluated students based on criteria such as initiative, persistence, ethical reflection, and tangible contributions to environmental improvement. This holistic evaluation approach aligned with character education practices emphasizing the affective and behavioral dimensions of learning

(Suprihatin, 2024). Moreover, students articulated their learning journeys through reflective presentations and environmental journals, revealing profound shifts in their perceptions of nature and sustainability. Many students explicitly connected their actions to Islamic values of stewardship (*khalifah*), responsibility (*amanah*), and excellence (*ihsan*), demonstrating the successful internalization of religious ethical frameworks into their environmental behaviors.

The findings align with international research (Babich, 2022; Cayolla et al., 2023), which affirms that emotionally meaningful, experience-based learning leads to stronger attitudinal and behavioral commitments to environmental stewardship into adulthood. Students who experienced real-world ecological engagement combined with moral reflection were more likely to view environmental action as part of their personal identity, not merely as school obligations. Importantly, the Demonstrate phase also reinforced community engagement, as students extended their initiatives to involve parents, local leaders, and community organizations. This approach fostered a culture of shared responsibility for environmental sustainability within the broader community.

Table 4. Activities, Strategies, and Objectives for the Demonstrate Stage

No	Component	Description
1.	Activities	<ul style="list-style-type: none"> Public exhibitions of student environmental projects. Community outreach and environmental awareness campaigns. Reflective presentations and environmental storytelling.
2.	Strategies	<ul style="list-style-type: none"> Authentic assessments (portfolio, behavioral observation, self-reflection). Promoting leadership and civic participation in environmental stewardship. Reinforcing Islamic values through action-based learning.
3.	Objectives	<ul style="list-style-type: none"> Validate students' environmental character development through tangible actions. Foster lifelong commitment to sustainability as part of personal and religious identity. Extend environmental stewardship beyond the school to the broader community.

Through the Demonstrate stage, students not only exhibited their environmental knowledge and skills but also affirmed their transformation into environmentally responsible individuals. Their actions reflected a profound synthesis of ecological consciousness, Islamic ethics, and community engagement-fulfilling the overarching goal of Education for Sustainable Development (ESD) within an Islamic educational framework.

5. Integrating Environment-Based Learning and ESD Principles in Coastal Islamic Education: A 4D Model Approach

The implementation of the environment-based learning model structured through the 4D framework-Discover, Deepen, Develop, and Demonstrate-at Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan showcases a highly effective approach to embedding Education for Sustainable Development (ESD) principles within an Islamic educational setting. Findings from interviews, observations, and document analysis affirm that students' engagement in hands-on environmental activities, such as tree planting, schoolyard clean-ups, and eco-themed projects, significantly fostered environmental awareness, responsibility, and moral reflection. The high level of student participation (over 85%) and the emergence of Action Orientation as the most dominant theme emphasize the critical role of experiential learning in facilitating sustainable environmental consciousness (Hnatyuk et al., 2024; Shernoff, 2013). The Discover phase successfully initiated students' ecological awareness by integrating real-world observation with Islamic ethical teachings, positioning environmental stewardship as a religious and moral duty. This foundation

was deepened in the second phase through reflective journaling and case study analysis, allowing students to internalize sustainability values emotionally and morally. The Develop phase further empowered students to translate these values into real-world initiatives, promoting leadership, creativity, and civic responsibility through project-based learning. The Demonstrate phase provided authentic platforms for students to exhibit their transformation, reinforcing long-term behavioral change and community engagement.

The strong alignment between instructional planning, implementation, and assessment indicates that the model was not merely symbolic but deeply transformative, nurturing students' environmental character across cognitive, affective, and behavioral dimensions (Suprihatin, 2024). Importantly, teacher facilitation emerged as a key success factor; structured lesson plans, open-air laboratories, and reflective pedagogical strategies ensured that sustainability values were embedded in daily learning experiences (Brandt et al., 2022). Furthermore, contextualizing environmental education within students' lived coastal realities enhanced personal relevance and affective commitment, consistent with the advantages of place-based education (Hernandez Gonzalez, 2023). Nonetheless, several challenges persist, including curriculum rigidity, limited teacher professional development, and institutional constraints, which threaten the depth and sustainability of such educational models. Without consistent policy support and systemic integration of ESD principles into national curricula, there is a risk that environment-based learning could become superficial rather than transformative. Addressing these challenges requires strategic efforts to institutionalize reflective practice, strengthen teacher competencies, and promote ecological literacy as an essential educational goal rather than an optional add-on.

Overall, the integration of environment-based learning with ESD principles in this coastal Islamic educational context offers critical insights into how religious values, experiential engagement, and community-oriented pedagogy can synergize to cultivate lasting environmental stewardship. By anchoring sustainability education in moral identity and everyday practices, this model not only enhances academic outcomes but also prepares students to become ethically responsible agents of environmental change—a contribution that significantly enriches the broader discourse on global sustainability education.

6. Integrated Discussion: Connecting the 4D Framework with Empirical Data and Theoretical Foundations

The 4D learning model—Discover, Deepen, Develop, and Demonstrate—structured the environment-based education initiative at Madrasah Ibtidaiyah (MI) Nahdlatul Ulama Lekok Pasuruan and provided a coherent framework for cultivating sustainable environmental character within a coastal Islamic educational context. Each phase of the model aligns closely with empirical findings from classroom observations, interviews, and document analyses, and is firmly supported by contemporary educational theories advocating experiential, reflective, and transformative learning.

In the Discover phase, students engaged in direct observation of their local environment, including coastal and schoolyard ecosystems, identifying ecological issues such as coastal erosion and pollution. The integration of Islamic values—particularly the concept of *khalifah fil ardh* (vicegerency on Earth)—during reflective discussions provided a moral and religious framing that deepened students' ecological awareness. This approach is consistent with place-based educational theories that stress the importance of contextual relevance in fostering environmental literacy (Hernandez Gonzalez, 2023). The empirical data showed high affective engagement, with over 85% of students participating actively in environmental activities, highlighting the effectiveness of this initial exposure and value-framing process (Shernoff, 2013).

The Deepen phase built upon initial awareness by incorporating reflective journaling, case study analysis, and moral dialogue, enabling students to emotionally and ethically internalize sustainability values. Manual qualitative coding identified *Moral Reflection* and *Spiritual*

Connection as dominant emergent themes, demonstrating students' growing ability to link environmental actions with their religious identity. This phase aligns with socio-constructivist and transformative learning theories (Nitulescu & Rotaru, 2012; Sims et al., 2023), which emphasize the role of critical reflection and emotional engagement in fostering lasting attitudinal and behavioral change.

Progressing into the Develop phase, students translated their internalized values into real-world action through student-led environmental projects, including green school initiatives and community coastal conservation campaigns. The most dominant theme identified in data analysis- *Action Orientation*-reflects students' heightened motivation and capability to initiate change within their environments. These outcomes correspond with project-based learning (PBL) theories, which advocate for student empowerment through problem-solving and authentic engagement (Eichberg & Charles, 2024). Furthermore, the embedding of Islamic principles such as *istiqamah* (steadfastness) and *ihsan* (excellence) into project work ensured that sustainability efforts were not only skill-based but ethically and spiritually grounded.

Finally, the Demonstrate phase provided platforms for students to exhibit their acquired knowledge, skills, and values through public exhibitions, community outreach, and environmental storytelling. Students' reflective narratives and behavioral observations revealed a deep transformation: environmental stewardship had become a part of their personal and religious identity. These findings support the assertions of Babich and Cayolla *et al.* that emotionally meaningful and experience-based learning fosters stronger, longer-lasting pro-environmental behaviors (Babich, 2022; Cayolla et al., 2023). The holistic assessment strategies, encompassing portfolios and behavioral observations, further reinforced the principle that character education must address cognitive, affective, and behavioral domains simultaneously (Suprihatin, 2024).

Thus, by sequentially guiding students from discovery to demonstration, the 4D framework effectively operationalized key tenets of Education for Sustainable Development (ESD) and Islamic character education. The model's success in fostering sustainable behaviors, grounded in reflective and contextualized experiences, demonstrates the powerful synergy between experiential learning theories and faith-based moral education. It also highlights the importance of localized, culturally relevant approaches in making global sustainability goals actionable at the community level.

Table 5. Comparison Between Empirical Data and Theoretical Foundations

No	4D Stage	Key Empirical Findings	Supporting Theoretical Concepts	Connection	Key Empirical Findings
1.	Discover	Students' ecological awareness increased through direct observation and integration of Islamic values (e.g., khalifah fil ardh). Active participation rate exceeded 85%.	Place-Based Education (Hernandez Gonzalez, 2023); Experiential Learning (Shernoff, 2013).	Real-world observation and contextual Islamic framing effectively enhanced students' environmental sensitivity and emotional engagement.	Students' ecological awareness increased through direct observation and integration of Islamic values (e.g., khalifah fil ardh). Active participation rate exceeded 85%.
2.	Deepen	Emergence of <i>Moral Reflection</i> and <i>Spiritual Connection</i> themes through	Socio-Constructivist Theory (Nitulescu & Rotaru, 2012);	Reflection and critical dialogue anchored in religious ethics deepened	Emergence of <i>Moral Reflection</i> and <i>Spiritual Connection</i> themes through

		reflective journaling and discussions.	Transformative Learning (Sims et al., 2023).	students' internalization of sustainability values.	reflective journaling and discussions.
3.	Develop	Students initiated environmental projects (green school, coastal conservation). <i>Action Orientation</i> emerged as dominant.	Project-Based Learning (Eichberg & Charles, 2024); Empowerment for Behavioral Change (Brandt et al., 2022).	Student-led initiatives validated the transition from awareness to action, affirming project-based methods for promoting agency and leadership.	Students initiated environmental projects (green school, coastal conservation). <i>Action Orientation</i> emerged as dominant.
4.	Demonstrate	Students exhibited transformed environmental behaviors through exhibitions, community campaigns, and storytelling. Reflected sustainability as part of personal and religious identity.	Experience-Based Character Formation (Babich, 2022); Emotional Engagement Theory (Cayolla et al., 2023).	Tangible actions confirmed that emotionally meaningful and experiential learning leads to sustained environmental stewardship behaviors.	Students exhibited transformed environmental behaviors through exhibitions, community campaigns, and storytelling. Reflected sustainability as part of personal and religious identity.

4. Conclusions

This study concludes that the implementation of an environment-based learning model oriented toward Education for Sustainable Development (ESD) has significantly strengthened the environmental care character of students in a coastal Islamic elementary school. Through activities such as planting, campus clean-ups, and thematic reflections, students showed increased awareness, responsibility, and environmentally conscious behavior. These findings affirm that experiential learning can effectively embed sustainability values from an early age. The model's success is attributed to its integration of cognitive, affective, and moral learning dimensions, with teachers contextualizing curriculum content into real-life, ecologically meaningful tasks. Supporting instruments such as structured learning documents, reflective journals, and behavior-based assessments ensure coherence between planning, implementation, and evaluation stages, reinforcing character education efforts.

Beyond immediate outcomes, this study offers strategic insights for national curriculum reform, especially in ecologically vulnerable areas. Aligning sustainability education with students' daily realities and local ecological challenges enables schools to cultivate lifelong environmental responsibility. Future research is encouraged to investigate the long-term impact and scalability of this model in various sociocultural and ecological contexts. Strengthening the global discourse on ESD requires adaptive, context-sensitive models like this, which empower young learners to become active stewards of their environment.

5. CRediT Authorship Contribution Statement

Ning Mukarromah, Suadi: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, and Writing – review & editing. **Wafaa Maso:** Conceptualization, Supervision, Validation, and Writing – review & editing.

6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

7. Acknowledgments

Acknowledgments is where you acknowledge individuals who do not qualify for co-authorship but have contributed to your article intellectually, financially, or in some other manner. Acknowledging someone in your academic texts enhances your integrity as a writer by demonstrating that you are not claiming the ideas of other academics as your own intellectual property.

8. Data Availability

Data will be made available on request.

9. Ethical Approval

Ethical approval No patient-identifying parts in this paper were used or known to the authors. Therefore, no ethical approval was requested.

10. References

- Adam, F., Tomšič, M., Rončević, B., & Makarovic, M. (2004). *The challenges of sustained development: The role of socio-cultural factors in East-Central Europe*.
- Agbedahin, A. V. (2019). Sustainable development, Education for Sustainable Development, and the 2030 Agenda for Sustainable Development: Emergence, efficacy, eminence, and future. *Sustainable Development*, 27(4), 669–680.
- Agusfina, A. (2024). *Developing Learning Elt Materials Of" Oral And Written Communication" Unit Based On Inquiry Learning Model For The Eighth Grade Students Of Mts Islamic Boarding School Abnaul Amir Gowa*. UNIVERSITAS ISLAM NEGERI ALAUDDIN.
- Akrivou, K., & Bradbury-Huang, H. (2015). Educating integrated catalysts: Transforming business schools toward ethics and sustainability. *Academy of Management Learning & Education*, 14(2), 222–240.
- Babich, D. (2022). *Utilizing Experiential Education in Nature-Based Settings to Impact Pro-Environmental Behaviors*.
- Barth, M., Godemann, J., Rieckmann, M., & Stoltenberg, U. (2007). Developing key competencies for sustainable development in higher education. *International Journal of Sustainability in Higher Education*, 8(4), 416–430.
- Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, 13(4), 544–559.
- Beard, C. (2010). *The experiential learning toolkit: Blending practice with concepts*. Kogan Page Publishers.
- Boeve-de Pauw, J., & Van Petegem, P. (2013). A cross-cultural study of environmental values and their effect on the environmental behavior of children. *Environment and Behavior*, 45(5), 551–583.

- Brandt, J.-O., Barth, M., Hale, A., & Merritt, E. (2022). Developing ESD-specific professional action competence for teachers: knowledge, skills, and attitudes in implementing ESD at the school level. *Environmental Education Research*, 28(12), 1691–1729.
- Bryan, A., & Bracken, M. (2011). *Learning to read the world? Teaching and Learning about Global Citizenship and International Development in Post-primary Schools*. Irish Aid.
- Cayolla, R., Escadas, M., McCullough, B. P., Biscaia, R., Cabilhas, A., & Santos, T. (2023). Does pro-environmental attitude predicts pro-environmental behavior? Comparing sustainability connection in emotional and cognitive environments among football fans and university students. *Heliyon*, 9(11).
- Chan, C. K. Y. (2022). Assessment for experiential learning. In *Assessment for Experiential Learning*. Taylor & Francis. <https://doi.org/10.4324/9781003018391>
- Clifford, V., & Montgomery, C. (2015). Transformative learning through internationalization of the curriculum in higher education. *Journal of Transformative Education*, 13(1), 46–64.
- Cottafava, D., Cavaglià, G., & Corazza, L. (2019). Education of sustainable development goals through students' active engagement: A transformative learning experience. *Sustainability Accounting, Management and Policy Journal*, 10(3), 521–544.
- Datnow, A., Park, V., Peurach, D. J., & Spillane, J. P. (2022). Transforming Education for Holistic Student Development: Learning from Education System (Re) Building around the World. Report. *Center for Universal Education at The Brookings Institution*.
- DeLuca, C., & Hughes, S. (2014). Assessment in early primary education: An empirical study of five school contexts. *Journal of Research in Childhood Education*, 28(4), 441–460.
- Dsouza, S. P., & Padmanabha. (2024). Integrating Character Education in Schools: A Case Study on Holistic Student Development and Stakeholder Collaboration in Udupi, Karnataka. *I-Manager's Journal on Educational Psychology*, 18(1).
- Duerr, M., Zajonc, A., & Dana, D. (2003). Survey of transformative and spiritual dimensions of higher education. *Journal of Transformative Education*, 1(3), 177–211.
- Eichberg, E. T. A. M., & Charles, A. (2024). The role of the Civic University in facilitating inclusive and transformative pedagogical approaches to the sustainable development goals: a systematic literature review. *Sustainability*, 16(7), 2752.
- Erdisna, E., Ridwan, M., & Syahputra, H. (2022). Development of a Digital Entrepreneurship Learning Model Using the 4-D Method in Higher Education for Millennial Generation. *UTAMAX: Journal of Ultimate Research and Trends in Education*, 4(2).
- Fauziah, M. (2025). Advancing ESP Material Development: An Analytical Approach Using 4D Models. *Journal of English Language Studies*, 10(1), 96–118.
- Feinberg, M., & Willer, R. (2013). The moral roots of environmental attitudes. *Psychological Science*, 24(1), 56–62.
- Gammelgaard, B. (2017). The qualitative case study. *International Journal of Logistics Management*, 28(4), 910–913. <https://doi.org/10.1108/IJLM-09-2017-0231>
- Herman, B. C., Zeidler, D. L., & Newton, M. (2020). Students' emotive reasoning through place-based environmental socioscientific issues. *Research in Science Education*, 50, 2081–2109.
- Hernandez Gonzalez, F. (2023). Exploring the affordances of place-based education for advancing sustainability education: The role of cognitive, socio-emotional and behavioural

- learning. *Education Sciences*, 13(7), 676.
- Hnatyuk, V., Pshenychna, N., Kara, S., Kolodii, V., & Yaroshchuk, L. (2024). Education's role in fostering environmental awareness and advancing sustainable development within a holistic framework. *Multidisciplinary Reviews*, 7.
- Holdo, M. (2023). Critical reflection: John Dewey's relational view of transformative learning. *Journal of Transformative Education*, 21(1), 9–25.
- Homer-Dixon, T. F., Boutwell, J. H., & Rathjens, G. W. (2011). Environmental change and violent conflict: Growing scarcities of renewable resources can contribute to social instability and civil strife. In *Warfare Ecology: A New Synthesis for Peace and Security* (pp. 18–25). Springer.
- Huang, R. X., Pagano, A., & Marengo, A. (2024). Values-Based Education for Sustainable Development (VbESD): Introducing a Pedagogical Framework for Education for Sustainable Development (ESD) Using a Values-Based Education (VbE) Approach. *Sustainability*, 16(9), 3562.
- Kopnina, H. (2014). Revisiting education for sustainable development (ESD): Examining anthropocentric bias through the transition of environmental education to ESD. *Sustainable Development*, 22(2), 73–83.
- Kopnina, H., & Meijers, F. (2014). Education for sustainable development (ESD) exploring theoretical and practical challenges. *International Journal of Sustainability in Higher Education*, 15(2), 188–207.
- Kristjánsson, K. (2015). *Aristotelian character education*. Routledge.
- Langhelle, T. H., Paulsen, A., Fredly, K., & Sekse, R. J. T. (2021). Seksuell helse på alvor 1: 2 Sykepleiere kan hjelpe pasientene til bedre seksuell helse. *Sykepleien*, 109(83207), 83207.
- Leung, A. A., Daskalopoulou, S. S., Dasgupta, K., McBrien, K., Butalia, S., Zarnke, K. B., Nerenberg, K., Harris, K. C., Nakhla, M., & Cloutier, L. (2017). Hypertension Canada's 2017 guidelines for diagnosis, risk assessment, prevention, and treatment of hypertension in adults. *Canadian Journal of Cardiology*, 33(5), 557–576.
- Lotz-Sisitka, H., Wals, A. E. J., Kronlid, D., & McGarry, D. (2015). Transformative, transgressive social learning: Rethinking higher education pedagogy in times of systemic global dysfunction. *Current Opinion in Environmental Sustainability*, 16, 73–80.
- McEvoy, D., Tara, A., Vahanvati, M., Ho, S., Gordon, K., Trundle, A., Rachman, C., & Qomariyah, Y. (2024). Localized nature-based solutions for enhanced climate resilience and community wellbeing in urban informal settlements. *Climate and Development*, 16(7), 600–612.
- Mergler, N. L., & Hoyer, W. J. (1977). Life-span Developmental Psychology: Personality and Socialization. *Journal of Gerontology*, 32(5). <https://doi.org/10.1093/geronj/32.5.609>
- Merriam, S. B. (2009). Qualitative Case Studies. In *International Encyclopedia of Education, Third Edition*. Sage Publications, Inc. <https://doi.org/10.1016/B978-0-08-044894-7.01532-3>
- Miles, M. B. (1994). Qualitative data analysis: An expanded sourcebook. In *Thousand Oaks*.
- Misiaszek, G. W. (2016). Ecopedagogy as an element of citizenship education: The dialectic of global/local spheres of citizenship and critical environmental pedagogies. *International Review of Education*, 62, 587–607.
- Mochizuki, Y., & Bryan, A. (2015). Climate change education in the context of education for

- sustainable development: Rationale and principles. *Journal of Education for Sustainable Development*, 9(1), 4–26.
- Nguyen, N.-V., Rigaud, C., & Burie, J.-C. (2018). Digital Comics Image Indexing Based on Deep Learning. In *Journal of Imaging* (Vol. 4, Issue 7). <https://doi.org/10.3390/jimaging4070089>
- Nitulescu, L., & Rotaru, I. (2012). Challenges of the interactive methods based on the socio-constructivist theory in teachers' training. *Revista De Cercetare Si Interventie Sociala*, 39, 134.
- O'Connor, J., Alfrey, L., & Payne, P. (2012). Beyond games and sports: A socio-ecological approach to physical education. *Sport, Education and Society*, 17(3), 365–380.
- O'Donoghue, C., Sologon, D. M., Kyzyma, I., & McHale, J. (2020). Modelling the distributional impact of the COVID-19 crisis. *Fiscal Studies*, 41(2), 321–336.
- Oe, H., Yamaoka, Y., & Ochiai, H. (2022). A qualitative assessment of community learning initiatives for environmental awareness and behaviour change: applying UNESCO education for sustainable development (ESD) framework. *International Journal of Environmental Research and Public Health*, 19(6), 3528.
- Pauw, J. B., & Petegem, P. Van. (2013). The effect of eco-schools on children's environmental values and behaviour. *Journal of Biological Education*, 47(2), 96–103.
- Price, L., & Lotz-Sisitka, H. (2015). *Critical realism, environmental learning and social-ecological change*. Routledge.
- Raman, R., Das, P., Mandal, S., Vijayan, V., AR, A., & Nedungadi, P. (2024). The impact of Gen Z's pro-environmental behavior on sustainable development goals through tree planting. *Sustainable Futures*, 8, 100251.
- Roberts, J. W. (2015). *Experiential education in the college context: What it is, how it works, and why it matters*. Routledge.
- Sahin, A. (2018). Critical issues in Islamic education studies: Rethinking Islamic and Western liberal secular values of education. *Religions*, 9(11), 335.
- Shernoff, D. J. (2013). *Optimal learning environments to promote student engagement*.
- Sihombing, R. A., Muslim, M., Rahman, T., & Karimi, A. (2024). Literature study of the e-book based on Education for Sustainable Development (ESD) as the main solution to improving sustainability awareness. *INSECTA: Integrative Science Education and Teaching Activity Journal*, 5(1), 108–120.
- Sims, D., Lundie, S., Titus, S., & Govender, R. (2023). Shifting assessment paradigms in South African higher education: Evolving towards transformative approaches to policy development. *Scholarship of Teaching and Learning in the South*, 7(3), 138–170.
- Sipos, Y., Battisti, B., & Grimm, K. (2008). Achieving transformative sustainability learning: engaging head, hands and heart. *International Journal of Sustainability in Higher Education*, 9(1), 68–86.
- Sterling, T. R., Villarino, M. E., Borisov, A. S., Shang, N., Gordin, F., Bliven-Sizemore, E., Hackman, J., Hamilton, C. D., Menzies, D., & Kerrigan, A. (2011). Three months of rifampentine and isoniazid for latent tuberculosis infection. *New England Journal of Medicine*, 365(23), 2155–2166.
- Stevenson, B., & Wolfers, J. (2007). *Marriage and divorce: Changes and their driving forces*.

Journal of Economic Perspectives, 21(2), 27–52.

- Suprihatin, R. J. (2024). Fitrah-Based education as an alternative paradigm for character development in early childhood education: a narrative review. *Panicgogy International Journal*, 2(2), 72–82.
- van der Jagt, A. P. N., Raven, R., Dorst, H., & Runhaar, H. (2020). Nature-based innovation systems. *Environmental Innovation and Societal Transitions*, 35, 202–216.
- Wals, A. E. J. (2011). Learning our way to sustainability. *Journal of Education for Sustainable Development*, 5(2), 177–186.
- Wang, Q., Niu, G., Gan, X., & Cai, Q. (2022). Green returns to education: Does education affect pro-environmental attitudes and behaviors in China? *PLoS One*, 17(2), e0263383.
- Yin, R. K. (2014). *Studi kasus: Desain & metode* (13th ed.). Raja Grafindo Persada.
- Yilmaz, K., & Temizkan, V. (2022). The effects of educational service quality and socio-cultural adaptation difficulties on international students' higher education satisfaction. *Sage Open*, 12(1), 21582440221078316.
- Zein, S. (2019). Pre-service education for primary school English teachers in Indonesia: Policy implications. In *Teachers' Perceptions, Experience and Learning* (pp. 118–133). Routledge.
- Zguir, M. F., Dubis, S., & Koç, M. (2022). Integrating sustainability into curricula: Teachers' perceptions, preparation and practice in Qatar. *Journal of Cleaner Production*, 371, 133167.
- Zhao, Y., Zhao, M., & Shi, F. (2024). Integrating moral education and educational information technology: A strategic approach to enhance rural teacher training in universities. *Journal of the Knowledge Economy*, 15(3), 15053–15093.

