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Integrating Ecoliteracy and Holistic Integrative Early Childhood Education to Support Sustainable Development Goals (SDGs)

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Abstract

This study examines the integration of ecoliteracy within Holistic Integrative Early Childhood Education (ECE), focusing on children's social-emotional development, healthy behavior, and the achievement of Sustainable Development Goals (SDGs). A qualitative case study was conducted at SPS Taam Fajrul Islam involving three teachers, 15 children, and five parents. Data were collected through observations, semi-structured interviews, and documentation. Observations were conducted in six 90-minute sessions focusing on ecoliteracy-based learning and children's participation. Findings indicate that ecoliteracy was integrated into daily learning through gardening, environmental exploration, waste sorting, material reuse, environmental care, and outdoor activities. Teacher scaffolding through explanations, demonstrations, questions, reminders, and reinforcement supported children's emerging understanding of environmental responsibility. These activities also fostered social-emotional behaviors, including cooperation, empathy, responsibility, helping peers, and positive participation, while reinforcing healthy habits such as handwashing and environmental cleanliness. Ecoliteracy was connected with the five dimensions of Holistic Integrative ECE: education; health, nutrition, and care; parenting; protection; and child well-being. These practices aligned with SDG 3, SDG 4, SDG 12, and SDG 13. The study concludes that ecoliteracy provides a practical integrative approach linking environmental learning with holistic child development and sustainability education. Future research should involve multiple ECE institutions and longitudinal or mixed-method approaches.

Keywords: *Ecoliteracy; ECE; Holistic Iintegrative; SDGs; Environmental Education.*

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INTRODUCTION

Early Childhood Education (ECE) plays a strategic role in shaping children's character, behavior, and lifelong developmental foundations. At this stage, children begin to develop habits, attitudes, and values that may influence their behavior and development in later life. Therefore, ECE is not only expected to support children's cognitive development but also to foster environmental awareness, healthy lifestyles, social-emotional skills, responsibility, and sustainability values from an early age. These developmental needs are increasingly relevant in the context of growing environmental challenges and climate change, which affect the quality and sustainability of children's living environments (Bulut 2020; J. Davis and Elliott 2014; Unesco 2020; Wang, Bourn, and Struthers 2025; Yadav et al. 2022).

Environmental problems and climate change have become global issues affecting various sectors of life, including education. Young children are exposed to environmental challenges such as plastic waste, environmental pollution, shrinking green spaces, and changing weather conditions. These conditions highlight the importance of introducing environmental education through meaningful and contextual learning experiences that enable children to interact directly with their surrounding environment. Rather than being introduced only as conceptual knowledge, environmental education in ECE can be developed through age-appropriate activities that encourage children to observe, explore, care for, and participate in maintaining their environment. Such an approach provides an important foundation for strengthening ecoliteracy in early childhood education (Anggraeni 2023a; Ardoin, Bowers, and Gaillard 2020).

Attention to environmental education in early childhood has increased significantly in recent years along with the growing concerns regarding climate change and sustainable education. Research has shown that ecoliteracy-based learning can improve environmental awareness, healthy living behavior, and children's social-emotional abilities from an early age. Anggraeni, Ramdani, and Hidayah (2025) explained that the implementation of ecoliteracy in early childhood education strengthens discipline, empathy, responsibility, and healthy lifestyle habits through participatory environmental learning activities. In addition, Anggraeni (2024) found that Nature-Based Deep Learning models effectively improve children's ecoliteracy skills through authentic exploration and direct experiences within their environment.

Ecoliteracy refers to the ability to understand ecological principles and apply them in daily life. In the context of ECE, ecoliteracy can be introduced through nature-based learning, environmental exploration, gardening activities, waste management, outdoor games, and simple recycling activities. These activities not only help children understand environmental issues but also encourage social-emotional development, communication, cooperation, empathy, and responsibility (Ariyatun et al. 2024; Budiarti et al. 2025; Daboti et al. 2025; Kahn 2010; Mascia and Wilson 2026; Pandis 2025). Research conducted by Krannich and Reiser (2023) demonstrated that the Food Garden School program significantly improved children's understanding of sustainability concepts and eco-literacy through gardening and environmental exploration activities.

The integration of ecoliteracy within Holistic Integrative ECE provides an opportunity to connect environmental learning with the broader developmental needs of young children. Ecoliteracy can complement the holistic dimension of ECE by engaging children in meaningful environmental experiences that support not only their understanding of ecological concepts but also their physical, social-emotional, cognitive, and moral development. In this context, environmental activities such as gardening, waste management, nature exploration, and simple sustainable practices can be embedded within educational, health, nutritional, parenting, and community-based services. Thus, ecoliteracy is not positioned as an additional learning component, but as a complementary dimension that can strengthen the holistic and integrative nature of early childhood education.

Furthermore, the concept of Holistic Integrative Early Childhood Education has become a relevant approach in addressing contemporary educational challenges. Holistic Integrative ECE emphasizes comprehensive services that include education, health, nutrition, parenting, child protection, and children's psychological well-being. This approach aligns with the goals of Sustainable Development Goals (SDGs), particularly SDG 3 concerning good health and well-being, SDG 4 concerning quality education, SDG 12 concerning responsible consumption and production, and SDG 13 concerning climate action (Auld, O'Mara, and White 2023; Buckingham 2025; Budiarti et al. 2025; Demirci et al. 2025; Goga and Pujol-Valls 2020; Muela-Bermejo and Pérez-Martínez 2025; Telleria 2022).

Although attention toward sustainable education continues to increase, the implementation of ecoliteracy-based learning in ECE still faces several challenges. Despite growing attention to environmental education and Holistic Integrative ECE, their integration within early childhood learning still warrants further investigation. Previous studies have identified practical challenges in implementing experiential ecoliteracy activities, including limitations in time, learning facilities, and institutional readiness (Saputri & Waluyo 2024). At the same time, research on Holistic Integrative ECE in Indonesia indicates that the capacity and effectiveness of implementation may vary across institutions and service domains (Murtoko et al. 2025; Sholihatun et al 2024). These findings suggest the need to explore how environmental learning can be systematically connected with the broader educational, health, nutritional, parenting, protection, and welfare dimensions of Holistic Integrative ECE. Such integration may provide a more comprehensive pathway for developing children's ecoliteracy while supporting their holistic development. Zamzam et al., (2023) emphasized that introducing waste management and zero-waste concepts from an early age is important in building environmentally caring character and healthy living behavior among children.

In addition to environmental concerns, the growing presence of digital technology in children's daily lives underscores the importance of ensuring that young children continue to have meaningful opportunities for active play, direct social interaction, and engagement with the natural environment. The World Health Organization (WHO, 2019) recommends that sedentary screen time for children aged 3–4 years should not exceed one hour per day, with less being preferable, while emphasizing the importance of physical activity and active play. Similarly, (UNESCO, 2024) highlights the need to consider the broader context in which digital technology is used, including the nature of the content and the role of adult guidance. These considerations point to the importance of providing balanced early childhood learning experiences that integrate appropriate technology use with opportunities for face-to-face interaction, physical activity, and direct exploration of the environment. Nature-based ecoliteracy learning offers one way to achieve this balance by engaging children in meaningful experiences such as gardening, observing plants and animals, exploring outdoor spaces, and participating in collaborative environmental care activities. Through these experiences, children can develop environmental awareness while also practicing cooperation, communication, empathy, and shared responsibility. This perspective is consistent with (Louv 2008) discussion of the importance of children's direct experiences with nature. Thus, nature-based ecoliteracy learning can serve as a meaningful educational approach that connects environmental awareness with children's social-emotional development through active, collaborative, and nature-oriented experiences.

Several previous studies have examined environmental education, ecoliteracy, and sustainability learning in early childhood settings. These studies have demonstrated that environmental learning through nature exploration, gardening, outdoor activities, waste management, and other experiential approaches can support children's environmental knowledge, awareness, attitudes, and sustainable behaviors (Anggraeni, Ramdani, and Hidayah 2025; Ariyatun et al. 2024; Budiarti et al. 2025; Krannich and Reiser 2023; Rizquna Saputri and Waluyo 2024). Research conducted by Anggraeni, Ramdani, and Hidayah (2025) for

example, demonstrated that an ecoliteracy-oriented approach could strengthen children's environmental awareness and encourage positive behavioral changes in the context of climate change education in ECE. Daboti et al., (2025) reported that gardening and environmental exploration activities contributed to children's understanding of sustainability concepts, while Saputri and Waluyo (2024) demonstrated the potential of a Food Garden School program to develop ecoliteracy through direct environmental experiences.

Nevertheless, most of these studies have primarily focused on environmental learning outcomes or specific ecoliteracy activities, rather than examining how ecoliteracy can be systematically integrated into a Holistic Integrative ECE framework. In particular, the integration of environmental learning with health, parenting, and children's well-being requires further attention. These dimensions are important because young children's environmental attitudes and sustainable behaviors do not develop solely through classroom instruction but are also influenced by their physical well-being, daily routines, family practices, social interactions, and the environments in which they live and learn. Health and nutrition provide the physical and developmental foundation for children to participate actively in environmental experiences; parenting provides continuity between environmental values learned at school and sustainable practices within the family; while social-emotional well-being supports children's empathy, sense of responsibility, cooperation, and connection with their environment. Therefore, integrating ecoliteracy with health, parenting, and children's well-being within a Holistic Integrative ECE approach may provide a more comprehensive framework for fostering sustainable behaviors from early childhood.

This gap is particularly relevant to the achievement of the Sustainable Development Goals (SDGs), as Holistic Integrative ECE connects quality education with health and well-being, responsible consumption and production, and climate action. Accordingly, the present study addresses this gap by examining the integration of ecoliteracy within a Holistic Integrative ECE approach, with particular attention to how environmental learning can be connected with children's broader developmental and family contexts to support sustainable development.

This study aims to: (1) identify the role of ecoliteracy in early childhood education; (2) analyze the contribution of ecoliteracy-based learning to children's social-emotional development and health; and (3) examine the relevance of Holistic Integrative ECE in supporting the achievement of Sustainable Development Goals (SDGs).

The findings of this study are expected to provide conceptual and practical contributions for educators, parents, and policymakers regarding the importance of integrating environmental education into early childhood development. Furthermore, this study is expected to strengthen the discourse on sustainable education and climate awareness in early childhood education.

METHODS

This study employed a qualitative case study design to obtain an in-depth and contextual understanding of the integration of ecoliteracy within the Holistic Integrative Early Childhood Education (ECE) approach. A case study design was considered appropriate because the research focused on exploring a bounded educational setting, namely SPS Taam Fajrul Islam, and examining how ecoliteracy was integrated into its learning practices and holistic services. Qualitative case studies enable researchers to investigate educational phenomena within their natural settings and to understand the experiences, practices, interactions, and contextual factors that shape the phenomenon under investigation (Liamputtong 2020).

SPS Taam Fajrul Islam was purposively selected as the research site because the institution had implemented several environment-related learning and habituation activities, including healthy lifestyle practices, gardening, environmental exploration, simple waste management, and outdoor activities. These practices provided a relevant context for examining how environmental learning could be connected with the broader dimensions of Holistic

Integrative ECE. Nature-based learning can provide opportunities for children to interact directly with their surrounding environment and support the development of ecological knowledge, awareness, and environmental concern from an early age (Pitney et al. 2024).

The case was examined through multiple sources of qualitative data, including observations of learning activities, interviews with relevant participants, and documentation of educational practices and institutional programs. These sources were used to develop a comprehensive understanding of how ecoliteracy was planned, implemented, and connected with the educational and holistic developmental needs of young children.

The study involved nine adult informants: one principal, three teachers, and five parents. Observations were conducted with 15 children aged 5–6 years across six learning sessions involving three teachers. Each session lasted approximately 90 minutes, resulting in a total of nine hours of observation. The children were randomly selected from Class B. The group comprised nine boys and six girls.

Data were collected through classroom and outdoor observations, semi-structured interviews, and document analysis. The observations focused on teacher facilitation and children's participation in environment-related learning activities. The observation instrument was a guide validated by an expert in Early Childhood Education. Interviews were conducted in Indonesian during June 2026 and audio-recorded. A semi-structured interview guide was used for the principal, teachers, and parents; no separate protocol was developed specifically for the principal. The interview recordings were transcribed verbatim in Indonesian. Documentary data included relevant school programs, daily lesson plans, and activity photographs. During observations, the researcher acted as an observer and kept reflexive notes on assumptions, decisions, and the researcher's potential influence on the research setting.

Data analysis followed the interactive model of deMarrais, Roulston, and Copple (2024) comprising data condensation, data display, and conclusion drawing and verification. After organizing the interview transcripts, observation notes, and documents, the researcher [or identify the actual analyst(s)] coded the material. Codes were generated [inductively from recurring data, deductively from the research questions/conceptual framework, or through a stated combination; specify the actual process]. Related codes were grouped into categories and themes concerning ecoliteracy integration, nature-based learning, healthy-lifestyle and environmental-care habituation, children's participation, teacher strategies, parental involvement, and institutional support. The coded material was then organized in displays to compare patterns across participants, observation records, and documents. Conclusions were developed iteratively and checked against the underlying data, including evidence that did not fit an emerging interpretation. In this model, "data condensation" is used consistently for selecting, focusing, simplifying, and organizing the data; it is not listed as a separate stage alongside "data reduction."

The credibility of the data was addressed through source and technique triangulation. Source triangulation involved comparing information from the principal, three teachers, and five parents to identify similarities and differences in their perspectives on waste management and composting activities. The comparison focused on the research themes: children's understanding of organic and inorganic waste, awareness of waste reduction, involvement in composting activities, and environmental-care habits at school and at home.

Technique triangulation involved comparing interview accounts with relevant observation notes and documents. Interviews were used to explore participants' perspectives and experiences, while observations recorded children's behavior and participation during activities. Documents, such as lesson plans and activity photographs, provided context and supported the examination of information obtained through interviews and observations. Comparisons across techniques were made when the evidence referred to the same activity or theme.

For example, under the composting theme, teachers' accounts of introducing and collecting organic materials such as dry leaves and plant residues were compared with observation notes on children's participation. The notes were examined to determine whether children collected or sorted materials themselves or mainly observed the teacher's explanation. The lesson plans were then reviewed to establish whether composting was included in the planned learning activities. Photographs, where available, were used to document visible aspects of the activity. Lesson plans and photographs served as supporting evidence; on their own, they could not establish children's understanding or confirm the final outcome of the composting process.

The comparison was used to examine the relationship between participants' accounts, children's observed behavior, and supporting documents. When information from different sources and techniques was consistent, this convergence supported the interpretation that children had learning experiences through composting activities. When discrepancies arose for example, if a teacher reported that all children participated actively while observation notes showed that only some children were directly involved the differences were recorded and analyzed in light of the context and available evidence. The analysis therefore considered both convergence and divergence without assuming that all evidence would necessarily agree.

Member checking should be reported as a research procedure only if participants were actually asked to review transcripts, interview summaries, or specific interpretations. If it was conducted, the manuscript should state what participants reviewed and how their feedback was addressed. Similarly, the use of an audit trail should be described according to the records actually retained, such as interview and observation notes, supporting documents, coding records, and analytic decisions.

Overall, data credibility was strengthened through systematic comparison across sources and techniques, based on the evidence available for each theme. The Findings section should demonstrate this process by presenting relevant interview, observation, and documentary evidence together. Claims of triangulation should be limited to themes for which such comparisons were actually made.

RESULTS AND DISCUSSION

Identify The Role of Ecoliteracy in Early Childhood Education

The findings indicate that ecoliteracy at SPS Taam Fajrul Islam was integrated into daily learning and habituation rather than presented as a separate environmental topic. This finding was derived from six observation sessions involving three teachers and 15 children, with each session lasting 90 minutes, resulting in a total of nine hours of observation. The observed activities included gardening, outdoor environmental exploration, waste sorting, simple reuse of materials, healthy-lifestyle habituation, and collaborative environmental activities. These activities provided children with direct opportunities to interact with plants, natural materials, waste, and their surrounding environment. The observation findings showed that children's engagement was particularly visible during activities involving direct interaction with environmental objects. In gardening activities, for example, children participated in watering plants, observing plant conditions, and maintaining the activity area. The teachers accompanied the children by providing explanations, demonstrations, questions, and reminders.

Documentary Evidence of Planned Ecoliteracy Activities

The daily lesson plans provide documentary evidence of how waste-related learning was planned at SPS Taam Fajrul Islam in June 2026. The RPPH dated 22 June 2026, for children aged 5–6, included storytelling about waste, a video about the consequences of littering, a song about waste disposal, and a comparison between clean and littered environments. The RPPH dated 24 June 2026 planned activities on waste classification, including a waste-detective game,

painting waste containers, and sorting waste by type. The RPPH dated 26 June 2026 planned a video on waste utilization and a compost-making activity. The plans also listed checklists, anecdotal records, and children's work as assessment techniques. These documents show that ecoliteracy activities were incorporated into the planned learning sequence; they do not, by themselves, demonstrate that every activity was implemented or establish children's learning outcomes. A field note from the first observation session recorded:

> *"Children actively participated in the gardening activity. They took turns watering the plants and observing the leaves. The teacher explained that plants need water and care to grow and demonstrated how to water the plants appropriately when some children used too much water."*
>
> (Observation 1, Gardening Activity, June 2026)

This observation indicates that gardening provided opportunities for children to develop emerging values of care, responsibility, and appropriate use of natural resources. Importantly, children's enthusiasm was not interpreted as direct evidence of environmental understanding. Rather, emerging understanding was identified from children's responses and actions following teacher guidance. Similar patterns were observed during outdoor exploration and waste-sorting activities. During environmental exploration, children were encouraged to observe plants, leaves, soil, and other objects in their surroundings. Teachers used simple questions and reminders, including guidance not to damage plants. During waste-sorting activities, children were introduced to basic distinctions between organic and inorganic waste. Some children initially required assistance, and teachers responded through demonstrations, repetition, and corrective guidance. As recorded in the third observation session:

> *"Children were asked to identify and place organic and inorganic waste into the appropriate containers. Several children still needed teacher assistance, and the teacher repeated the demonstration and provided reminders when waste was placed incorrectly."*
>
> (Observation 3, Waste-Sorting Activity, June 2026)

These observations suggest that ecoliteracy development occurred through a gradual learning process supported by teacher scaffolding. The children's ability to engage in environmental practices was not assumed to indicate complete conceptual understanding. Rather, their responses to explanations, demonstrations, questions, and repeated practice were interpreted as signs of emerging understanding of cleanliness, responsibility, and environmental care. The observations also revealed connections between environmental learning, healthy-lifestyle habituation, and social development. Following outdoor activities, children were guided to clean the learning area, return materials to their appropriate places, and wash their hands. During collaborative activities, children shared materials, assisted peers, followed agreed procedures, and helped organize the learning environment. These practices can be understood within the framework of early childhood education for sustainability, which connects environmental responsibility with children's broader social and emotional learning. Watt and Frydenberg (2025) highlight the potential of sustainability-oriented early childhood education to support social-emotional learning alongside environmentally sustainable attitudes and behaviours. Similarly, Johnstone et al. (2022) found associations between nature-based early childhood education and developmental outcomes, including social skills, self-regulation, and social-emotional development, although the strength of the evidence varied across outcomes. Taken together, these findings suggest that nature-based ecoliteracy activities provide opportunities for children to practise environmental care, personal hygiene, cooperation, and social responsibility within meaningful, everyday learning experiences. Given

the qualitative case study design, these observations are interpreted as evidence of emerging practices and developmental opportunities rather than definitive proof of causal effects.

Teacher Scaffolding in Ecoliteracy Development

The observations indicate that teachers consistently supported children's learning through demonstrations, questions, explanations, prompts, reminders, corrections, and reinforcement. This support helped children participate in activities and connect concrete experiences with simple environmental concepts. Thus, teachers' roles extended beyond providing information to guiding children as they observed, identified, and handled environmental materials.

The Day 3 activity transcript illustrates this support during compost making. The teacher introduced materials such as dry leaves, wet leaves, kitchen waste, and soil. Children named some of the materials, after which the teacher organized them into groups and distributed equipment. The photographs complement the transcript by documenting the materials prepared for the activity, children participating in groups, and the teacher guiding them.



Figure 1. Waste Management Activities

The three teachers' accounts converged on the view that children's participation in compost-making required gradual involvement and teacher guidance. Teacher 1 explained, "We involve the children gradually. For example, they collect dry leaves from the school yard, and we explain that the leaves can be used as compost. The children are accompanied by a teacher when placing the materials in the composter" (Teacher 1 interview).

Teacher 2 emphasized the use of concrete examples and noted differences in children's understanding: "Some children can identify dry leaves as compost material, while others still confuse the types of waste. Therefore, we need to repeat the explanation and provide direct examples" (Teacher 2 interview).

Teacher 3 likewise described variation in participation, explaining that some children were enthusiastic about collecting leaves, whereas others needed encouragement and step-by-step guidance (Teacher 3 interview).

Comparing these accounts shows agreement among the teachers that compost-making activities should be adapted to children's varying levels of participation and understanding. The activity transcript provides complementary evidence: it records the teacher introducing compost materials, children naming some of them, and the teacher organizing the children into groups and distributing equipment. The photographs document the activity materials, children's participation, and the teacher's presence. Together, the three teachers' accounts demonstrate source triangulation, while comparison of the interviews with the activity transcript and photographs demonstrates methodological triangulation.

The combined evidence indicates that compost making was conducted as a concrete, teacher-guided learning activity in which children had opportunities to identify organic materials and participate in group tasks. The RPPH documents the activity as part of the planned learning sequence; the transcript records actions and interactions during the activity; the photographs document visible materials and participation; and the teacher interviews provide

perspectives on how children were guided and how their differing responses were understood. This convergence strengthens the interpretation that teacher scaffolding supported children's participation. However, the evidence does not establish that every child independently understood the composting process or that the final composting outcome was successful..

Table 1. Synthesis of Field Findings

Environmental Activity	Observable Child Behavior	Teacher Scaffolding	Emerging Ecoliteracy Value
Gardening	Watering and observing plants	Demonstration, explanation, reminders	Care and responsibility
Environmental exploration	Observing plants, leaves, soil, and surroundings	Questioning and guidance	Environmental awareness
Waste sorting	Identifying and placing waste	Demonstration, repetition, correction	Cleanliness and responsibility
Reuse activities	Reusing previously used materials	Modeling and explanation	Resource conservation
Healthy-environment habituation	Cleaning the area and washing hands	Reminders and reinforcement	Environmental and personal hygiene
Collaborative activities	Sharing, helping peers, and organizing materials	Guidance and reinforcement	Cooperation and responsibility

Overall, the field evidence suggests that the role of ecoliteracy in early childhood education extends beyond the transmission of environmental knowledge. At SPS Taam Fajrul Islam, ecoliteracy was developed through the integration of direct environmental experiences, teacher scaffolding, and repeated habituation. Direct experiences enabled children to encounter environmental concepts concretely, teacher scaffolding helped them interpret these experiences, and repeated practices provided opportunities to develop environmentally responsible behaviors.

These findings support (Davis 2021), who emphasized the importance of integrating environmental education into children's everyday experiences. They are also consistent with research indicating that gardening and direct interaction with nature can support children's environmental awareness and sustainability-related behaviors (Saputri & Waluyo 2024). Similarly, play-based environmental learning provides opportunities for children to engage meaningfully with their surroundings through active and contextual experiences (Cutter-Mackenzie and Edwards 2013a). However, the present findings provide a more specific explanation of how ecoliteracy was developed in the observed setting. Rather than assuming that participation or enthusiasm automatically indicates environmental understanding, the findings highlight the importance of teacher scaffolding in helping children connect environmental activities with values and behaviors. This suggests that ecoliteracy in ECE is strengthened not simply by providing environmental activities, but by intentionally guiding children to experience, understand, practice, and habituate environmentally responsible behaviors.

Within the Holistic Integrative ECE framework, these findings further indicate that environmental learning can be connected with other dimensions of children's development. Gardening supported care and responsibility, waste sorting promoted cleanliness and responsible behavior, healthy-environment habituation connected environmental education with health, and collaborative activities supported cooperation and social-emotional

development. Therefore, ecoliteracy can function as an integrated component of holistic early childhood development rather than as an additional or isolated learning activity.

Analyze the Contribution of Ecoliteracy-Based Learning to Children's Social-Emotional Development and Health

The findings indicate that ecoliteracy-based learning provided meaningful opportunities for supporting children's social-emotional development through participation in environmental activities. Based on six observation sessions involving three teachers and 15 children, the most consistently observed social-emotional behaviors included cooperation, sharing, helping peers, caring, responsibility, following rules, and behavioral regulation during group activities. These findings suggest that environmental activities created authentic social contexts in which children could practise social-emotional skills while interacting with nature and caring for their surroundings. This interpretation is consistent with the framework of Early Childhood Education for Sustainability (ECEfS), which positions sustainability learning as involving not only environmental knowledge and responsible behaviours but also children's social and emotional development. Watt and Frydenberg (2025), for example, found that participation in a nature-based sustainability program was associated with increased prosocial behaviour and empathy, alongside improvements in several social-emotional outcomes.

The relationship between the learning environment and children's social-emotional development is also supported by Tamblyn et al., (2023), whose systematic scoping review identified associations between physical, classroom, and outdoor environmental factors and children's social-emotional competence in early childhood education settings. In addition, Johnstone et al., (2022) reported positive associations between nature-based early childhood education and children's social skills, self-regulation, social-emotional development, and play interaction, although they emphasized that the overall certainty of evidence remained limited. More recent evidence from the Indonesian early childhood education context further emphasizes the importance of empathy, emotional regulation, cooperation, and prosocial behaviour as developmental foundations for education for sustainable development, highlighting the need to connect socio-emotional development with sustainability practices in culturally relevant ways. Taken together, these perspectives suggest that ecoliteracy-based learning can be understood not merely as environmental instruction but as a socially situated learning process in which children develop environmental responsibility through interaction, cooperation, and participation.

Cooperation and Sharing during Environmental Activities

Cooperation was one of the most visible social-emotional indicators during ecoliteracy-based activities. Gardening, ecological games, waste-sorting activities, and reuse activities were conducted in situations that encouraged children to interact with their peers. Children were required to share materials, take turns using tools, follow simple group rules, and participate in activities collectively. During gardening activities, for example, children did not work entirely independently. They took turns using available tools, shared materials, and assisted peers when necessary. One observation note recorded:

> *"The children worked together during the gardening activity. Several children took turns using the available tools and waited when another child was using the same tool. The teacher reminded the children to share the tools and give their friends an opportunity to participate."*
>
> (Observation 3, Gardening, June 2026)

This observation indicates that environmental activities created concrete opportunities for children to practise sharing, turn-taking, cooperation, and behavioural regulation. These behaviours can be interpreted through the social and emotional dimensions of ECEfS, in which

collaborative engagement with sustainability issues provides opportunities for children to develop interpersonal relationships, empathy, prosocial behaviour, and responsibility (Watt and Frydenberg 2025) The finding is also consistent with Johnstone et al. (2022), who identified social interaction and diverse forms of play as potential pathways through which nature-based early childhood education may support social-emotional development. Furthermore, Tamblyn et al. (2023) demonstrate that environmental characteristics within early childhood education settings can be associated with children's social and emotional competence, suggesting that the learning environment itself forms an important context for children's social development.

The findings can also be interpreted in relation to recent Indonesian scholarship on social-emotional development and education for sustainable development, which emphasizes cooperation, empathy, emotional regulation, and prosocial behaviour as important foundations for developing sustainable dispositions in early childhood. Thus, the contribution of ecoliteracy-based learning to social-emotional development was not derived solely from the environmental content of the activities, but also from the social interactions embedded within them. When children participated collectively in gardening, ecological games, waste sorting, and reuse activities, they encountered authentic situations that required them to coordinate their actions with peers, negotiate access to shared materials, follow mutually agreed rules, and respond to the needs of others. In this sense, nature-based ecoliteracy activities functioned as socially situated learning experiences in which environmental responsibility and social-emotional development could be practised simultaneously.

Caring and Prosocial Behavior

Another social-emotional indicator observed during the study was the emergence of caring and prosocial behavior. During environmental activities, children were encouraged to care for plants, maintain cleanliness, and assist peers who experienced difficulties. An observation note documented:

> *"When one child experienced difficulty completing the activity, another child helped by providing the required material and showing the procedure demonstrated by the teacher. The teacher reinforced the helping behavior and encouraged the children to support one another."*
>
> (Observation Session 4, June 2026)

This behavior indicates the emergence of prosocial responses, particularly helping and supporting peers. In the context of ecoliteracy-based learning, such behaviors developed through concrete situations in which children encountered the needs of others and responded appropriately. The teacher's role was important in reinforcing these behaviors by providing guidance and positive reinforcement during collaborative activities. This interpretation is consistent with the perspective of early childhood education for sustainability, which recognizes that sustainability learning can provide opportunities for children's social-emotional development alongside environmental responsibility (Watt and Frydenberg 2025). Recent research in the Indonesian early childhood education context also highlights cooperation, empathy, emotional regulation, and prosocial behavior as important social-emotional dimensions that can be connected with education for sustainable development (Listiana et al. 2026). The observation findings were further supported by an interview conducted with Teacher 1 on June 18, 2026. The teacher explained that helping and caring behaviors were intentionally encouraged during environmental activities:

> *"We always remind the children to help one another whenever a friend is having difficulty. If a child is unable to perform a task, we usually ask a peer who already knows how to do it to provide assistance or show them the way."*
>
> (Interview Teacher 1, June 18, 2026)

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The teacher further explained that repeated guidance was necessary to help children develop these behaviors:

> *"Children still need frequent reminders to help their peers and work together. If this is done repeatedly, they begin to get into the habit of offering help and looking out for friends who are in need."*
>
> (Interview Teacher 1, June 18, 2026)

These interview accounts provide additional evidence that helping and caring behaviors were supported through intentional teacher guidance and repeated opportunities for collaborative participation. The convergence between observation and interview data strengthens the interpretation that helping and caring behaviors were emerging within the children's everyday environmental learning experiences rather than occurring as isolated incidents. Caring behavior was also observed in children's interactions with living things. During gardening activities, teachers reminded children to handle plants carefully and avoid damaging them. One observation note stated:

> *"The teacher reminded the children not to pull or damage the leaves. The children then handled the plants more carefully. The teacher explained that plants are living things that need to be cared for."*
>
> (Observation Session 3, June 2026)

This observation was also supported by the interview with Teacher 1 on June 18, 2026. The teacher explained how caring for plants was introduced as part of children's environmental habituation:

> *"We teach the children that plants are also living things that must be cared for. So, when they are working in the garden, the children are reminded not to pull off leaves or damage the plants. We constantly remind them to be careful."*
>
> (Interview Teacher 1, June 18, 2026)

The convergence of observational and interview data suggests that caring for plants was intentionally incorporated into children's environmental learning and supported through teacher explanation, reminders, and repeated practice. From the perspective of nature-based early childhood education, direct engagement with natural environments can provide meaningful opportunities for children to develop social interaction, self-regulation, and social-emotional competencies (Johnstone et al. 2022). Similarly, the learning environment itself can provide an important context for children's social and emotional development, particularly when children are given opportunities to interact, participate, and engage in meaningful activities (Tamblyn et al. 2023). Within an education-for-sustainability perspective, caring for living things can also be understood as an early form of practising responsibility and environmentally appropriate behaviour (Watt and Frydenberg 2025).

However, children's caring behavior toward plants should not be equated directly with fully developed empathy or a stable environmental disposition. Rather, the observation and interview data indicate emerging caring behaviors that were gradually supported through teacher guidance, repeated practice, and children's direct experiences with living things. Thus, ecoliteracy-based learning provided a contextual and socially meaningful setting in which children could practise helping others, caring for living things, and taking responsibility for their immediate environment. The findings therefore suggest that the social-emotional contribution of ecoliteracy-based learning emerged not only from the environmental content of the activities but also from the interpersonal interactions, teacher scaffolding, and repeated opportunities for children to practise caring and prosocial behaviors.

Responsibility and Behavioral Regulation

The development of social-emotional competence was also reflected in children's emerging ability to follow simple rules, regulate their behaviour, and take responsibility for their roles during environmental activities. Throughout the six observation sessions, teachers established simple behavioural expectations, such as taking turns, caring for plants, placing waste in appropriate containers, using materials appropriately, and returning tools after activities. At the end of activities, children were encouraged to organize materials and clean the learning environment. The observation record indicated:

> *"After the activity, the teacher asked the children to return the tools and clean the activity area. Most of the children followed the instructions and helped organize the materials with their peers."*
>
> (Observation 5, Environmental Clean-up Activity, June 2026)

This observation illustrates how ecoliteracy-based activities created authentic opportunities for children to practise responsibility and behavioural regulation. Rather than simply following adult instructions, children were expected to manage their actions within a shared environment, consider the use of common materials, and participate in maintaining the learning space. This interpretation is consistent with the social-emotional dimension of early childhood education for sustainability, in which children develop responsibility, participation, cooperation, and socially appropriate behaviours through meaningful engagement with sustainability-related activities (Watt and Frydenberg 2025). Recent research in the Indonesian early childhood education context similarly identifies self-regulation, cooperation, empathy, and prosocial behaviour as important dimensions of children's social-emotional development in relation to education for sustainable development (Listiana et al. 2026).

The observed turn-taking behaviour provides a particularly relevant example of emerging self-regulation. When children waited for their turn to use a gardening tool, they had to regulate their immediate desire to access the resource and recognize the participation rights of their peers. This interpretation is supported by Johnstone et al. (2022), whose systematic review identified self-regulation and social skills among the developmental outcomes associated with nature-based early childhood education, although the authors noted variation in the strength of evidence across outcomes. In addition, Tamblyn et al. (2023) emphasize that physical, classroom, and outdoor environmental conditions can provide important contexts for children's social and emotional development. Within the present study, the outdoor and activity-based environment therefore provided children with concrete situations in which behavioural regulation could be practised rather than taught only through verbal instruction.

Responsibility was also evident when children returned tools, disposed of waste appropriately, and participated in cleaning the learning area. These behaviours suggest an emerging understanding that individual actions have consequences for shared spaces and other members of the group. Thus, following rules in this context was not interpreted merely as obedience to teachers. Instead, it represented an emerging capacity to regulate behaviour, participate cooperatively, and assume responsibility within a shared social and environmental context. However, because the study employed a qualitative case study design, these observations should be interpreted as evidence of emerging self-regulatory and responsible behaviours rather than as evidence of fully developed or stable self-regulation. Repeated environmental practices, teacher scaffolding, and opportunities for collaborative participation appeared to provide a meaningful context for children to practise these competencies.

Teacher Scaffolding in Social-Emotional Development

An important finding across the six observation sessions was the consistent role of the three teachers in providing scaffolding for children's social-emotional development. Teachers used modeling, reminders, guidance, turn-taking arrangements, positive reinforcement, and

mediation when children experienced difficulties during social interactions. For example, when several children wanted to use the same tool, the teacher guided them to take turns rather than simply selecting one child to use it. When a child helped a peer, the teacher reinforced the behavior by acknowledging the importance of helping others. When children demonstrated inappropriate behavior toward plants or materials, the teacher provided reminders and explanations. This finding suggests that environmental activities did not automatically produce social-emotional development. Rather, the development of these skills was supported by intentional teacher facilitation of children's social interactions. The role of scaffolding is particularly important because young children are still developing their ability to regulate emotions and behavior in social situations. Environmental activities provide the context, while teacher guidance helps children understand and practice appropriate ways of interacting with peers, living things, and their shared environment.

Tabel 2. Relationship between Ecoliteracy and Social-Emotional Development

Ecoliteracy-Based Activity	Observed Social-Emotional Behavior	Social-Emotional Indicator
Collaborative gardening	Sharing tools and taking turns	Cooperation and behavioral regulation
Caring for plants	Handling plants carefully	Caring and responsibility
Waste sorting	Following rules and working together	Responsibility and cooperation
Reuse activities	Sharing materials and helping peers	Prosocial behavior
Ecological games	Participating according to group rules	Cooperation and self-regulation
Environmental clean-up	Completing tasks together	Responsibility and cooperation

The table demonstrates that the relationship between ecoliteracy and social-emotional development primarily occurs through the social interactions embedded within environmental activities. Children practiced social-emotional skills when they had to share resources, cooperate with peers, wait for their turns, help others, follow rules, and take responsibility for shared tasks.

These findings can be interpreted through the ecoliteracy and early childhood environmental education perspectives introduced in the Introduction, as well as the Holistic Integrative Early Childhood Education (HI-ECE) (PERPRES No. 60 Tahun 2013 tentang Pengembangan Anak Usia Dini Holistik-Integratif)framework. During the composting activity, children encountered organic materials directly and participated in a teacher-guided group task. This connected ecological concepts with a practical, everyday activity and gave children opportunities to observe, discuss, and handle materials from their environment. Such an interpretation is consistent with early childhood environmental education approaches that emphasize meaningful, experience-based engagement with the environment (Elliott 2014; Cutter-Mackenzie and Edwards 2013b) The activity also illustrates how environmental learning may be integrated with the educational and developmental dimensions of HI-ECE. Children’s participation in a shared task provided opportunities to practice cooperation and responsibility; however, the observations do not establish individual learning outcomes or changes in social-emotional development.

The findings are also consistent with Anggraeni (2023a, 2024b) study of Project-Based Learning, which found that collaborative learning activities supported cooperation and social interaction among children aged 5-6 years. The present study extends this perspective by showing that environmental activities can provide a concrete and meaningful context for practicing social-emotional skills. Children were not simply working in groups; they were

collaborating around meaningful environmental purposes, such as caring for plants, maintaining cleanliness, and managing environmental materials.

This finding positions ecoliteracy as more than an approach for developing environmental awareness. When intentionally facilitated by teachers, ecoliteracy-based learning can serve as a pedagogical context for fostering children's social-emotional development through concrete, collaborative, and repeated experiences. Within the Holistic Integrative ECE framework, this integration is particularly relevant because environmental learning can simultaneously provide meaningful opportunities for children to develop relationships with peers, teachers, living things, and their shared environment.

Conceptual Alignment of Holistic Integrative ECE and Ecoliteracy with the Sustainable Development Goals (SDGs)

The findings indicate that ecoliteracy-based learning at SPS Taam Fajrul Islam was integrated with the five dimensions of Holistic Integrative Early Childhood Education (ECE), namely education; health, nutrition, and care; parenting; protection; and child well-being. The integration was reflected in daily activities such as gardening, environmental exploration, waste sorting, reuse of materials, environmental clean-up, handwashing, healthy food habituation, and family involvement. Thus, ecoliteracy was not implemented as a separate environmental topic but was incorporated into children's learning and daily habituation.

The education dimension was reflected through nature-based and experiential learning. Children learned about plants, waste, cleanliness, and environmental care through direct experiences rather than theoretical explanations. During the six observation sessions, children participated in gardening, environmental exploration, waste sorting, and reuse activities. Teachers supported these activities through explanations, demonstrations, questions, and reminders. These practices are conceptually aligned with SDG 4 (Quality Education) because they reflect meaningful, contextual, and participatory learning. This study did not measure SDG 4 achievement indicators. The findings are consistent with (Noguchi 2022), who emphasized that sustainability education in early childhood is more meaningful when introduced through contextual and experience-based learning. Similarly, , Biswas et al., (2025) and Jia and Wang (2024) reported that environmental learning in early childhood can strengthen children’s environmental awareness and sustainability-oriented behaviors. The present study extends this discussion by examining how environmental learning can be embedded within the broader framework of Holistic Integrative ECE.

The health, nutrition, and care dimension was evident in the connection between environmental activities and healthy-living practices. After outdoor activities, teachers guided children to wash their hands, clean the activity area, and return learning materials to their appropriate places. Healthy food habits were also introduced through daily routines. These practices connect environmental education with personal hygiene, environmental cleanliness, and children’s physical well-being, and are conceptually aligned with SDG 3 (Good Health and Well-being). No SDG 3 achievement indicators were measured. This finding is consistent with McKenna (2023), who discussed the potential of integrated health and environmental education to develop healthy habits and environmental responsibility among young children. The present finding indicates that health and environmental learning may be addressed together through everyday routines.

The parenting dimension was reflected in the involvement of five parents who reinforced environmental practices at home. Parents reported encouraging children to maintain cleanliness, reduce unnecessary plastic use, and participate in simple gardening activities. This finding indicates that environmental learning was extended beyond the school environment and reinforced within the family. Such continuity is important because children's habits develop through repeated experiences across different social environments. The finding supports Anggraeni (2023b), which highlighted the importance of parental involvement and school-

family communication in sustaining children's learning experiences. However, the present study provides a more specific connection by showing that parental participation can help extend ecoliteracy-related habits from school into everyday family practices. This dimension is conceptually aligned with SDG 4 through continuity of learning and with SDG 12 (Responsible Consumption and Production) through responsible environmental habits. These practices are not evidence of SDG achievement.

The protection dimension was demonstrated through teachers' supervision and guidance during environmental activities. Teachers ensured that children used learning materials appropriately, interacted safely with plants and other natural objects, and followed simple rules during outdoor activities. Teachers also reminded children not to damage plants or misuse materials. These practices indicate that environmental exploration was conducted within a safe and supportive learning environment. These practices are conceptually related to the health, safety, and well-being themes of SDG 3; no SDG 3 achievement indicators were measured. It also demonstrates that environmental education should not only encourage children's exploration but also provide appropriate adult supervision and protection.

The child well-being dimension was evident through children's participation in collaborative environmental activities. During gardening, ecological games, and environmental clean-up, children were observed sharing materials, taking turns, helping peers, and taking responsibility for shared spaces. These experiences provided opportunities for children to participate actively and develop positive relationships within the learning environment. These observations are conceptually aligned with well-being and meaningful-learning themes associated with SDG 3 and SDG 4. They do not demonstrate achievement of either SDG.

Table 3. Conceptual Mapping of Holistic Integrative ECE, Ecoliteracy, and Selected SDGs

Holistic Integrative ECE Dimension	Ecoliteracy-Based Practice	SDG Theme Referenced	Conceptual Alignment
Education	Gardening, exploration, waste sorting	SDG 4	Experiential and participatory learning is conceptually aligned with SDG 4.
Health, nutrition, and care	Handwashing, cleanliness, healthy food habits	SDG 3	Health, hygiene, and care practices are conceptually aligned with SDG 3.
Parenting	Gardening and environmental habits at home	SDG 4, SDG 12	Home–school continuity and responsible habits are conceptually aligned with SDG 4 and SDG 12
Protection	Supervised outdoor activities and care for living things	SDG 3	Supervised activities are conceptually related to health, safety, and well-being themes in SDG 3.
Child well-being	Cooperation, environmental games, helping peers	SDG 3, SDG 4	Participation and positive relationships are conceptually related to well-being and meaningful learning themes in SDG 3 and SDG 4
Cross-dimensional integration	Waste reduction, reuse, and plant care	SDG 12, SDG 13	Waste reduction, reuse, and plant care provide learning contexts conceptually aligned with

	sustainability themes in SDG 12 and SDG 13.

The matrix presents the researchers' conceptual interpretation of how ecoliteracy may connect the five dimensions of Holistic Integrative ECE with selected SDG themes. One activity may relate to several dimensions. For example, gardening can be interpreted in relation to education when children learn about plant growth, health and care when they practice hygiene after outdoor activities, parenting when related activities are continued at home, protection when teachers supervise children's interaction with plants and tools, and well-being when children cooperate and participate. These relationships represent conceptual alignment; they should not be interpreted as evidence that the institution achieved any SDG target.

The findings of this study generally confirm previous research showing that environmental and sustainability education in early childhood is most effective when children are involved in direct, meaningful, and contextual experiences. (Noguchi 2022) emphasized the importance of experiential and participatory approaches to sustainability education, while Biswas et al., (2025) and Jia and Wang (2024)reported that ecoliteracy-oriented learning can support environmental awareness and sustainability-related behaviors among young children. The present findings are consistent with these studies because children at SPS Taam Fajrul Islam learned through direct interaction with plants, waste, outdoor spaces, and environmental activities.

However, the present study differs from studies that primarily examine ecoliteracy as an environmental education strategy. The findings demonstrate that ecoliteracy was implemented within a Holistic Integrative ECE framework, allowing environmental activities to be connected with education, health and care, parenting, protection, and child well-being. In this respect, the study provides a broader interpretation of ecoliteracy by positioning it not only as a means of developing environmental awareness but also as a contextual mechanism for integrating multiple dimensions of early childhood services.

The findings concerning parental involvement are also consistent with Anggraeni (2023b), who highlighted the importance of school-family collaboration in supporting children's learning. Nevertheless, this study further indicates that parental involvement is particularly important for sustainability education because environmental habits require continuity between school and home. Similarly, the connection between environmental activities and health practices supports McKenna (2023), who identified the potential relationship between environmental and health education. The present study adds that this relationship can be operationalized through simple daily routines, such as handwashing, environmental cleanliness, and healthy food habituation.

The findings reaffirm Bronfenbrenner's Ecological Systems Theory as the grand theoretical basis for understanding the integration of ecoliteracy within Holistic Integrative ECE. Bronfenbrenner's theory explains that children's development occurs through continuous interaction between children and the multiple environments in which they participate. In the present study, children's environmental learning was shaped by interactions among the child, teacher, peers, school environment, family, and natural environment. At the microsystem level, children directly interacted with teachers, peers, plants, waste materials, and the physical environment during learning activities. These immediate interactions provided opportunities for children to practice environmental responsibility, cooperation, care, and healthy habits. At the mesosystem level, the relationship between school and family became evident when parents continued environmental habituation at home. This connection demonstrates that children's experiences across school and family environments can reinforce one another.

The findings therefore reaffirm the central proposition of ecological systems theory that children's development cannot be understood independently from their surrounding environments. The natural environment, school environment, and family environment

functioned as interconnected contexts that supported children's learning and habituation. This theoretical perspective also helps explain why the implementation of ecoliteracy was more meaningful when environmental activities were connected with teacher guidance, peer interaction, family participation, and daily routines.

The theory is further supported by the findings because the development of sustainable behavior was not observed as the result of a single environmental activity. Instead, it emerged through repeated interactions within interconnected environments. Gardening, waste sorting, hygiene routines, environmental clean-up, and family practices provided repeated contexts in which children could experience and practice sustainability-related behaviors. Thus, the findings strengthen the relevance of Bronfenbrenner's ecological perspective in explaining how environmental experiences and social contexts interact in early childhood development.

The findings suggest that SDG-related themes need not be introduced to young children as abstract global concepts; they can instead be explored through developmentally appropriate everyday experiences. SDG 3 can be introduced through hygiene, healthy food, and clean environments; SDG 4 through meaningful and experiential learning; SDG 12 through waste sorting, reuse, and responsible use of materials; and SDG 13 through caring for plants and developing awareness of environmental responsibility.

The observed practices can be interpreted as conceptually aligned with selected SDG themes because they connect sustainability with children's everyday experiences. Ecoliteracy may provide a practical link between the five dimensions of Holistic Integrative ECE and sustainability-oriented practices. The findings illustrate how environmental education, health, parenting, protection, and well-being may be addressed through interconnected daily activities; they do not establish SDG achievement.

Overall, the findings are consistent with research on experiential environmental education in early childhood, which emphasizes children’s direct and guided engagement with their surroundings (Elliott 2014; Cutter-Mackenzie and Edwards 2013b). Viewed through the Holistic Integrative Early Childhood Education (HI-ECE) (Peraturan Presiden (Perpres) 2013) framework, the observed ecoliteracy practices such as waste sorting, composting, and environmental-care activities show conceptual alignment with SDG 4 (quality education), SDG 12 (responsible consumption and production), and, in relation to healthy-environment habits, SDG 3 (good health and well-being). Their connection to SDG 13 (climate action) is conceptual and should be interpreted cautiously, as the study did not assess children’s climate-related knowledge or action. The research examined practices at one institution through six observation sessions and did not measure specific SDG indicators. Therefore, the findings describe the practices observed and their possible conceptual relevance to selected SDGs; they do not demonstrate that the institution achieved any SDG target.

CONCLUSION

This study concludes that the integration of ecoliteracy within Holistic Integrative Early Childhood Education (ECE) at SPS Taam Fajrul Islam can be understood through three main findings. First, ecoliteracy was integrated into daily learning through gardening, environmental exploration, waste sorting, reuse of materials, environmental care, and outdoor activities. These practices were supported by teacher scaffolding, including explanations, demonstrations, questions, reminders, and reinforcement, which helped children develop emerging understanding of environmental responsibility through direct experience.

Second, ecoliteracy-based learning provided meaningful contexts for children’s social-emotional development and healthy habits. Children were observed cooperating, sharing materials, helping peers, caring for plants, maintaining cleanliness, and following healthy routines. These findings indicate that environmental activities can simultaneously provide

opportunities for developing responsibility, cooperation, empathy, and healthy behavior when supported by appropriate teacher guidance.

Third, the integration of ecoliteracy was relevant to the five dimensions of Holistic Integrative ECE education; health, nutrition, and care; parenting; protection; and child well-being and was aligned with SDG 3, SDG 4, SDG 12, and SDG 13. The findings therefore reaffirm that ecoliteracy can serve as a practical bridge between children's everyday learning experiences, holistic development, and sustainability-oriented education.

This study has several limitations. First, the research was conducted at only one early childhood education institution, SPS Taam Fajrul Islam, with a relatively small number of participants. Therefore, the findings provide an in-depth understanding of the particular context but cannot be generalized to all Holistic Integrative ECE institutions. Second, the study employed a qualitative case study design and relied primarily on observations, interviews, and documentation. The findings consequently describe emerging patterns and practices rather than measuring the causal effect of ecoliteracy-based learning on children's development. Third, the observation was conducted over six sessions involving three teachers and 15 children, so longer-term changes in children's environmental behavior could not be examined comprehensively.

Future research should therefore involve multiple ECE institutions with different geographical, social, and educational contexts to examine whether similar patterns of ecoliteracy integration emerge across settings. Further studies could also employ longitudinal or mixed-method approaches to examine changes in children's ecoliteracy, social-emotional development, healthy behavior, and sustainability-oriented practices over a longer period. In addition, future research could investigate more specifically how teacher scaffolding, parental involvement, and institutional support influence the development and sustainability of ecoliteracy practices within the Holistic Integrative ECE framework.

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