

Integration of Health Education and Character Building in Children through Ecoliteracy Learning: A Multiple Case Study in Early Childhood Education

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Abstract

This research examines ecoliteracy-based learning practices that integrate health education and character building in Early Childhood Education settings using a qualitative multiple case study approach. The research uses a qualitative approach with a multiple case study design conducted in three Early Childhood Education institutions in the city of Pangkalpinang, Bangka Belitung Islands Province. Data were collected through participatory observation, in-depth interviews with teachers and parents, as well as document studies, and then analyzed using thematic analysis assisted by NVivo. Research results indicate that ecoliteracy implementation in Early Childhood Education is manifested through three principal patterns: routine-based habituation, narrative-reflective learning and participatory experiential activities. Collectively, these three approaches demonstrate how ecological awareness, clean and healthy lifestyle practices, and holistic character development are meaningfully integrated in children's daily learning experiences. In addition to increasing environmental awareness, ecoliteracy-based learning also contributes to strengthening values of responsibility, discipline, empathy, and cooperation in young children. The findings position ecoliteracy as an integrative pedagogical approach relevant to sustainability, health, and character education, with implications for educators and policymakers in developing sustainability-oriented early childhood learning.

Keywords: character education; ecoliteracy; early childhood education; health education; lifelong learning

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Introduction

Early Childhood Education plays a foundational role in shaping children's behavior, character and life skills during critical developmental periods. Early childhood is widely recognized as a golden age, a phase in which cognitive, emotional, and behavioral patterns are formed rapidly and tend to persist across the life course. Values, habits, and learning experiences acquired during this stage significantly influence individual behavior in adulthood, including attitudes toward health, the environment, and social responsibility (Anggraeni, 2023). Consequently, the early internalization of pro-environmental behavior, healthy lifestyles, and character values is widely viewed as a strategic investment in the long-term quality of human resources.

At the global level, ECE systems are increasingly challenged by interconnected crises, particularly environmental degradation, declining moral values, and persistent child health problems. Empirical studies demonstrate that environmental conditions and family-level health literacy have a direct impact on early childhood development outcomes, affecting both physical growth and socio-emotional well-being (Ha et al., 2023). These challenges highlight the need for educational approaches that do not merely transmit knowledge but actively cultivate sustainable habits and responsible behavior from an early age. In the Indonesian context, environmental problems present a pressing national concern. National waste generation has reached approximately 56.63 million tons per year, with 60.99% of this waste remaining inadequately managed. Household waste constitutes the largest proportion, indicating that environmentally responsible behavior has

not yet been systematically embedded in daily practices (Putra, 2025). This condition reflects not only infrastructural limitations but also behavioral and cultural gaps, suggesting that environmental awareness and responsibility have not been sufficiently cultivated through formal and informal education, including at the early childhood level.

Beyond environmental issues, child health challenges remain equally critical. The 2024 Indonesian Nutrition Status Survey reports that national stunting prevalence has declined to 19.8%, yet this figure still represents millions of children who remain vulnerable to growth and developmental impairments (Aurelia, 2025). Empirical evidence indicates that stunting is closely associated with low health literacy, inadequate clean and healthy living behavior as well as unsustainable household waste management practices (Irhamni, 2024). These overlapping conditions demonstrate that environmental behavior, sanitation, and child health constitute structurally interconnected issues, rather than isolated sectoral problems.

Within this context, ecoliteracy-based habituation in Early Childhood Education emerges as a strategic long-term intervention. Recent studies in developmental and educational sciences emphasize that early childhood represents a sensitive period for behavioral consolidation, during which repeated daily practices are internalized into stable behavioral patterns (Herreras, 2024). Contemporary longitudinal research further confirms that early exposure to pro-environmental and health-related routines such as waste segregation, personal hygiene, and environmental care significantly increases the persistence of environmentally responsible and health-conscious behavior into later childhood and adulthood (Madanipour et al., 2025). Through structured routines, play-based pedagogy, and adult role modeling within ECE settings, ecoliteracy operates as a mechanism of behavioral habituation, not merely as cognitive knowledge transmission.

Therefore, integrating ecoliteracy, health education, and character development within Early Childhood Education functions as a theory of change that links micro-level behavioral habituation to macro-level societal outcomes. By shaping environmentally responsible and health-aware behaviors at the earliest developmental stage, Early Childhood Education contributes to long-term reductions in household waste mismanagement, gradual improvements in public health indicators, and the cultivation of a more sustainable and resilient society. This perspective positions Early Childhood Education not only as a pedagogical space, but also as a strategic entry point for addressing national-scale environmental and health challenges through preventive and transformative education.

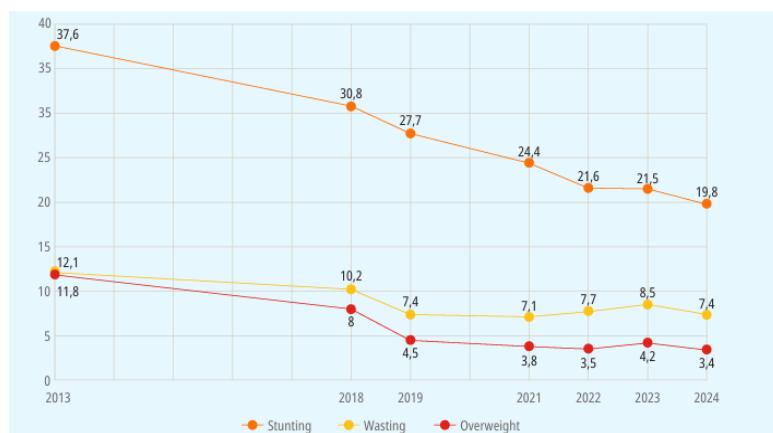


Figure 1. Nutritional Status of Under-Five Children in Indonesia, 2013-2024 (UNICEF, 2025)

On the other hand, access to and the equal distribution of Early Childhood Education services in Indonesia still face structural issues. Although the number of Early Childhood Education units has reached 198,482 institutions, the Gross Enrollment Rate (GER) for Early Childhood Education remains around 36.03%, with approximately 4 million children aged 1–6 years not yet served by Early Childhood Education, especially in remote areas and among vulnerable communities (Yulianti, 2025). This situation indicates that Early Childhood Education has not fully become a strategic priority in national education policy, which impacts the limitations of access and service quality (Afifah, 2023). Nonetheless, data shows that around 76.54% of first-grade elementary school children have attended Early Childhood Education, highlighting the strategic role of Early Childhood

Education in preparing children's readiness for learning holistically, including aspects of health, character, and ecological awareness (Nurkolis et al., 2023).

In this context, the ecoliteracy approach becomes one of the relevant strategies in addressing the challenges of sustainable education in Early Childhood Education. Ecoliteracy was first introduced by Capra & Stone in Oktapyanto (2018), not only focusing on mastery of environmental knowledge, but also fostering awareness of the interconnectedness of humans and nature, ecological responsibility, as well as environmentally friendly life habits. Several studies emphasize that ecoliteracy-based learning has the potential as an integrative approach in instilling ecological awareness, moral values, and healthy living behaviors from an early age.

Introduction to green behavior through ecoliteracy in early childhood has been proven to foster environmental awareness through habituation, direct experience, and role modeling in the learning process (Putri & Niakwanti, 2018). In addition, the concept of ecoliteracy, rooted in Capra's thinking, emphasizes the importance of understanding the interconnectedness between humans, the environment, and life systems as the foundation of education oriented towards sustainability and the development of holistic child character (Erlangga, 2024).

In the Indonesian context, research shows that environment-based learning contributes to increasing ecological awareness and the development of early childhood character (Berman, 2021); (Dabotri et al., 2025). Recent studies also indicate that the implementation of ecoliteracy in Early Childhood Education is carried out through various approaches, such as project-based learning, nature-based learning, and the use of environment-based learning media, which can enhance the engagement of both children and teachers in the learning process (Dos Santos et al., 2024). However, existing the implementation of ecoliteracy in Early Childhood Education are often fragmented and activity-based, with limited integration of health education and systematic character development. This gap highlights the need for a more holistic pedagogical framework (Anggraeni, 2024); (Bertoldi, 2024).

Previous research has established that ecoliteracy-based learning contributes to increased environmental awareness and supports the development of discipline and responsibility in early childhood (Anggraeni & Yanti, 2024); (Ghorbanpour & Davari, 2024). However, this body of research remains partial in two critical respects. First, most studies emphasize cognitive understanding or isolated environmental practices, without examining how ecoliteracy is pedagogically integrated with health education (clean and healthy living behavior) and character development within everyday learning processes. Second, the mechanisms through which such integration occurs in daily classroom routines, narratives, and social interactions remain underexplored.

This partial focus has important theoretical consequences. When ecoliteracy, health education, and character formation are treated as separate learning domains, early childhood learning risks becoming fragmented, limiting the internalization of values and the sustainability of behavior change. In contrast, early childhood education requires pedagogical approaches that operate holistically, embedding knowledge, habits, and values within children lived experiences that connects environmental education, health education, and character building within a comprehensive learning framework.

This research addresses this gap by examining ecoliteracy as an integrative pedagogical approach that connects environmental education, health education, and character building through everyday learning practices in Early Childhood Education. The novelty of this research lies in its focus on the mechanism of integration, demonstrating how ecoliteracy structures clean and healthy living habits, internalizes responsibility and discipline, and strengthens children's socio-emotional awareness through routine-based, narrative-reflective, and participatory learning experiences. By doing so, this study advances ecoliteracy theory within the Early Childhood Education domain and offers practical insights for educators and policymakers in designing sustainability-oriented early childhood learning responsive to 21st-century challenges.

Methodology

This research uses a qualitative approach with a multiple case study design to gain an in-depth understanding of the implementation of ecoliteracy-based learning integrated with health education and

character development in Early Childhood Education settings. The qualitative approach was chosen because it allows the researcher to explore the meanings, processes, and dynamics of interactions occurring within the natural learning context of young children. The multiple case study design is used to identify patterns of similarities and differences in practices across sites through literal and theoretical replication logic, so that the findings can be understood more comprehensively within the framework of ecoliteracy (Creswell, 2020).

The research subjects were selected purposively, taking into account variations in social context, institutional characteristics, and pedagogical approaches. This research was conducted in three Early Childhood Education in Pangkalpinang City, Bangka Belitung Islands Province, namely: (1) Raudhatul Athfal Bustanul Athfal Aisyiyah, an Islamic-based Early Childhood Education located in a semi-urban area with a teacher-child ratio of 1:12; (2) Al-Fazza Islamic School Playgroup, a pesantren community-based Early Childhood Education with a teacher-child ratio of 1:15; and (3) Pangkalpinang Independent Kindergarten, a self-funded Early Childhood Education in a rural area with a teacher-child ratio of 1:10. The selection of these three institutions aimed to represent the diversity of early childhood learning contexts while enriching cross-site analysis.

The research participants consisted of 39 individuals, comprising 9 teachers, 12 parents, and 18 children, with a relatively balanced distribution across each institution. The involvement of teachers and parents was essential to capture pedagogical perspectives and habitual practices in both school and family environments. Data were collected over three months, from September to November 2025, using participatory observation, in-depth interviews, and document studies. Participatory observation was conducted two to three times per week at each site to examine learning practices, teacher-child interactions, and children's responses to ecoliteracy, health, and character education activities, with all observations documented in descriptive and reflective field notes.

In-depth interviews were carried out in a semi-structured manner with teachers and parents to explore their understanding, experiences, and perceptions regarding the implementation of ecoliteracy-based learning, while documentation included lesson plans, activity photographs, children's work, and audio recordings to support the analysis process. All research interactions were conducted primarily in Indonesian, with limited use of local Sundanese expressions when appropriate for child communication (Machali, 2024). Prior to data collection, ethical clearance was obtained from the relevant institutional authority, and informed consent was secured from teachers and parents; ethical principles related to child participation, including voluntary involvement, confidentiality, and non-harm, were strictly observed.

It should be noted that data concerning children's behaviors and understanding were largely mediated through observations and reports from teachers and parents, without the application of direct child-centered methods such as drawings or child-friendly interviews, which may introduce social desirability bias and limit the depth of children's perspectives. Additionally, given the three-month duration of the study, the findings are interpreted cautiously as reflecting early indications of habit formation or initial stages of value internalization rather than fully internalized behaviors. This cautious interpretation is consistent with contemporary formulations of behavior change theory, particularly the Transtheoretical Model, which conceptualizes behavioral change and value adoption as a gradual, stage-based process that unfolds over time, from initial awareness and engagement to maintenance and internalization (Koch et al., 2025).

The research instruments consisted of semi-structured interview guidelines and observation sheets developed based on indicators of ecoliteracy, healthy and cleanliving behaviors, and character development in early childhood, encompassing children's environmental understanding, personal hygiene practices, care for nature, and values of responsibility, discipline, and cooperation. Instrument validation was conducted through expert judgment involving two Early Childhood Education experts and one environmental education expert, guided by systematic criteria of content relevance, construct clarity, contextual appropriateness, integration and coherence among indicators, and practical usability. Experts assessed the alignment of each item with theoretical constructs, its conceptual and developmental suitability for early childhood, and its feasibility for observation and interviews, and their feedback was used to clarify indicators, simplify wording, eliminate redundancies, and strengthen alignment with research objectives, thereby ensuring the validity, clarity, and applicability of the instruments and enhancing the credibility of the research findings (Miles et al., 2020).

Data analysis was conducted using a thematic analysis approach, following the stages of data reduction, data presentation, and conclusion drawing as proposed by (Sugiyono, 2022). The coding process began with the development of a codebook that combined a deductive approach based on the theories of ecoliteracy, health education, and character education, as well as an inductive approach derived from field findings. The unit of analysis was focused on learning events and practice narratives that represented the integration of ecological, health, and character values. The entire analysis process was assisted by NVivo 14 software to ensure consistency and traceability of coding.

The validity of the data was maintained through several strategies, including increasing the diligence of researchers during fieldwork, continuous reflection, and peer debriefing with two colleagues who have a background in qualitative research. In addition, inter-analyst reliability testing was conducted by involving two researchers in the data coding process, resulting in an agreement rate of 87 percent. Differences in interpretation were resolved through discussion until a consensus was reached. To clarify the flow and interconnections between research components, this research's design is presented in the form of a conceptual diagram

Results and Discussion

This research was conducted in three Early Childhood Education institutions in Pangkalpinang City, Bangka Belitung Islands Province, namely Raudhatul Athfal Bustanul Athfal Aisyiyah, Al-Fazza Islamic School Playgroup, and Pangkalpinang Independent Kindergarten from September to November 2025. These three institutions were chosen because they have different learning environment characteristics but all apply the principles of ecoliteracy in children's daily activities. The main focus of this research is on how ecoliteracy is integrated with health and character education through everyday learning practices in Early Childhood Education. Data were obtained through observation of children's activities, in-depth interviews with teachers and parents, and documentation of school programs. The analysis process used a cross-site thematic approach to identify patterns, variations, and relationships between the strategies employed.

Routine-Based Ecological Habituation

The research results indicate that Raudhatul Athfal Bustanul Athfal Aisyiyah implements ecoliteracy learning through structured and repetitive daily routines, so that ecological values are gradually internalized in children's behavior. This practice is evident in daily activities, such as the habit of washing hands before and after activities, bringing personal water bottles, sorting organic and inorganic waste, and caring for vegetable plants grown in small pots in the classroom environment. These activities are not positioned as additional tasks, but rather become an inherent part of the learning and child-rearing process.

Interview findings with teachers revealed that the habituation process does not happen instantly, but rather through stages of adaptation and consistent reinforcement. Teachers explained that in the initial stage, children still relied on verbal guidance, but over time they began to show initiative and self-awareness. In practice, teachers used positive reinforcement in the form of verbal appreciation and visual symbols such as a "green star" to strengthen environmentally friendly behaviors demonstrated by the children. One teacher mentioned that the children not only obeyed rules in the classroom but also began to reflect on these values in their social interactions, for example, by reminding their peers or bringing these practices into their home environment.

Empirically, this behavioral change is evident in children's ability to independently initiate waste sorting and handwashing routines without teacher prompts. Children show a practical understanding of the reasons behind these habits, such as the importance of reducing plastic waste or maintaining personal and environmental cleanliness. This indicates that the habits formed do not stop at compliance but develop into a more reflective behavioral awareness.

From a contemporary theoretical perspective, these findings reinforce the view that the habituation of ecological behaviors and healthy living in early childhood is formed through the repetition of behaviors within a stable and meaningful learning context (Reilly et al., 2021). Furthermore, intensive interactions between children,

teachers, and peers demonstrate a cognitively-social-based social learning mechanism, where values and habits are internalized through observation, behavior modeling, and contextual social reinforcement within the Early Childhood Education environment (Schunk & Benedetto, 2020).

Furthermore, ecological habituation integrated with personal hygiene routines also contributes to reinforcing character values, particularly responsibility and discipline. Children learn to understand the consequences of their daily actions on themselves and their surroundings. This finding aligns with the perspective of moral education, which places everyday practices as the primary means of internalizing values (Enke et al., 2022). Thus, ecoliteracy learning at Raudhatul Athfal Bustanul Athfal Aisyiyah not only serves as a means of environmental introduction but also as a medium for character building and the implementation of Clean and Healthy Living Behaviors in line with the Early Childhood Education Independent Curriculum policy direction.

Narrative and Reflection as Character Builders

Field findings at Al-Fazza Islamic School Playgroup show that ecoliteracy learning is not built solely through technical routines, but rather through narrative and reflective approaches that emphasize children's emotional engagement. Teachers consistently use storytelling and role play as the main mediums to instill ecological awareness and character values. The stories highlighted focus on children's everyday experiences and are presented through symbolic characters, such as the character "Si Daun Hijau", which represents behaviors of environmental care, cleanliness, and social responsibility.

In practice, storytelling activities do not stop at the listening process. Children are encouraged to reenact the characters of the story through role-playing, express the characters' emotions, and make simple moral decisions. This process is then followed by a brief reflection session guided by the teacher through open-ended questions, such as what action should be taken when seeing litter scattered around or when a friend forgets to wash their hands. This pattern shows that the learning is designed to connect narrative experiences with the real-life context of the children.

The results of interviews with teachers indicate that this reflective approach triggers conscious and non-coercive changes in behavior. Teachers describe that children begin to recognize behavioral mistakes independently and show a desire to correct them without the need for punishment. This awareness is seen as a result of understanding the meaning behind the behavior, not merely compliance with classroom rules. Thus, storytelling serves as a bridge between cognitive understanding, emotional experience, and children's self-control. These findings align with international studies that suggesting that narrative-based learning supports empathy development and moral reasoning by linking emotional engagement with reflective dialogue (Blewitt et al., 2020).

In addition, the use of story-based role-playing enhances children's ability to take the perspective of others and reflect on the social consequences of their actions. Fleer (2021) emphasizes that learning based on imaginative worlds (conceptual playworlds) allows children to connect narratives, emotions, and actions into a unified learning experience, making ecological values and character easier to internalize. Thus, storytelling in the context of ecoliteracy does not merely serve as a pedagogical activity, but as a strategic medium for fostering empathy, self-awareness, and social responsibility in children from an early age.

Thus, these findings indicate that the narrative-reflective approach in ecoliteracy learning in community-based Early Childhood Education in pesantren can provide a meaningful and transformative learning process. Storytelling and role play are not merely supporting activities, but core pedagogical strategies that integrate ecological awareness, health, and character development through emotional experiences and contextual moral reflection.

Outdoor and Creative-Based Participatory Ecology

Research findings at Pangkalpinang Independent Kindergarten indicate that the implementation of ecoliteracy is developed through experiential and outdoor learning that is participatory and contextual. Children routinely engage in outdoor activities such as simple gardening, learning about Family Medicinal Plants, and using recycled materials to create educational play tools. These activities are carried out in a relatively free play environment, but are still guided by clear learning objectives, with parental involvement at certain moments.

The observation results showed that the children displayed a high level of active engagement when interacting directly with the physical environment. The children appeared enthusiastic when planting chili peppers, watering plants, or designing toys from used plastic bottles. The teacher assessed that these experiences encouraged curiosity, care for nature, and the ability to collaborate in small groups. In the interview, the teacher described that the children began to show a sense of ownership over the plants they tended and felt responsible for the results of their activities. This behavior reflects the development of ecological awareness, which is not instructive but grows from the children's personal experiences.

In addition to the ecological aspect, creative activities based on recycling at Pangkalpinang Independent Kindergarten also strengthen children's character and socio-emotional dimensions. The process of designing games from used materials requires children to discuss, share roles, and agree on decisions together. Teachers assess that this collaborative activity helps children learn to appreciate friends' ideas, manage emotions when differences of opinion arise, and solve problems in simple ways. These findings support the research of (Misbah et al., 2022) which shows that outdoor and project-based activities can enhance environmental awareness as well as problem-solving skills in early childhood.

From a cross-site perspective, Pangkalpinang Independent Kindergarten exhibits a different pattern of creative and participatory ecoliteracy compared to the other two institutions. While Raudhatul Athfal Bustanul Athfal Aisyiyah emphasizes ecological habits through daily routines, and Al-Fazza Islamic School Playgroup stands out in moral reflection based on narratives, Pangkalpinang Independent Kindergarten prioritizes nature exploration and creativity as the main entry points for learning. Nevertheless, all three show similarities in integrating values of health, character, and environmental care into children's learning experiences. Observational data indicate a high level of active child engagement, particularly during gardening and recycling-based creative activities at Pangkalpinang Independent Kindergarten, highlighting the effectiveness of hands-on learning approaches.

Furthermore, these cross-site findings emphasize that the success of ecoliteracy implementation is not solely determined by the type of activities, but by the school culture and community support. Parental involvement in outdoor activities and simple home projects strengthens the continuity of ecological habits between school and family environments. This aligns with the research of (Nurfurqon et al., 2024), which highlights the importance of school-family partnerships in early childhood environmental education.

From the perspective of character education, the three approaches identified contribute to the development of children's moral knowledge, moral feelings, and moral actions. However, the outdoor experience-based approach at Pangkalpinang Independent Kindergarten specifically strengthens the moral action aspect, because children not only understand and feel the value of environmental care, but also practice it directly through real actions. Thus, ecoliteracy in this context functions as an integrative means that connects environmental, health, and character learning into a unified, meaningful learning experience.

Theoretical Contribution of Ecoliteracy in Early Childhood Education

Findings from this cross-site study provide an important theoretical contribution to the development of the concept of ecoliteracy in the context of Early Childhood Education. First, this research confirms that ecoliteracy does not only operate in the cognitive-ecological domain as knowledge about the environment, but also functions as a pedagogical integrator that connects environmental education, health education, and character formation within a comprehensive, contextual, and meaningful learning framework for young children. Beyond confirming previous findings (Daboti et al., 2025), this research extends the concept of ecoliteracy by demonstrating its operational integration across cognitive, socio-emotional, and behavioral domains in Early Childhood Education.

Furthermore, this research expands the conceptualization of ecoliteracy from merely ecological awareness to the social-emotional domain and moral action of young children. Through habitual activities, reflective narratives, and participatory learning experiences such as outdoor learning and creative projects, ecoliteracy has been shown to contribute to the formation of moral values such as responsibility, discipline, empathy, and self-regulation in children. Therefore, ecoliteracy in Early Childhood Education operates in three main dimensions of education, namely head (knowledge), heart (affection/emotion), and hands (action/behavior),

as also emphasized in early childhood environmental education literature, which highlights the importance of integrating cognitive, affective, and behavioral aspects to support the development of meaningful and sustainable pro-environmental behavior (Dabot et al., 2025).

Several national studies also reinforce these findings by showing that an ecoliteracy learning approach, whether through storytelling or project-based learning with real-life experiences, encourages children not only to understand ecological concepts but also to articulate them in daily actions. For example, research by (Siregar et al., 2020) shows that narrative-based learning and character role-playing can enhance children's understanding and emotional engagement with environmental issues. Meanwhile, a project-based learning approach in ecoliteracy education supports children in expressing their learning experiences through real actions, such as making ecobricks and participating in simple waste management programs at school and home (Irfana et al., 2023). These findings confirm that ecoliteracy serves as a learning platform that connects children's understanding, emotional reflection, and practical action.

In the context of global theory, the findings of this research can be strongly positioned within the framework of Education for Sustainable Development (ESD) as developed by UNESCO. Education for Sustainable Development emphasizes that sustainable education is not merely focused on the transfer of knowledge about the environment, but must integrate cognitive, socio-emotional, and behavioral dimensions (action-oriented learning) to encourage changes in students' thinking and actions from an early age (UNESCO, 2020). Cross-site findings in this research indicate that ecoliteracy in Early Childhood Education has empirically fulfilled this Education for Sustainable Development mandate through learning that is contextual, participatory, and based on children's life experiences.

Furthermore, UNESCO emphasizes that at the early education level, ESD serves as a foundation for the development of sustainable values, attitudes, and behaviors, rather than merely mastering abstract concepts (UNESCO, 2020). Within this framework, this research clarifies that ecoliteracy in Early Childhood Education functions as an effective pedagogical medium for ESD, as it can integrate environmental issues with health education, Clean and Healthy Living Habits, as well as character building and self-regulation in children. Thus, this research expands the ESD discourse by providing empirical evidence that an ecoliteracy approach based on routines, reflective narratives, and participatory learning constitutes a relevant and practical implementation of ESD in the context of Early Childhood Education in developing countries (Wals et al., 2016).

In addition, the theoretical contribution of this research can be directly mapped to the 15 Principles of Ecological Literacy developed by the Center for Ecoliteracy. These principles emphasize that ecological literacy includes an understanding of life systems (systems thinking), the interconnectedness of humans and nature, ethical responsibility, as well as the ability to act consciously in daily life (Husamah et al., 2025). The findings of this research indicate that ecoliteracy in Early Childhood Education does not stop at introducing the natural environment, but actively develops awareness of cause-and-effect relationships, a sense of ownership of the environment, and personal responsibility in children through simple yet meaningful learning practices.

More specifically, the ecological habituation approach reflects the principles of interdependence and responsibility, the use of reflective storytelling represents the principles of empathy and moral imagination, while outdoor and creative learning aligns with the principles of learning from place and participation (Ballard et al., 2024). Thus, this research provides a theoretical contribution in the form of operationalizing global ecoliteracy principles into Early Childhood Education pedagogical practices, which in international literature have tended to be presented at a conceptual and normative level, rather than in concrete early childhood learning practices (Blewitt et al., 2020).

Another important contribution is the expansion of the understanding of ecoliteracy as a framework that bridges moral knowledge, moral feelings, and moral actions of early childhood, in line with the action-oriented learning approach in Education for Sustainable Development, which emphasizes the integrated development of students' values, emotions, and capacity to act from early education (Rieckmann, 2022). The findings of this research affirm that moral action in the environmental context does not emerge instantly, but is shaped through repeated experiences, emotional engagement, and meaningful social interactions in children's daily lives. This reinforces the argument that ecoliteracy in Early Childhood Education is a holistic pedagogical

approach that integrates knowing, caring, and acting as a unified aspect of child development (Schunk & Benedetto, 2020); (Enke et al., 2022).

By positioning ecoliteracy as a pedagogical bridge between ESD and early childhood character education, this research contributes to the enrichment of global theory through empirical evidence from the local Indonesian context. This contribution is relevant for the development of international sustainable education theory, particularly in addressing the need for a contextual, inclusive ESD implementation model that aligns with the developmental characteristics of young children, while also supporting the involvement of families, teachers, and communities in building sustainability education from an early age (Fleer, 2021); (Nopiana, 2025).

Practical Implications and Policies of Ecoliteracy-Based Learning in Early Childhood Education

The findings of this research have important practical implications for early childhood educators. Teachers are encouraged to integrate ecoliteracy into daily classroom routines, such as structured handwashing schedules, waste sorting systems, and reflective storytelling sessions linked to children's daily experiences. Simple habits such as washing hands, sorting waste, caring for plants, as well as the use of reflective narratives and outdoor learning have been proven effective in instilling ecological, health, and character values sustainably. This aligns with studies on the implementation of ecoliteracy through a project-based learning approach, which show that children's direct involvement in project-based activities encourages more meaningful and contextual learning experiences in ecoliteracy (Sari et al., 2025).

Therefore, strengthening teachers' competence in designing learning based on experience, reflection, and habituation has become a strategic necessity. The role of teachers is not only to impart knowledge but also to facilitate direct and reflective experiences that reinforce the connection between ecological concepts and children's real-life situations, as emphasized in literature strategies that stress the integration of environmental literacy into daily interactive activities and collaboration with parents and the community (Haula et al., 2024).

For Early Childhood Education institutions, this research emphasizes the importance of fostering a school culture that supports ecoliteracy through consistent practices, the example set by educators, and parental involvement as learning partners. Nopiana (2025) study also shows that family involvement greatly contributes to instilling ecological skills and attitudes in children from an early age, where patterns of communication and environmentally-based activities at home reinforce the learning received at school (the family's role in ecoliteracy) and extend its educational impact on the child's social life.

The integration of ecoliteracy with health and character education will be more effective if supported by internal institutional policies, child and environmentally-friendly physical environments, and continuous communication between schools and families. In addition, nature-based learning models have been identified as an effective approach in the development of ecoliteracy, where exploration of the concrete environment becomes the main driver of children's learning and actions towards the environment (Nopiana, 2025).

From a policy perspective, these findings provide empirical support for the direction of the Early Childhood Education Merdeka Curriculum, which emphasizes holistic learning, character strengthening, and real-life contexts for children. Ecoliteracy can be considered as one of the strategic approaches in developing Early Childhood Education policies that are responsive to child health issues, environmental crises, and sustainable education. Integrating ecoliteracy into teacher training, Early Childhood Education learning guides, and PHBS programs has the potential to strengthen the readiness of generations from an early age to face the sustainability challenges of the 21st century.

Conclusion

This research concludes that ecoliteracy in Early Childhood Education as an integrative and developmentally appropriate pedagogical framework that bridges sustainability, health, and character education within children's everyday learning experiences. Rather than operating as a stand-alone environmental subject, ecoliteracy is embedded through routines, narratives, and participatory activities that simultaneously foster ecological awareness, clean and healthy living behavior as well as core character values.

The principal theoretical contribution of this research lies not merely in confirming existing ecoliteracy and Education for Sustainable Development frameworks, but in refining them within an early childhood and Indonesian socio-cultural context. Unlike much of the Western literature that emphasizes cognitive environmental literacy, this research demonstrates that ecoliteracy in Indonesian Early Childhood Education is behaviorally grounded and culturally mediated. The findings reveal that ecoliteracy operates through daily moral practices (habitual ecoliteracy), supported by collective values such as gotong royong, care for shared spaces, and community-oriented responsibility. This extends existing ecoliteracy theory by highlighting habit formation and socio-cultural embeddedness as central mechanisms in early childhood, rather than abstract ecological understanding alone.

Practically, the findings generate actionable implications at multiple levels. For teachers, ecoliteracy can be operationalized through concrete routines such as daily waste sorting, handwashing linked to environmental narratives, storytelling that connects moral values with nature, and outdoor learning activities that involve observation and care for living elements. For early childhood institutions, ecoliteracy indicators may include the consistency of ecological routines, children's participation in environmentally responsible actions, integration of health and environmental themes in learning plans, and the involvement of families in reinforcing these practices at home. For policymakers, ecoliteracy can be explicitly integrated into Early Childhood Education Curriculum guidelines and accreditation standards by positioning it within clean and healthy living behavior implementation, character education outcomes, and sustainability-oriented school culture, rather than as an optional enrichment program.

Overall, ecoliteracy emerges from this research as a practical, culturally relevant and theoretically grounded pedagogical framework that strengthens sustainability, health, and character education simultaneously in early childhood contexts. Future research with broader geographic coverage and longitudinal designs is recommended to examine the long-term developmental impacts of ecoliteracy-based learning.

Acknowledgments

The author expresses gratitude to Raudhatul Athfal Bustanul Athfal Aisyiyah, Al-Fazza Islamic School Playgroup, and Pangkalpinang Independent Kindergarten for their cooperation and support during the research process. Thank are also extended to the teachers, students, and parents who contributed through active participation in observation, interviews, and documentation activities. In addition, the author appreciates the assistance from colleagues and other parties who have provided valuable input, enabling this article to be completed and ready for publication.

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