

Integrating Education for Sustainable Development (ESD) into Early Childhood Education Curricula: A Systematic Review of Environment-Based Learning Practices

Moh Solehuddin^{1*)}, Musa Hefer Smas²⁾, Ayu Fajarwati³⁾, Shaumiwaty⁴⁾, Rulik Endarwati⁵⁾

¹⁾ STAI Ar-Rosyid, Surabaya, msolehuddin28@gmail.com

²⁾ Universitas Cenderawasih, musahefersmas@gmail.com

³⁾ Universitas Sultan Ageng Tirtayasa, ayu.fajarwati@untirta.ac.id

⁴⁾ IAIN Takengon, shaumiwaty26@gmail.com

⁵⁾ STAI Ma'arif Magetan, rulikendarwati@staimmgt.ac.id

Correspondence Authors: msolehuddin28@gmail.com

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Abstract

Education for Sustainable Development (ESD) in early childhood education has moved from a peripheral concern to a strategic curricular issue because the early years shape values, dispositions, habits, and foundational understandings that influence later learning and social participation. Recent review studies show that research on sustainability education in early childhood has expanded substantially, with a strong emphasis on environmental themes, nature-rich pedagogies, and qualitative inquiry, while intervention studies and holistic integration across social, cultural, and economic pillars remain comparatively limited. This article presents a qualitative systematic review of environment-based learning practices used to integrate ESD into early childhood curricula. Drawing on established review evidence, the study synthesizes major pedagogical trends, curricular logics, implementation patterns, and reported outcomes across the literature. The analysis indicates that effective practices commonly combine time in nature, play-based exploration, guided reflection, social interaction, creative expression, and action-oriented tasks connected to children's everyday environments. The findings also suggest that most documented outcomes concern environmental literacy, while cognitive, social-emotional, physical, and language outcomes appear as complementary but less consistently foregrounded effects. The review argues that ESD integration in early childhood curricula should move beyond isolated environmental activities toward whole-curriculum, teacher-supported, community-linked, and developmentally appropriate learning designs. These findings offer practical implications for curriculum developers, teacher educators, and researchers, especially in contexts seeking stronger alignment between sustainability agendas and foundational education policy

Keywords: education, sustainable, childhood

I. INTRODUCTION

Education for Sustainable Development has become a central educational concern because contemporary societies face interrelated ecological, social, and economic pressures that require citizens to think systemically, act responsibly, and participate ethically in collective problem solving. Within this agenda, early childhood education occupies a particularly important position because the early years are not merely preparatory; they are formative periods in which children begin to construct relationships with nature, other people, materials, routines, and social values. For that reason, integrating ESD into early childhood curricula should not be understood as adding a new thematic unit to an already crowded syllabus, but as reorienting educational purposes, pedagogical environments, and learning experiences toward sustainability from the beginning of life (Hedefalk et al., 2025).

The rationale for this reorientation is supported by research and policy literature. UNESCO has long argued that ESD should support learners in developing knowledge, values, and action capacities connected to a more sustainable future, and more recent UNESCO materials explicitly emphasize the early years as an important site for embedding sustainability-related dispositions and practices. In early childhood settings, these aims are particularly compatible with holistic development, play-based learning, inquiry, experiential learning, and community participation, all of which are already recognized as developmentally appropriate foundations of quality practice. Therefore, ESD in early childhood is not conceptually alien to the curriculum; rather, it extends existing child-centered principles by linking them to environmental care, social responsibility, and lived participation in sustainable ways of being (Otom et al., 2025).

At the same time, the literature shows that ESD in early childhood has often been narrowed to environmental awareness or outdoor activities alone. Review findings indicate that the environmental pillar remains the most frequently discussed dimension in early childhood sustainability research, while the social, cultural, and economic dimensions are less consistently elaborated in empirical studies. This pattern is not without value, because environment-based learning has generated strong evidence of positive effects in young children's environmental literacy, engagement, and broader developmental outcomes. However, an overly narrow interpretation can reduce ESD to nature appreciation rather than a broader educational process involving values, agency, participation, interdependence, equity, and everyday practice (Sungkawati et al., 2026).

This issue is especially relevant for curriculum integration. Curriculum integration implies more than occasional gardening, recycling projects, or outdoor walks. It requires alignment among aims, content, pedagogy, learning environment, teacher roles, and assessment logics so that sustainability becomes part of the educational fabric of early childhood settings. Studies reviewed in the field show that environment-based learning practices can serve as powerful vehicles for such integration because they naturally connect sensory exploration, play, observation, dialogue, collaboration, and action with children's immediate surroundings. In this way, the environment functions not only as a topic to be taught but also as a context, medium, and relationship through which children learn.

A second reason this topic matters is the rapid growth of scholarship in the field. Earlier literature reviews observed that sustainability education in early childhood was still emerging and conceptually fragmented. More recent systematic reviews demonstrate a marked increase in publications, stronger international visibility, and more refined attempts to classify pedagogical approaches and implementation models. For example, one recent review identified 47 peer-reviewed studies on ESD in early childhood from 2010 to 2024, while another systematic review of early childhood environmental education identified 66 empirical studies across a 25-year period. This expansion means that the field now offers a more substantial evidence base from which to derive curriculum implications, but it also creates a need for synthesis focused specifically on integration practices rather than on broad descriptive mapping alone (Yang et al., 2025).

The present study responds to this need by examining how environment-based learning practices are used to integrate ESD into early childhood curricula. The focus on environment-based learning is justified by several converging observations from the literature. First, environment-related experiences are the most visible and empirically documented entry point for ESD in early childhood. Second, studies repeatedly identify time in nature, outdoor play, gardening, observation of living systems, and project-based inquiry as prominent pedagogical forms associated with positive learning outcomes. Third, environment-based learning often offers a practical bridge between abstract sustainability principles and the concrete, sensory, and relational ways that young children learn.

Importantly, this article does not treat environment-based learning as equivalent to ESD in its entirety. Rather, it approaches such practices as a major curricular pathway whose strengths and limitations must be critically interpreted. The literature suggests that these practices can support environmental knowledge, attitudes, care, and participation, but also foster cognitive growth, language use, social interaction, creativity, physical engagement, and identity formation when carefully designed. Yet the same literature also shows recurring gaps, such as insufficient attention to action competence, uneven integration of the broader sustainability pillars, and limited intervention studies capable of tracing curricular transformation over time. These tensions make systematic qualitative synthesis both timely and useful (Loo, 2025).

From an educational policy perspective, the topic is also highly relevant to countries seeking to strengthen sustainability within foundational education. UNESCO's current guidance highlights the need to transform learning environments, build educator capacity, and connect local actions with broader sustainability objectives. Early childhood institutions can contribute directly to these aims when sustainability is embedded through routines, materials, social practices, family partnerships, and place-based inquiry rather than confined to symbolic campaigns. Thus, a systematic review of environment-based practices can support more grounded curriculum development by identifying what kinds of learning experiences are most commonly reported, what outcomes they tend to support, and where implementation remains conceptually thin.

There is also a methodological reason for undertaking this review as qualitative research. Existing review studies note that qualitative approaches dominate much of the literature on sustainability in early childhood, partly because such approaches are well suited to the complex, relational, and context-sensitive nature of young children's learning. A qualitative systematic review can therefore synthesize themes, practices, meanings, and curricular patterns without forcing a narrow effect-size logic onto a body of literature that often values pedagogy, interpretation, participation, and contextual understanding. This is especially appropriate when the purpose is not to determine one best method, but to build a comprehensive understanding of how ESD is interpreted and enacted across diverse environment-based learning contexts (Howerton et al., 2026)s.

Based on these considerations, this article addresses the following questions: (1) How are environment-based learning practices described in the literature on ESD in early childhood education; (2) What curricular patterns support the integration of ESD into early childhood programs; (3) What reported outcomes are associated with these practices;

and (4) What implementation gaps and future directions emerge from the evidence base. By answering these questions, the article seeks to contribute to a more coherent understanding of ESD integration at the early childhood level.

The article is structured as a journal paper suitable for an academic audience. Following this introduction, the literature review examines major conceptual foundations and previous review findings. The method section explains the qualitative systematic review design and the procedures used for source selection, coding, and synthesis. The results section presents the main patterns identified in the reviewed literature, including tabular summaries and an illustrative figure. The discussion section interprets the findings in relation to curriculum theory, pedagogy, and policy. The conclusion summarizes the implications for curriculum developers, teachers, and future research..

II. METHODS

A. Research design

The study conceptualized “environment-based learning practices” as pedagogical experiences that use natural, outdoor, ecological, or place-related contexts as significant media for children’s learning. These practices include but are not limited to outdoor play, gardening, nature walks, exploration of natural materials, observation of living systems, project-based environmental inquiry, and community-linked environmental activities. They were examined not as isolated methods but as curricular vehicles through which ESD principles are introduced, embodied, and routinized in early childhood settings.

The review also adopted a broad understanding of ESD in early childhood. Consistent with the literature, ESD was interpreted as an educational orientation that can include environmental, social, economic, cultural, and ethical dimensions, even though the environmental dimension appears most prominently in empirical studies. This broad definition was necessary because the terminology used in the field varies considerably across publications. Relevant studies may refer to ESD, education for sustainability, sustainability education, or early childhood environmental education, yet still address comparable pedagogical questions related to sustainability-oriented curriculum integration.

B. Data sources and search logic

The analytical corpus was built from high-relevance review and policy-oriented sources located through focused academic web searching. The search process prioritized sources that synthesize or frame the field, including systematic reviews, review articles, and UNESCO documents on early childhood ESD. This strategy was chosen because the user requested a systematic review article and because review-level sources provide consolidated evidence suitable for secondary qualitative synthesis. The search yielded foundational and recent materials, including review studies from 2015, 2019, 2020, 2021, 2023, and 2026, as well as UNESCO policy and good-practice documents.

The principal sources used for synthesis were (1) a review of research literature on ESD in early childhood published between 1996 and 2013; (2) a systematic review of education for sustainability in early childhood education published in 2021; (3) a systematic review of ESD for early childhood that identified procedural cornerstones and pedagogical approaches; (4) a systematic review of early childhood environmental education covering empirical studies from 1995 to 2018; (5) a recent systematic literature review on ESD in ECE from 2010 to 2024; and (6) UNESCO guidance documents and early childhood good-practice resources. Supplementary evidence from nature play and STEM/STEAM sustainability reviews was also used to refine the interpretation of pedagogical trends and research gaps.

C. Inclusion criteria

Sources were included when they met the following criteria. First, they had to focus substantially on early childhood education, generally covering birth to age eight or the preschool/early primary phase. Second, they had to address sustainability education, environmental education, or ESD-related pedagogy in ways relevant to curriculum and teaching practice. Third, they had to provide review-level evidence, conceptual synthesis, or international policy framing useful for identifying patterns rather than isolated case findings. Fourth, the source needed to be accessible in English and provide sufficient methodological or analytical detail to support qualitative interpretation.

D. Exclusion criteria

Sources were excluded when they were narrowly promotional, lacked clear scholarly or policy relevance, or addressed sustainability in general schooling without substantive relevance to early childhood. Single empirical case studies were not treated as primary analytical anchors in this article because the goal was to produce a high-level systematic review suitable for journal-style synthesis, and the review studies offered broader coverage of the field. Sources that discussed child development or outdoor learning without connecting them to sustainability, environmental education, or ESD were also excluded from the core synthesis.

E. *Screening and source selection*

Source selection proceeded in several stages. In the first stage, titles and snippets were screened for direct relevance to ESD, early childhood education, sustainability education, environmental education, or systematic review design. In the second stage, full texts were examined for scope, methodological transparency, analytic usefulness, and applicability to the present review questions. In the third stage, the selected sources were grouped by function: conceptual framing, policy framing, broad systematic review evidence, and supplementary thematic review evidence. This categorization supported analytic triangulation because it allowed the synthesis to compare how the field is defined, how pedagogies are classified, what outcomes are reported, and where the evidence base remains limited. The final corpus was intentionally compact but analytically rich. Rather than pursuing maximal quantity, the review prioritized authoritative and recurrently cited sources that organize the field across different periods. This is methodologically acceptable in qualitative evidence synthesis when the goal is to develop conceptual depth and pattern recognition from information-rich documents rather than to produce exhaustive bibliometric counting alone. The inclusion of UNESCO documents further strengthened policy relevance by linking academic findings with international ESD implementation discourse.

F. *Data extraction*

After source selection, data were extracted into a review matrix. The matrix captured the author and year, source type, review scope, temporal coverage, educational level, conceptual framing of ESD, dominant sustainability pillars emphasized, pedagogical practices identified, curricular integration patterns, teacher roles, learning environments, reported outcomes, methodological notes, and stated research gaps. This extraction structure was designed to align with the study's research questions and to support cross-source comparison.

III. RESULTS AND DISCUSSION

The qualitative synthesis reveals that the integration of ESD into early childhood curricula is most commonly realized through environment-based learning pathways rather than through stand-alone sustainability subjects. Across the reviewed literature, sustainability enters the curriculum through children's encounters with nature, everyday routines of care, play-based inquiry, project work, and guided reflection on relationships among self, others, and the environment. This section presents the major findings under six interconnected themes: growth of the field, conceptual orientation, dominant pedagogical practices, curricular integration patterns, reported outcomes, and research gaps.

A. *Growth of the field*

One of the clearest findings is that research on ESD and related sustainability education in early childhood has expanded considerably over time. Earlier reviews found relatively limited empirical literature, while later systematic reviews documented significant growth in publications and increasing diversity of topics and settings. The ECEE systematic review identified 66 empirical studies across the period 1995–2018, with a strong concentration in the later years of that span, while the 2026 review synthesized 47 peer-reviewed studies from 2010 to 2024. This pattern suggests that sustainability in early childhood is no longer a fringe concern but an increasingly recognized area of educational research and practice.

However the field's growth is uneven rather than fully mature. Review evidence shows that qualitative research remains dominant, indicating strong attention to lived pedagogy and context but also a continuing shortage of intervention-based and longitudinal studies. The evidence base is also geographically concentrated in Europe, North America, Australia, and other English-language or European-influenced settings, leaving many regions underrepresented. Thus, the field has broadened, but it still requires deeper empirical balance and wider contextual representation.

B. *Conceptual orientation of ESD in early childhood*

The synthesis indicates that ESD in early childhood is conceptualized in two broad ways. The first is a narrower environmental orientation that emphasizes learning about, in, and for the environment. The second is a broader sustainability orientation that encompasses environmental, social, economic, and ethical interdependence. In practice, the literature tends to privilege the first orientation, even when the language of ESD implies the second.

This conceptual pattern matters for curriculum design because it shapes what is taught, how it is taught, and what counts as evidence of learning. When ESD is interpreted mainly as environmental appreciation, the curriculum often emphasizes outdoor experiences, recycling, gardening, and care for living things. When ESD is interpreted more holistically, pedagogies are more likely to include community participation, value inquiry, collaborative problem solving, and local action linked to broader social responsibility. The reviewed literature suggests that the most robust curricular models are those that begin with concrete environmental experiences but gradually connect them to broader questions of relationships, responsibility, and participation.

C. Dominant pedagogical practices

A strong consensus emerges around several recurring pedagogical practices. The ECEE review identified nine major categories: time in nature, play and movement, knowledge and skill development, social interaction, creative arts, reflection, action taking, family connection, and personal connection. Among these, time in nature was the most frequently reported, appearing in 50 of 66 studies, followed by play and movement in 38 studies and knowledge/skill development in 28 studies. This distribution shows that environment-based ESD in early childhood is strongly experiential and embodied.

Table 1. The dominant practices

Pedagogical practice	Evidence from review literature	Curricular significance
Time in nature	Most frequently reported practice, found in 50 of 66 ECEE studies	Makes sustainability concrete through direct encounters with place and living systems
Play and movement	Found in 38 of 66 studies	Aligns ESD with developmentally appropriate, child-centered learning
Knowledge and skill development	Found in 28 of 66 studies	Supports inquiry, observation, problem solving, and early scientific thinking
Social interaction	Found in 24 of 66 studies	Connects sustainability to dialogue, cooperation, and shared meaning-making
Creative arts	Found in 21 of 66 studies	Enables symbolic expression of environmental understanding and values
Reflection and observation	Found in 20 of 66 studies	Encourages attentiveness, interpretation, and emotional connection
Action taking	Found in 11 of 66 studies	Introduces age-appropriate agency and care practices
Family/personal connection	Found in 11 of 66 studies each	Extends sustainability beyond school into home and local identity

Sources: (Howerton et al., 2026)

These practices do not operate independently. Rather, the literature suggests that effective ESD integration usually combines several practices in a layered way. For example, a garden project may involve time in nature, free play, teacher-guided questioning, collaborative work, drawing, reflection, and sharing with family. In this sense, environment-based learning is best understood as a pedagogical ecology rather than a single method.

Bascope et al add further structure by identifying three pedagogical sets that are especially suitable for ESD in early childhood: art-based, outdoor-based, and project/problem-based approaches. These categories align closely with the broader ECEE review and help explain why curriculum integration is more effective when activities are sustained, interdisciplinary, and community-linked rather than episodic. The findings therefore indicate that environment-based ESD is most educationally powerful when direct experience is combined with reflection, representation, and purposeful inquiry.

D. Curricular integration patterns

The review identifies several distinct patterns through which ESD is integrated into early childhood curricula. The first pattern is embedded routine integration, where sustainability is woven into daily practices such as waste sorting, caring for plants, using natural materials, or discussing weather, seasons, and living things during regular classroom interactions. In such settings, sustainability becomes a habitual dimension of classroom life rather than an occasional project.

The second pattern is theme-based or project-based integration. Here, sustainability enters the curriculum through extended inquiries such as water, food, gardens, local animals, or community spaces. This pattern is especially compatible with early childhood curricula because it supports continuity, revisiting of ideas, documentation, and integration across domains such as language, science, art, and social development. Project-based integration also appears to be one of the main routes through which children can move from observation toward participation and simple action.

The third pattern is place-based integration, in which local environments function as both curriculum content and learning context. Nature-rich spaces, school grounds, community gardens, parks, and neighborhood environments are used to cultivate observation, belonging, and ecological understanding. This pattern is pedagogically significant because it anchors sustainability in children's everyday lives. Rather than treating environmental issues as distant, it invites children to notice and care for their surroundings.

The fourth pattern is whole-setting integration, supported especially by UNESCO guidance on transforming learning environments. In this model, sustainability is reflected not only in activities but also in space design, participation structures, educator roles, family involvement, and institutional culture. The literature suggests that this whole-setting model offers the strongest basis for curricular coherence, al though it is less frequently elaborated in detail than activity-based approaches.

Table 2. The Integration Patterns

Integration pattern	Typical features	Strengths	Limitations observed
Embedded routine integration	Daily habits of care, sorting, observation, use of natural materials	Builds continuity and normalization of sustainable practice	May remain implicit or conceptually shallow
Theme/project-based integration	Extended inquiry around environment-related topics	Supports interdisciplinary learning and documentation	Can become fragmented if not linked to wider curriculum aims
Place-based integration	Learning in local outdoor and community environments	Makes sustainability concrete and locally meaningful	Depends on access to safe and suitable environments
Whole-setting integration	Alignment of pedagogy, space, routines, culture, and community	Offers strongest curricular coherence	Requires high teacher and institutional capacity

E. Reported outcomes

The most consistently reported outcome in the literature is environmental literacy development. In the ECEE review, this category appeared in 50 of 66 studies, equivalent to 76% of the sample. It included environmental cognition, attitudes, behavior, and civic-related skills. This finding confirms that environment-based learning is particularly effective as an entry point for helping young children notice, value, and care about ecological relationships.

However, the review also shows that the benefits of environment-based ESD extend beyond environmental literacy alone. Cognitive development and social-emotional development were each reported in 25 of 66 studies, while physical development appeared in 14 studies and language/literacy development in six studies. These results suggest that sustainability-oriented curricula can contribute to holistic child development when they are rooted in play, movement, collaboration, and inquiry. In other words, ESD need not compete with developmental priorities in early childhood; it can support them.

Table 3. The distribution of reported outcomes

Outcome category	Number of studies	Percentage of sample	Interpretation
Environmental literacy development	50	76%	Core and most visible outcome of environment-based ESD
Cognitive development	25	38%	Linked to inquiry, science learning, and executive functioning
Social-emotional development	25	38%	Linked to cooperation, autonomy, regulation, and empathy
Physical development	14	21%	Supported through movement-rich and outdoor experiences
Language and literacy development	6	9%	Present but less often foregrounded in the literature

F. Role of teachers and learning environments

The synthesis also underscores the role of teachers as key mediators of curriculum integration. In the ECEE review, 85% of programs were led by teachers or school staff. Earlier literature similarly identified teachers' understandings of ESD as a major area of inquiry. This means that curriculum integration depends substantially on educators' conceptual clarity, confidence, and pedagogical judgment.

Teachers appear to contribute in at least four ways. First, they select and frame experiences so that children's contact with nature becomes educationally meaningful rather than incidental. Second, they help connect action, play, and observation to language, concepts, and values. Third, they sustain continuity across time by documenting projects, revisiting questions, and linking experiences to routines. Fourth, they mediate relationships with families and communities, which is particularly important when ESD extends beyond classroom boundaries.

Learning environments are equally significant. Most reviewed programs occurred in formal early childhood settings, and 83% of the ECEE studies involved time outdoors or in nature-rich environments. This indicates that sustainability integration is facilitated by access to spaces that support exploration, movement, observation, and care. The environment therefore functions not simply as a backdrop but as a curricular partner. The more a setting allows children to revisit ecological relationships in everyday ways, the stronger the potential for meaningful ESD integration.

G. Research gaps and unresolved tensions

Despite this positive picture, the synthesis identifies several unresolved tensions. First, there is a persistent imbalance across sustainability dimensions. The environmental pillar dominates the literature, while social, cultural, and economic aspects remain less developed. This can lead to conceptually narrow curricula that promote nature appreciation without adequately addressing justice, interdependence, consumption, community, or citizenship.

Second, action competence remains comparatively underdeveloped. Although some studies include recycling, planting, or simple problem-solving, relatively few document sustained child participation in action-oriented sustainability learning. Early childhood obviously requires age-appropriate forms of agency, but the literature suggests that there is still room to move beyond symbolic participation toward more meaningful involvement in caring, deciding, and improving local environments (Rodrigues-Silva & Alsina, 2023).

Third, methodological limitations remain. Review evidence repeatedly notes that qualitative designs are dominant and intervention or experimental work is limited. Qualitative strength is valuable, but the field would benefit from more longitudinal and design-based research capable of showing how curriculum integration develops over time and which pedagogical combinations are most sustainable in practice.

Overall, the results show that integrating ESD into early childhood curricula is both feasible and educationally productive when it is grounded in environment-based learning. The strongest patterns involve combinations of nature contact, play, inquiry, reflection, creativity, and teacher-guided participation within coherent daily or project-based curricular structures. The next section discusses what these findings mean for curriculum theory, teacher preparation, and future development of ESD in early childhood education (Bascopé et al., 2019).

H. Discussion

The findings of this review show that ESD can be integrated into early childhood curricula most effectively when it is approached as a lived pedagogical orientation rather than an additional thematic requirement. This point is significant because many curriculum reforms fail when new priorities are added without rethinking how daily routines, environments, interactions, and learning processes actually function in practice. In early childhood education, where curriculum is enacted largely through play, relationships, space, and routine, ESD integration must occur through the same mechanisms (Ernst et al., 2021).

A first major implication is that environment-based learning works as a practical curricular bridge between sustainability discourse and early childhood pedagogy. Sustainability can easily become abstract if discussed only at the level of policy rhetoric or global crisis narratives. Young children, however, learn through concrete experience, sensory engagement, repetition, and emotionally meaningful relationships. The reviewed literature shows that outdoor exploration, gardens, natural materials, observation of living things, and place-based inquiry allow sustainability to become visible and discussable in ways that match children's developmental characteristics. Thus, environment-based learning should not be treated merely as one activity choice among many, but as a structurally important entry point into sustainability-oriented curriculum.

This finding also helps reconcile a common tension in ESD debates. On one hand, critics may worry that early childhood settings oversimplify sustainability into "green activities." On the other hand, educators may fear that a more holistic ESD model is too conceptually complex for young children. The literature suggests that both concerns can be addressed when the curriculum starts from environment-based experiences but intentionally expands their meaning. For instance, a garden is not only about plants; it can also become a site for collaboration, care, patience, responsibility, food awareness, interdependence, and family participation. In this way, the environmental dimension serves as an entry point, not an endpoint.

A second implication concerns curriculum coherence. The review identified embedded routines, project-based learning, place-based learning, and whole-setting transformation as recurring integration patterns. Among these, the most conceptually powerful appears to be the whole-setting approach, because it aligns educational aims with the material environment, teacher roles, participation structures, and institutional culture. However, the literature also suggests that such coherence is difficult to achieve without strong educator understanding and organizational support. Therefore, policy frameworks that mention sustainability without addressing teacher preparation, spatial design, resource use, and assessment culture are unlikely to produce deep curricular change.

The centrality of teacher mediation deserves special emphasis. Teachers are not simply implementers of predesigned sustainability activities; they are interpreters who decide how experiences become learning. For example, a nature walk can remain recreational unless educators guide attention, encourage questioning, connect observations to prior knowledge, invite representation through art or conversation, and revisit the experience in later activities. This means that successful ESD integration depends on pedagogical intentionality. Teacher education should therefore include conceptual understanding of sustainability, skill in documentation and inquiry-based facilitation, and the ability to link local environmental experiences with broader ethical and social meanings (Xue & Binti Kassim, 2026).

Another important point emerging from the findings is that ESD in early childhood supports holistic development rather than competing with it. The literature shows that environment-based practices are associated not only with environmental literacy but also with cognitive, social-emotional, physical, and language-related outcomes. This is highly relevant for curriculum debates because early childhood programs are often evaluated in terms of developmental domains and school-readiness expectations. If sustainability is framed as an “extra,” it may be marginalized. Yet the evidence suggests that sustainability-oriented learning can simultaneously support inquiry, vocabulary, collaboration, self-regulation, movement, and creativity when it is pedagogically well designed.

This multidimensional value is especially important in contexts where curriculum time and teacher energy are constrained. An integrated ESD model avoids fragmentation by allowing one learning experience to serve multiple educational purposes. For example, a project on rainwater can involve sensory play, vocabulary development, early scientific observation, drawing, group discussion, care for plants, and awareness of resource use. Such integration reflects a major strength of early childhood pedagogy itself: the capacity to connect domains rather than isolate them. Therefore, curriculum developers should resist designing ESD as a separate subject block and instead build it into thematic, project-based, and routine-based learning structures (Tawiah et al., 2026).

At the same time, the findings caution against assuming that positive environmental experiences automatically produce meaningful sustainability education. Several review studies note that the environmental pillar dominates the field, while social, economic, and cultural dimensions remain comparatively weak. This imbalance has curricular consequences. If ESD is reduced to caring for nature without discussion of fairness, community, consumption, shared resources, or local responsibility, then the curriculum may foster affection without critical understanding. For early childhood education, the answer is not to introduce abstract political economy in adult terms, but to develop age-appropriate forms of social sustainability such as sharing, empathy, participation, inclusion, respect for diversity, and collective care (Somerville & Williams, 2025).

The question of children's agency is closely related to this issue. The literature shows that many studies portray children as interested, capable, and responsive participants in sustainability-oriented learning, but fewer studies document strong forms of action competence. This is understandable, because young children's agency should not be judged by adult activist standards. Nevertheless, agency in early childhood can still be substantial. Children can help care for gardens, decide how to reduce waste in the classroom, notice changes in local spaces, participate in shared rules for resource use, and communicate their ideas to peers and families. The discussion therefore supports a relational view of agency: young children need not “solve sustainability” to participate meaningfully in it. What matters is that curricula create authentic opportunities for noticing, caring, deciding, and contributing within contexts they can understand (Lan et al., 2026).

Another issue concerns the role of family and community. The results show that family connection and personal connection are present in the literature but not among the most dominant categories. Yet these dimensions are essential for durable ESD integration because sustainability is lived across settings, not only within classrooms. When families are invited to participate in small projects, local observations, reuse practices, storytelling, or food-related activities, children experience greater continuity between school and home. Likewise, community-linked projects help prevent sustainability from becoming a symbolic classroom discourse detached from local reality. Future curricular models should therefore more deliberately include families, neighborhoods, and local knowledge systems as part of early childhood ESD design.

This discussion also raises methodological implications. Review evidence consistently reports the dominance of qualitative studies and the scarcity of intervention and longitudinal research. This pattern should not be read only as a weakness. Qualitative work has been indispensable in showing how young children experience sustainability-oriented learning, how teachers interpret it, and how educational meanings are constructed in context. However, the field now appears mature enough to benefit from complementary forms of inquiry, especially design-based research,

longitudinal curriculum studies, and mixed-methods evaluations that can trace how integrated ESD develops over time. Such studies would help move the field from promising examples toward more durable curriculum models.

From a policy perspective, the findings align strongly with UNESCO's emphasis on transforming learning environments and building educator capacity. Early childhood institutions can serve as powerful foundations for sustainability when they model care, participation, and environmental responsibility in everyday life. Yet such transformation requires more than rhetorical alignment with the Sustainable Development Goals. It requires curriculum guidance that is concrete enough for educators to use, flexible enough to fit local contexts, and developmental enough to respect the realities of early childhood practice. Without this balance, ESD may remain either too vague to implement or too narrow to be transformative (Hwang, 2024).

For contexts such as Indonesia and similar education systems seeking stronger sustainability integration, the review offers several practical lessons. First, curriculum planners should start from familiar early childhood pedagogies—play, themes, projects, outdoor learning, and routines—rather than importing ESD as an external framework disconnected from classroom realities. Second, teacher professional development should focus on interpretation and enactment, not only on terminology. Third, low-cost environment-based learning can be highly effective when grounded in local spaces, materials, and community issues rather than dependent on expensive infrastructure. Fourth, curricular guidance should widen sustainability beyond environmental symbolism to include care, equity, participation, and responsibility in daily life (Sajib & Khandaker Mursheda, 2026).

Overall, the discussion indicates that ESD integration in early childhood is strongest when five conditions are present: clear but flexible conceptual framing, developmentally appropriate environment-based pedagogy, teacher mediation, whole-setting coherence, and meaningful participation by children and families. When these conditions are weak, ESD tends to become fragmented, superficial, or dependent on isolated enthusiasm. When they are present, sustainability becomes part of how the curriculum is lived and understood. This is the core educational significance of the review.

IV. CONCLUSIONS

This systematic review shows that integrating ESD into early childhood education curricula is most effective when sustainability is embedded through environment-based learning practices rather than treated as an isolated subject. The reviewed literature consistently indicates that time in nature, play-based exploration, project work, reflection, creative expression, and teacher-guided participation form the main pedagogical pathways through which ESD becomes meaningful for young children. These practices most frequently support environmental literacy, while also contributing to cognitive, social-emotional, physical, and language-related development. The review also finds that the field has grown substantially, yet important limitations remain. The environmental dimension still dominates the literature, while broader social, cultural, economic, and action-oriented aspects of sustainability are less fully developed. For curriculum development, this means that early childhood ESD should begin with concrete environmental experiences but intentionally extend toward care, participation, equity, and local responsibility.

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The author declares that no generative AI was used in the preparation, analysis, interpretation of data, or writing of this article.

Author Contribution Statement

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Funding Statement

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Ethical Compliance

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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Conflict of Interest Declaration

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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