

Nature-Based Learning to Improve Emotional Regulation and Environmental Awareness in Early Childhood: A Narrative Literature Review

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ABSTRAK

Early childhood is a sensitive period for the development of emotional regulation and environmental awareness, two capacities that underpin lifelong wellbeing and pro-environmental behavior. Conventional indoor, teacher-directed early childhood education (ECE) often provides limited opportunities for children to practice self-regulation through embodied, sensory-rich experience, or to develop authentic connectedness to the natural world. Nature-based learning (NBL) pedagogical approaches that situate children's play and learning in natural or naturalized outdoor settings has been proposed as a promising alternative. This article presents a narrative literature review synthesizing 25 peer-reviewed studies published between 2021 and 2026 that examine the relationship between NBL and children's emotional regulation and environmental awareness. Sources were retrieved from Scopus- and Google Scholar-indexed journals with active digital object identifiers, appraised for relevance, and thematically synthesized. Findings indicate that NBL consistently supports self-regulation, reduces externalizing behavior, and fosters nature connectedness, which in turn mediates children's environmental awareness and early stewardship behavior. Evidence further suggests that unstructured nature play, sensitive teacher scaffolding, and repeated, place-based engagement with natural elements are key mechanisms driving these outcomes. The novelty of this review lies in explicitly linking the emotion-regulation and environmental-awareness literatures through a nature-connectedness mediation pathway, an integration rarely made explicit in prior nature-based learning studies. Implications for early childhood curriculum design and teacher practice are discussed.

INTRODUCTION

Early childhood, broadly defined as the period from birth to approximately eight years of age, is widely recognized by developmental scientists as a foundational window



during which the architecture of self-regulation, social-emotional competence, and basic environmental dispositions is laid down (Ernst & Stelley, 2024; Hosokawa et al., 2024). During this period, children's brains display heightened plasticity, and the everyday settings in which they play, explore, and interact with caregivers and peers exert a disproportionate influence on later developmental trajectories. Two constructs that have attracted particular attention from early childhood researchers are emotional regulation (ER) and environmental awareness (EA). Emotional regulation refers to the processes by which children monitor, evaluate, and modulate the intensity and expression of their emotional reactions in order to accomplish goals and adapt to social demands (Ernst & Stelley, 2024). Environmental awareness, meanwhile, denotes children's growing recognition of, sensitivity toward, and concern for the natural environment, including rudimentary understandings of ecological relationships and early stewardship dispositions (Najmina et al., 2025; Biber & Börekci, 2026).

Both constructs carry substantial long-term significance. Deficits in early emotion regulation are associated with poorer school readiness, weaker peer relationships, and elevated risk of later behavioral and mental health difficulties, whereas well-regulated children tend to show stronger academic engagement and social competence across the transition to formal schooling (Ernst & Stelley, 2024; Hosokawa et al., 2024). Environmental awareness cultivated in the early years, in turn, has been theorized as a precursor to the pro-environmental attitudes and behaviors that societies will require to confront escalating ecological challenges; children who develop an early emotional bond with nature are more likely to sustain environmentally responsible behavior into adulthood (Kosta et al., 2022; Arola et al., 2023). Despite the importance of both outcomes, conventional early childhood education in many contexts, including much of urban Indonesia and comparable middle-income settings, remains dominated by indoor, teacher-directed, worksheet-based instruction that affords children limited opportunity for embodied self-regulation practice or authentic, sensory-rich contact with living systems (Janita & Kuswanto, 2026).

In response to these limitations, nature-based learning (NBL) has emerged internationally as an increasingly prominent pedagogical movement. NBL encompasses a family of approaches — forest schools, bush kindergartens, green schoolyards, garden-based curricula, and structured "bug safari" or nature-exploration programs — that deliberately situate children's play, inquiry, and social interaction within natural or naturalized outdoor environments rather than conventional classrooms (Sella et al., 2023; Cudworth & Lumber, 2021; Speldewinde & Campbell, 2023; Biber & Börekci, 2026). Proponents argue that repeated, unhurried engagement with natural elements — loose parts such as sticks, stones, water, mud, and living organisms — offers children rich opportunities for self-directed problem solving, risk negotiation, and emotional co-regulation with peers and teachers, while simultaneously nurturing curiosity about, and connectedness with, the living world (Harris, 2021; Cudworth & Lumber, 2021). A growing body of empirical and review literature has examined these claims. Large-scale systematic reviews such as that of Johnstone et al. (2022), which synthesized evidence from thirty-six studies across twelve countries, and Mann et al. (2022), which reviewed nature-specific outdoor learning more broadly, report generally positive but methodologically heterogeneous associations between nature-based provision and children's self-regulation, social-emotional development, and nature relatedness. More recent primary studies extend this evidence base into specific cultural contexts, including forest-school programs in Europe (Sella et al., 2023; Kiviranta et al., 2023), bush kinder

programs in Australia (Speldewinde & Campbell, 2023; Acharibasam & McVittie, 2022), ecological-awareness programs in Türkiye (Biber & Börekci, 2026), pilot interventions in Pakistan (Jabeen et al., 2025), and a rapidly expanding body of Indonesian early childhood research examining outdoor physical activity, ecoliteracy, and nature-based strategies for environmental awareness (Janita & Kuswanto, 2026; Nurhidayah & Bastian, 2026; Najmina et al., 2025).

The plausibility of NBL's dual benefit for emotional regulation and environmental awareness is further supported by several converging theoretical frameworks. The biophilia hypothesis proposes that humans possess an innate affiliative tendency toward living systems, such that direct contact with nature is intrinsically rewarding and calming from early childhood onward. Attention restoration theory similarly suggests that natural environments, unlike built or highly stimulating indoor settings, replenish children's directed-attention resources, thereby indirectly supporting the executive-function capacities that underlie emotional self-regulation. Complementing these environmental-psychology perspectives, self-regulation theory in developmental science emphasizes that regulatory skill is built through repeated, graduated practice in managing arousal and frustration under conditions of relative safety — conditions that unstructured outdoor and nature play are argued to provide in abundance, through manageable physical risk, sensory variability, and open-ended problem solving (Ernst & Stelley, 2024; Cudworth & Lumber, 2021). Finally, the nature-connectedness framework, which conceptualizes children's emotional and cognitive bond with the natural world as a distinct, measurable psychological construct, offers a plausible bridge between these regulatory processes and the development of ecological concern, since a child who feels emotionally close to nature is thought to be more motivated to protect it (Arola et al., 2023; Kosta et al., 2022). Together, these frameworks provide converging theoretical justification for expecting NBL to influence emotional and environmental outcomes through a shared, rather than parallel, developmental pathway. Notwithstanding this expanding literature, three interrelated gaps remain evident. First, the emotional-regulation and environmental-awareness literatures on NBL have largely developed in parallel rather than in dialogue with one another. Reviews and primary studies addressing self-regulation and behavioral outcomes (e.g., Ernst & Stelley, 2024; Hosokawa et al., 2024; Aykut & Ertürk Kara, 2025) rarely engage explicitly with the parallel literature on nature connectedness and environmental attitudes (e.g., Kosta et al., 2022; Arola et al., 2023; Najmina et al., 2025), even though both outcome families are theorized to be grounded in the same underlying construct of connectedness to nature. Second, existing systematic reviews explicitly caution that the certainty of evidence remains low, owing to small samples, heterogeneous outcome measures, and a scarcity of controlled experimental designs (Johnstone et al., 2022; Kiviranta et al., 2023); yet few narrative syntheses have attempted to integrate this international evidence with the more recent, context-specific Indonesian and Southeast Asian literature (e.g., Sauli et al., 2026; Janita & Kuswanto, 2026) to identify where local implementation aligns with, or diverges from, the global evidence base. Third, most prior reviews treat "dose" and "quality" of nature exposure as secondary considerations rather than as central explanatory mechanisms, despite mounting evidence that teacher scaffolding, program duration, and the ecological richness of the outdoor setting substantially moderate outcomes (Kiviranta et al., 2023; Smedsrud et al., 2024, as cited in outdoor-play literature).

The present review addresses these gaps and, in doing so, offers three elements of novelty relative to prior work. First, rather than treating emotional regulation and

environmental awareness as separate literatures, this review proposes and empirically grounds an integrative mediation pathway in which nature-based learning fosters nature connectedness, which in turn functions as a common psychological mechanism driving both improved self-regulation and heightened environmental awareness — a linkage implied but rarely made explicit in earlier reviews (cf. Aykut & Ertürk Kara, 2025; Arola et al., 2023). Second, the review deliberately synthesizes robust international systematic-review evidence (Johnstone et al., 2022; Mann et al., 2022; Sella et al., 2023) alongside recent Indonesian and broader Asia-Pacific primary studies (Janita & Kuswanto, 2026; Nurhidayah & Bastian, 2026; Sauli et al., 2026; Jiang & Hussain, 2023), producing a synthesis that is both globally grounded and locally relevant to early childhood practice in Indonesia and comparable contexts. Third, the review foregrounds implementation-level moderators — teacher role, program dose, and setting quality — as an explicit analytic theme, rather than as an incidental limitation, thereby offering more actionable guidance for curriculum designers and early childhood educators seeking to design or evaluate nature-based programs. Taken together, these contributions position this review not merely as a summary of existing findings but as a conceptual bridge connecting two previously disconnected strands of early childhood scholarship.

The remainder of this article is organized as follows. The next section outlines the narrative review methodology, including the search strategy, inclusion criteria, and thematic synthesis procedure. The results and discussion section then presents the characteristics of the included studies, followed by a thematic synthesis organized around four themes: (1) nature-based learning and emotional regulation, (2) nature-based learning and environmental awareness, (3) the mediating role of nature connectedness, and (4) implementation factors that moderate program effectiveness. The article concludes with a discussion of theoretical and practical implications, acknowledged limitations, and directions for future research.

METHODOLOGY

This study employed a narrative literature review methodology, a design well suited to synthesizing a thematically diverse body of evidence spanning systematic reviews, quasi-experimental studies, mixed-methods case studies, and qualitative program evaluations that cannot be meaningfully pooled through meta-analytic techniques owing to substantial heterogeneity in outcome measures, sample ages, and cultural settings. The review followed a structured, four-stage identification-screening-eligibility-inclusion procedure broadly informed by PRISMA reporting conventions, adapted for narrative rather than systematic quantitative synthesis. Figure 1 depicts the complete search and synthesis procedure.

Search strategy and data sources. Records were identified through structured searches of Scopus-indexed and Google Scholar-indexed databases, including ScienceDirect, SpringerLink, Frontiers, MDPI, Taylor & Francis Online, and PLOS, using combinations of the keywords "nature-based learning," "outdoor learning," "forest school," "emotional regulation," "self-regulation," "environmental awareness," "nature connectedness," and "early childhood." The search was restricted to peer-reviewed journal articles published between 2021 and 2026 to ensure the currency of evidence, written in English or Indonesian, and possessing an active, resolvable digital object identifier (DOI) to ensure verifiability and accessibility through Google Scholar. An initial pool of 118 records was identified.

Screening and eligibility. Titles and abstracts were screened to remove duplicates and to exclude records unrelated to early childhood (defined here as approximately ages two to eight) or unrelated to nature-based pedagogy, yielding 79 unique records. Full texts of these records were then assessed against explicit inclusion criteria: (a) the study reported empirical findings or a systematic synthesis of empirical findings concerning children's emotional regulation, self-regulation, behavioral outcomes, environmental awareness, or nature connectedness; (b) the intervention or setting under study could reasonably be classified as nature-based learning (forest school, bush kinder, garden-based learning, outdoor free play in naturalized settings, or comparable programs); and (c) the article was published in a peer-reviewed venue with a verifiable, currently active DOI. Records were excluded if they duplicated a dataset already represented by another included study, if the DOI could not be verified as active, or if relevance to early childhood emotional or environmental outcomes was judged marginal upon full-text reading. This process yielded 46 eligible full-text articles, of which 25 were retained for the final narrative synthesis after a final relevance and quality appraisal that prioritized methodological transparency, sample description, and contribution to the review's thematic scope.

Study characteristics and synthesis procedure. The 25 included studies (summarized in Table 1) comprised systematic and mixed-methods reviews ($n = 6$), quasi-experimental and intervention studies ($n = 7$), qualitative and case-study designs ($n = 8$), and cross-sectional or correlational studies ($n = 4$), drawn from 14 countries across Europe, North America, Australia, the Middle East, East and Southeast Asia, including Indonesia, Malaysia, Pakistan, China, and Türkiye. Data extracted from each study included authorship and year, country and setting, research design, sample characteristics, the specific nature-based learning practice examined, and the reported outcomes relevant to emotional regulation and/or environmental awareness. Extracted data were organized using an inductive thematic coding procedure: two rounds of open coding were used to identify recurring outcome patterns and mechanisms, which were then grouped into the four synthesis themes reported in the Results and Discussion section, following the coding structure depicted in the lower portion of Figure 1. Because this review is narrative rather than meta-analytic, no formal risk-of-bias score was computed for individual studies; instead, the methodological caveats noted by the authors of each systematic review (particularly Johnstone et al., 2022, and Kiviranta et al., 2023) were retained and reported transparently in the discussion of evidence certainty.

Figure 1. Flow Diagram of the Literature Search and Synthesis Procedure

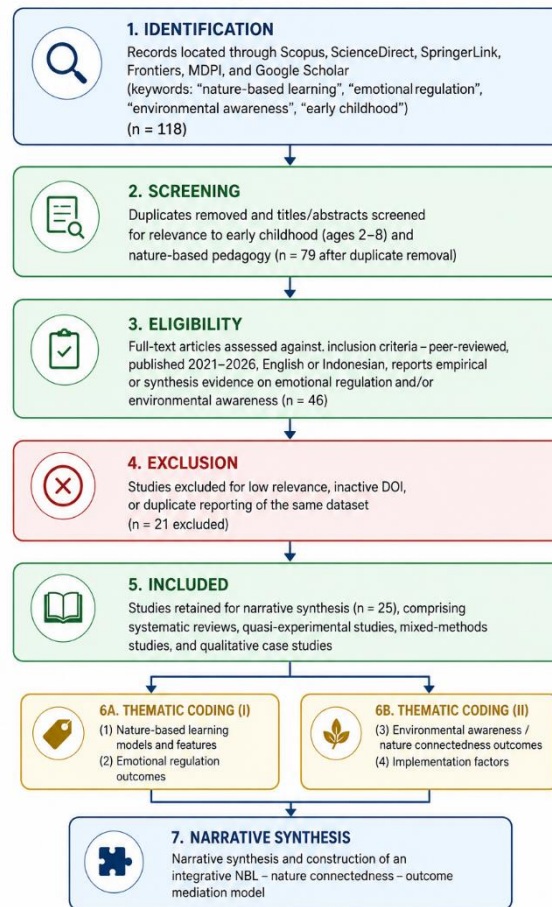


Figure 1. Flow diagram of the literature search and thematic synthesis procedure used in this review

RESULTS AND DISCUSSION

Overview of included evidence. Table 1 summarizes the 25 studies retained for narrative synthesis. The evidence base is dominated by qualitative case studies and small-to-moderate quasi-experimental designs, complemented by six systematic or mixed-methods reviews that themselves aggregate dozens of primary studies (notably Johnstone et al., 2022, and Mann et al., 2022). Geographically, the literature spans high-income contexts in Europe, North America, and Australia, where forest-school and bush-kinder traditions are longest established, alongside a rapidly growing cluster of studies from Indonesia, Malaysia, Pakistan, and China documenting the adaptation of nature-based principles to Southeast and South Asian early childhood settings. This geographic spread strengthens confidence that the reported associations are not artifacts of a single cultural or institutional context, while also revealing that rigorous experimental designs remain comparatively rare outside a handful of Anglophone and Nordic contexts.

Table 1. Summary of the 25 studies included in the narrative synthesis

Author (Year)	Country / Region	Design	Key Findings
Johnstone et al. (2022)	Multi-country (12)	Mixed-methods systematic review (n = 36 studies)	Nature-based ECE positively associated with self-regulation, social-emotional development, and nature relatedness; certainty of evidence low
Mann et al. (2022)	Multi-country	Systematic review	Nature-specific outdoor learning linked to gains in wellbeing, engagement, and social-emotional development
Sella et al. (2023)	Europe	Systematic review	Forest-school attendance associated with improved emotional wellbeing and reduced stress behaviors in preschoolers
Ernst & Stelley (2024)	United States	Quasi-experimental (n = 115 children)	Unstructured nature play predicted gains in preschool self-regulation assessment scores
Hosokawa et al. (2024)	Japan	Intervention study	Structured social-emotional learning combined with outdoor activity enhanced early social-emotional skills
Aykut & Ertürk Kara (2025)	Türkiye	Cross-sectional, mediation analysis	Connection with nature mediated the relationship between behavioral problems and emotion regulation
Kiviranta et al. (2023)	Finland	Qualitative	Outdoor learning benefits self-regulation and social skills but is moderated by teacher confidence and weather constraints
Cudworth & Lumber (2021)	United Kingdom	Qualitative case study	Forest School fosters pathways to nature connection through sensory, emotional, and meaningful engagement
Harris (2021)	United Kingdom	Qualitative case study	Forest School supports development of place attachment and relationship with nature
Speldewinde & Campbell (2023)	Australia	Qualitative case study	Bush Kinder builds children's relationships with the environment through repeated place-based visits
Acharibasam & McVittie (2022)	Canada	Qualitative	Integrating Indigenous ecological knowledge strengthens children's connection to nature
Kosta et al. (2022)	Greece	Quasi-experimental	School-based environmental programs improved pupils' ecological knowledge and connectedness to nature

Arola et al. (2023)	Multi-country	Systematic review	Nature connectedness positively associated with children's wellbeing across multiple study designs
Biber & Börekci (2026)	Türkiye	Quasi-experimental ("Bug Safari" program)	Structured invertebrate-focused nature program increased ecological awareness among preschoolers
Najmina et al. (2025)	Indonesia	Qualitative	Nature-based learning strategies (gardening, outdoor exploration) build early environmental awareness
Nurhidayah & Bastian (2026)	Indonesia	Classroom action research	Nature-based deep-learning approach develops early ecoliteracy skills
Janita & Kuswanto (2026)	Indonesia	Quasi-experimental	Outdoor, nature-based physical activity improved emotion regulation and gross-motor skills
Sauli et al. (2026)	Malaysia	Systematic literature review	Nature-based learning in Malaysian ECE settings associated with holistic developmental gains, though evidence remains uneven
Jiang & Hussain (2023)	China	Case study	Nature-based learning promoted physical, cognitive, and emotional development in a Chinese kindergarten
Jabeen et al. (2025)	Pakistan	Pilot intervention study	Nature-based activities produced transformative improvements in engagement and emotional expression
Permatasari et al. (2025)	Indonesia	Qualitative	Nature-based learning fostered creativity and independence in early childhood
Watt & Frydenberg (2024)	Australia	Mixed-methods	Education-for-sustainability programs supported social and emotional learning outcomes
Craig et al. (2024)	United States	Literature-based design review	Nature-based outdoor environments for infants/toddlers linked to broad developmental and wellbeing benefits
Smedsrud et al. (2024)	Norway	Systematic review	Teacher scaffolding strategies shape the quality of children's play in nature-based outdoor spaces
Ramsden et al. (2025)	Canada	Observational (behaviour mapping)	Gardening areas and natural play features increased diverse and exploratory play, including bio-play

Theme 1: Nature-based learning and emotional regulation. Across the reviewed studies, the most consistent finding is a positive association between sustained engagement in nature-based settings and children's capacity for emotional and behavioral self-regulation. Ernst and Stelley (2024), in a quasi-experimental study of 115 preschoolers, found that children who spent a substantial portion of their day in unstructured nature play showed measurable gains on the Preschool Self-Regulation Assessment, suggesting that time in nature is not simply compatible with, but may actively support, school readiness. This finding aligns with the broader systematic review by Johnstone et al. (2022), which reported consistent, albeit low-certainty, positive associations between nature-based early childhood education and self-regulation across studies from twelve countries. Complementary evidence from Türkiye indicates that the relationship between behavioral problems and emotion regulation is not direct but is mediated by children's connection with nature, such that stronger nature connectedness buffers the association between early behavioral difficulties and poorer emotion regulation (Aykut & Ertürk Kara, 2025). Similarly, an intervention study in Japan combining structured social-emotional learning with outdoor engagement produced measurable improvements in early social-emotional competencies (Hosokawa et al., 2024), while an Indonesian quasi-experimental study found that nature-based, outdoor physical activity improved both emotion regulation and gross-motor development among young children (Janita & Kuswanto, 2026). Taken together, these studies converge on a plausible mechanism: unstructured, sensory-rich outdoor play affords children frequent, low-stakes opportunities to encounter and manage mild frustration, physical risk, and social negotiation — precisely the repeated practice conditions that self-regulation theory identifies as necessary for skill consolidation. Notably, several of the included studies report that these regulatory benefits appear even without highly structured curricular intervention: it is the frequency and quality of unstructured exposure, more than the sophistication of the accompanying pedagogy, that most consistently predicts gains (Ernst & Stelley, 2024). This nuance is practically encouraging, since it suggests that meaningful regulatory benefits may be attainable even in early childhood settings with limited resources for elaborate curriculum redesign, provided that children are given regular, protected time for outdoor, nature-based play.

Theme 2: Nature-based learning and environmental awareness. A second cluster of studies examines how nature-based pedagogy cultivates environmental awareness and early stewardship dispositions. In Türkiye, a structured "Bug Safari" program in which preschoolers engaged in guided exploration of invertebrate life produced measurable increases in ecological awareness (Biber & Börekci, 2026), while in Greece, school-based environmental programs improved both ecological knowledge and connectedness to nature among young pupils (Kosta et al., 2022). Within the Indonesian literature, Najmina et al. (2025) documented how gardening and outdoor exploration strategies embedded within early childhood curricula fostered children's early environmental awareness, and Nurhidayah and Bastian (2026) reported that a nature-based "deep learning" approach supported the development of early ecoliteracy skills, including recognition of local plants, animals, and simple ecological relationships. A qualitative case study from China similarly found that nature-based learning simultaneously promoted physical, cognitive, and emotional development, underscoring that environmental engagement rarely occurs in isolation from other developmental domains (Jiang & Hussain, 2023). These findings collectively suggest that environmental awareness in early childhood is not primarily transmitted through didactic instruction about ecological facts, but rather emerges from

direct, repeated, embodied contact with living systems planting seeds, observing insects, handling natural materials through which abstract ecological concepts become emotionally and experientially grounded. This pattern is consistent with the broader environmental-education literature's long-standing distinction between "knowledge about" nature and "relationship with" nature; the studies reviewed here indicate that early childhood programs achieving the latter, more relational form of engagement tend to report the strongest and most durable gains in children's ecological sensitivity and expressed concern for living things (Kosta et al., 2022; Biber & Börekci, 2026).

Theme 3: The mediating role of nature connectedness. The most theoretically significant pattern to emerge from this synthesis is that nature connectedness children's subjective sense of emotional closeness to, and identification with, the natural world functions as a common psychological pathway linking nature-based learning to both emotional-regulation and environmental-awareness outcomes. The systematic review by Arola et al. (2023) found that nature connectedness was positively associated with children's wellbeing across a range of study designs, while Aykut and Ertürk Kara (2025) demonstrated statistically that nature connectedness mediates the pathway from early behavioral problems to emotion-regulation outcomes. Qualitative evidence from Forest School research in the United Kingdom reinforces this interpretation: Cudworth and Lumber (2021) describe how sensory, embodied, and emotionally meaningful encounters with natural elements constitute the specific "pathways" through which children come to feel connected to nature, while Harris (2021) similarly documents the development of place attachment through repeated Forest School visits. In Australia, Speldewinde and Campbell (2023) observed that Bush Kinder programs build children's relationships with the environment cumulatively, through familiarity developed across repeated visits to the same natural site rather than through single exposures, and Acharibasam and McVittie (2022) found that integrating Indigenous ecological knowledge into early environmental education further deepened this relational connection. Read together, this body of evidence supports the integrative model proposed in this review: nature-based learning does not act on emotional regulation and environmental awareness through two separate mechanisms, but rather cultivates a shared underlying psychological resource connectedness to nature from which both outcomes subsequently draw. This reframing has practical significance, because it implies that programs designed primarily to build emotional regulation (for example, calming outdoor "cool-down" spaces) may simultaneously build environmental awareness, and vice versa, if they are designed to deepen children's relational engagement with the natural setting rather than treating nature merely as a backdrop for activity.

Theme 4: Implementation factors that moderate program effectiveness. A final theme concerns the conditions under which nature-based learning succeeds or falls short of its intended benefits. Several studies caution that simply relocating instruction outdoors is insufficient; the quality, dose, and pedagogical scaffolding of the nature experience substantially moderate outcomes. Kiviranta et al. (2023), studying outdoor learning in Finnish early childhood education, found that benefits for self-regulation and social skills were moderated by teachers' confidence in outdoor pedagogy and by practical constraints such as weather and staffing, indicating that positive outcomes are not automatic but depend on sustained institutional and teacher support. Complementary evidence from a systematic review of teacher practices in nature-based outdoor spaces found that the specific scaffolding strategies teachers use — when to intervene, when to withdraw, and how to extend children's self-directed exploration — substantially shape the richness of

children's play and, by extension, its developmental yield (Smedsrud et al., 2024). Observational research using behavior-mapping methods further shows that not all natural features are equally effective: gardening areas and semi-natural play features were associated with markedly higher rates of exploratory and "bio-play" behavior than manufactured play structures, suggesting that the ecological richness and openness of the physical setting itself is a critical design variable (Ramsden et al., 2025; Craig et al., 2024). Malaysian and Indonesian evidence adds a further contextual caveat: Sauli et al. (2026), in a systematic review of nature-based learning in Malaysian early childhood education, reported that although outcomes were generally positive, implementation was uneven across institutions with differing access to green space, staff training, and curricular flexibility, a pattern echoed in Indonesian studies documenting localized, small-scale nature-based interventions rather than systemic curricular integration (Permatasari et al., 2025; Watt & Frydenberg, 2024). Collectively, this theme underscores that "nature-based learning" is not a single standardized intervention but a spectrum of practices whose developmental benefits are contingent on deliberate pedagogical design, adequate program dose, and institutional investment in outdoor infrastructure and teacher capacity. An important practical corollary is that program evaluators and policymakers should resist treating "outdoor time" as a single undifferentiated variable; two programs reporting equivalent hours of outdoor exposure may yield markedly different developmental outcomes depending on whether that time is spent in ecologically rich, loosely structured natural settings with attentive teacher facilitation, or in barren, manufactured playgrounds with minimal adult scaffolding.

Synthesis and evidentiary caveats. Integrating across the four themes, the reviewed literature offers converging, cross-cultural evidence that nature-based learning supports both emotional regulation and environmental awareness in early childhood, and that these two outcome domains are substantively linked through the shared mechanism of nature connectedness. At the same time, several authors of the largest systematic reviews explicitly caution that the overall certainty of this evidence remains low to moderate, owing to the predominance of small-sample, non-randomized, and qualitative designs, considerable heterogeneity in how "nature-based learning" and its outcomes are operationalized across studies, and a continuing scarcity of longitudinal designs capable of establishing durable, causal effects (Johnstone et al., 2022; Mann et al., 2022; Kiviranta et al., 2023). The Indonesian and Southeast Asian evidence base, while rapidly growing and broadly consistent with international findings, remains particularly concentrated in small-scale, single-site qualitative or quasi-experimental studies (Najmina et al., 2025; Janita & Kuswanto, 2026; Permatasari et al., 2025), indicating a clear need for larger, better-controlled, and longitudinal studies within this regional context before strong causal or policy claims can be made.

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CONCLUSION

This narrative review synthesized 25 peer-reviewed studies published between 2021 and 2026 to examine how nature-based learning contributes to two developmentally significant outcomes in early childhood: emotional regulation and environmental awareness. The synthesized evidence indicates that sustained, repeated, and pedagogically scaffolded engagement with natural settings is consistently associated with improvements in children's self-regulation and social-emotional competence, as well as with the growth of ecological knowledge, sensitivity, and early

stewardship dispositions. Critically, this review's central contribution is to make explicit a mechanism that prior literature has largely treated implicitly or separately: nature connectedness functions as a shared psychological pathway through which nature-based learning simultaneously shapes both emotional and environmental outcomes, rather than acting through two independent processes. This integrative reframing suggests that early childhood educators and curriculum designers need not treat emotional-regulation goals and environmental-education goals as competing priorities for limited outdoor learning time; well-designed nature-based programs that deepen children's relational engagement with living systems are positioned to advance both goals concurrently.

The review also highlights that the benefits of nature-based learning are not automatic. Evidence from Finland, Norway, Canada, and Southeast Asia converges on the conclusion that teacher scaffolding, program dose, ecological richness of the outdoor setting, and institutional support for outdoor pedagogy are decisive moderators of program effectiveness. For practitioners, this implies that simply moving children outdoors is unlikely to yield the reported benefits; deliberate attention to program duration, teacher training in outdoor facilitation, and the design of naturalistic (rather than purely manufactured) play features is required. For policymakers and early childhood institutions in Indonesia and comparable contexts, the review suggests that investment in accessible green outdoor spaces, teacher professional development in nature pedagogy, and curricular flexibility to accommodate regular outdoor engagement represent concrete, evidence-aligned priorities.

Several limitations of this review should be acknowledged. As a narrative rather than systematic meta-analytic review, the synthesis does not provide pooled effect-size estimates, and study selection, while guided by explicit criteria, retains an element of interpretive judgment. The underlying primary literature is itself dominated by small-sample, non-randomized, and qualitative designs, and the certainty of evidence for several reported associations remains low, as acknowledged by the authors of the major systematic reviews included here. Future research would benefit from larger-scale, longitudinal, and quasi-experimental or randomized studies — particularly within Indonesian and broader Southeast Asian early childhood settings — that directly test the proposed nature-connectedness mediation model using validated, developmentally appropriate measures of emotional regulation and environmental awareness administered at multiple time points. Such research would allow the promising, theoretically integrative model advanced in this review to be evaluated with greater causal confidence, ultimately strengthening the evidence base available to guide the design of nature-based early childhood curricula.

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