Journal of Culture and Values in Education

https://cultureandvalues.org

E-ISSN: 2590-342X

Volume: 9 Issue: 3 2026

pp. 298-327

Reframing Education for Sustainable Development Through Deep Ecology: A Systematic Review and Transformative Education Framework

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Article Info
Received: April 08, 2026
Accepted: September 08, 2026
Published: October 6, 2026

10.46303/jcve.2026.50

How to cite
Maesaroh, M., Al Muhdhar, M. H. I., Lestari, S. R., Suhadi, S., Mustofa, A., Ritonga, R. F. (2026). Reframing Education for Sustainable Development Through Deep Ecology: A Systematic Review and Transformative Education Framework. *Journal of Culture and Values in Education*, *9*(3), 298-327. https://doi.org/10.46303/jcve.2026.50

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ABSTRACT

Education for Sustainable Development (ESD) is widely regarded as the primary educational response to global ecological crises; however, it is frequently criticised for its anthropocentric and instrumental orientation. Deep ecology, with its emphasis on the intrinsic value of all beings and the relational nature of existence, offers a radical philosophical foundation for reorienting sustainability education toward ontological and ethical transformation. Research connecting deep ecology and education, however, remains fragmented and lacks a systematic synthesis. This study therefore conducts a Systematic Literature Review (SLR) of 34 peer-reviewed articles, retrieved through a structured Scopus search, screened following PRISMA guidelines, and analysed by qualitative thematic synthesis. The findings indicate that deep ecology is predominantly conceptualised as an ethical and philosophical foundation, while experiential and nature-based pedagogies dominate its practical application. Reported outcomes concentrate at the level of ecological awareness and value orientation; fewer studies reach ecological identity, and fewer still report sustained sustainability action. A gap analysis across five domains curriculum, teaching practice, teacher beliefs, policy, and assessment shows deep ecology to be partially addressed rather than systematically integrated. In response, the study proposes the Deep Ecology Transformative Education Framework (DETEF), a five-stage model linking ethical reflection, relational understanding, ecological identity formation, experiential engagement, and action integration. DETEF bridges deep-ecological philosophy and transformative educational practice within ESD, offering clear guidance for curriculum development, pedagogical innovation, and empirical inquiry. The framework provides a structured pathway for embedding deep ecology into ESD, thereby fostering ontological and ethical transformations in both learners and educators.

KEYWORDS
Deep ecology; Education for Sustainable Development; Ecocentrism; Transformative education; Systematic literature review

INTRODUCTION

Education for Sustainable Development (ESD) has emerged as an educational response to global sustainability challenges such as climate change, environmental degradation, and social injustice (Acosta Castellanos & Queiruga-Dios, 2021). According to UNESCO, ESD is a process that empowers learners to make responsible decisions regarding environmental, social, and economic sustainability, both now and in the future (Leal Filho et al., 2020). Therefore, ESD is closely linked to the 2030 Agenda and the Sustainable Development Goals (SDGs), especially Target 4.7, which calls for education that advances sustainable development, human rights, and global citizenship (Tafese & Kopp, 2025). However, critics argue that ESD remains largely anthropocentric, prioritising human needs and well-being while neglecting the holistic dimensions of human-nature relationships (Metuonu & Irivike, 2025). This critique highlights ESD's tendencies toward instrumentalism and technocracy, with a predominant focus on human competencies and limited attention to reconnecting humans with the wider web of life (Kohl et al., 2025).

Scholars further contend that sustainability education often emphasises literacy and technical skills over deeper paradigm shifts (Desmarais, 2025). Sterling (2001) argues that education should transform its paradigms, moving from mechanistic models toward reflective, holistic, and transformative approaches, where learning reshapes consciousness, not just knowledge. This aligns with ESD scholarship advocating holistic, pluralistic, and action-oriented frameworks to foster sustainability competencies and learner agency (Rajab et al., 2026; Sihombing et al., 2024). Transformative learning theory further reinforces this shift, emphasising changes in meaning-making, values, identity, and action (Grund et al., 2024). Collectively, these perspectives position transformative learning as a robust foundation for advancing ESD in reflective, critical, and emancipatory ways.

Within environmental philosophy, deep ecology offers a more radical perspective by challenging anthropocentrism in sustainability thinking (Abakare, 2021). Arne Naess, the founder of deep ecology, argued that sustainability must recognise the intrinsic value of all living beings and their interdependent relationships, not just human well-being (Glasser, 1996; Naess, 1973). Deep ecology thus asserts that ecocentrism or biocentrism provides a stronger moral foundation for sustainability than instrumental views of nature. Key concepts include biospheric egalitarianism, the ecological self, and a holistic understanding of life's interconnectedness (Umam et al., 2024). This perspective directly challenges the anthropocentric paradigm underpinning many contemporary sustainability policies and practices, including strands of ESD discourse that continue to frame nature primarily as a resource for human use (Holma et al., 2025). In doing so, deep ecology opens space for an ethical and ontological reorientation in education moving beyond environmental management towards a deeper transformation in how humans relate to the more-than-human world.

Naess distinguishes the shallow ecology movement which fights pollution and resource depletion for human health and affluence from the deep movement, which rejects the

anthropocentric worldview. He proposes eight platform principles affirming that all living beings have equal intrinsic worth, regardless of their utility to humans. Central to this philosophy is the ecological self: through deep identification with other beings, the boundary between self and nature blurs, such that harming nature is experienced as harming oneself (Naess, 1973). This perspective grounds voluntary simplicity a conscious reduction of consumption and calls for fundamental changes in economic systems, technology, and thinking, moving away from consumerist cultures toward ecologically conscious living (Glasser, 1996; Sessions, 1987). Deep ecology thus fosters ecological awareness and encourages a transformation in how humans perceive themselves and their environment, opening space for an ethical and ontological reorientation in education.

Despite its philosophical relevance, deep ecology remains marginally and unsystematically integrated into ESD literature. Some studies adopt nature-based, experiential, or project-based approaches to cultivate ecological affinity from early childhood (Pratiwi et al., 2025). Others address ecological ethics or socio-ecological dimensions of sustainability, but often without explicit reference to deep ecology or a coherent ecocentric framework (Grosseck et al., 2019). Existing scholarship has yet to provide a comprehensive synthesis of how deep ecology is conceptualized and pedagogically translated into educational practice across formal and non-formal ESD (Acosta Castellanos & Queiruga-Dios, 2021). This gap calls for a systematic assessment of how deep ecology has been employed in sustainability education (Lutfauziah et al., 2024), and how its principles can reframe existing ESD approaches (Metuonu & Irivike, 2025). Accordingly, this study explores how deep ecology is positioned in sustainability education literature and how its principles inform learning practices, drawing on recent ESD developments that emphasise transformational, holistic, and post-anthropocentric perspectives (Aboytes & Barth, 2020). Through a systematic literature review, this study also develops a conceptual framework bridging deep ecology philosophy and transformative educational practice, responding to calls for a more ecocentrically grounded ESD.

Research Questions

Guided by the above rationale, this review is structured around the following research questions:

1. How is deep ecology conceptualized and positioned in educational literature related to ESD?
2. What pedagogical approaches are employed to translate deep ecology principles into educational practice?
3. What sustainability-related outcomes are most frequently reported, and to what extent do these outcomes reflect transformations in learners' consciousness, identities, and actions?
4. What gaps remain in existing literature, and how might a new conceptual framework help bridge the gap between deep ecology philosophy and transformative education?

METHODS

This section presents the methodological design, organised in accordance with established reporting standards for systematic reviews. The methods are structured under six sub-sections: (1) design, (2) data sources, (3) tools of data collection, (4) data collection, (5) data analysis, and (6) trustworthiness of data. This structure ensures transparency, replicability, and methodological coherence throughout the review process.

Design

This study adopts a Systematic Literature Review (SLR) design to identify, evaluate, and synthesize existing research on the integration of deep ecology within educational contexts and Education for Sustainable Development (ESD). The SLR design was selected because it enables a structured, transparent, and reproducible examination of a fragmented body of literature, allowing for the identification of conceptual patterns, pedagogical pathways, and research gaps across studies (Page et al., 2021). The review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which provide a standardised protocol for the identification, screening, eligibility assessment, and inclusion of studies. Given that the present review is interpretive and conceptual in orientation, the design also incorporates a qualitative thematic synthesis component that supports the integration of philosophical, pedagogical, and outcome-oriented dimensions across the included studies.

Data Sources

The primary data sources for this review were peer-reviewed journal articles indexed in the Scopus database. The search was restricted to articles published between 2016 and 2025, reflecting the most current and relevant scholarship on deep ecology and ESD. The search was restricted to peer-reviewed articles published in English. After applying all eligibility criteria, a final corpus of 34 articles was identified for in-depth thematic analysis.

Tools of Data Collection

Two principal tools were used to support the data collection. First, a structured search string was developed to retrieve relevant records from the Scopus database, combining keywords across three core dimensions: (a) deep ecology philosophy, (b) educational contexts, and (c) sustainability. The final Boolean search string was as follows: *("deep ecology" OR "ecocentric philosophy" OR "biocentric equality" OR "ecocentrism") AND ("education" OR "environmental education" OR "sustainability education" OR "education for sustainable development" OR "ESD" OR "curriculum" OR "teaching" OR "learning") AND ("sustainability" OR "sustainable development" OR "environmental ethics" OR "ecological consciousness")*

This search string was designed to ensure that the identified studies simultaneously addressed the philosophical, pedagogical, and sustainability-related dimensions relevant to the study objectives. Second, a structured data extraction form was developed as the principal instrument for organising information from each included article (Figure 1).

Data Collection

Data collection followed the PRISMA framework in four stages. In the identification stage, a Boolean search string was applied to Scopus, yielding an initial set of 96 records. Screening filtered records by year (66 records), subject area (55), and document type (41). A further five records were excluded because their keywords fell outside the review scope, leaving 36 records. Two non-English articles were then excluded during the language and eligibility assessment. The final stage yielded 34 articles for in-depth analysis (see Figure 1 for the PRISMA flow).

Table 1.

Inclusion and Exclusion Criteria

No	Inclusion Criteria	Exclusion criteria
1.	Peer-reviewed articles were published in academic journals.	Non-academic publications or studies not subjected to peer-review processes.
2.	Studies that discuss deep ecology, ecocentrism, or closely related concepts within educational contexts are included.	Philosophical discussions of deep ecology that do not engage with educational contexts were excluded.
3.	Research focusing on formal, non-formal, or community-based education oriented towards sustainability.	Technical or scientific environmental studies that lack an educational dimension.
4.	Articles that addressed pedagogical approaches, curriculum design, or learning outcomes.	Articles for which full-text access was unavailable were excluded.

Study Selection Process (2016–2025). Total records identified: n = 96; records excluded by year: n = 30; records excluded by subject area: n = 11; records excluded by document type: n = 14; records excluded by keyword screening: n = 5; records excluded by language: n = 2; final included articles: n = 34.

Data Analysis

Data analysis was conducted using a qualitative thematic synthesis approach applied to the 34 included articles. The analysis was conducted in three iterative phases. In the first phase, the extracted data were openly coded to identify patterns related to (a) how deep ecology is conceptualized in educational research, (b) the pedagogical pathways employed, and (c) the sustainability-related outcomes reported. In the second phase, the open codes were grouped into higher-order categories aligned with the four research questions (RQ1–RQ4). For RQ1, the codes were organised around the conceptualisation of deep ecology (explicit, implicit, normative, transformative). For RQ2, the codes were clustered into pedagogical types (experiential, reflective, critical, systemic). For RQ3, the codes were grouped into outcome levels (ecological awareness, ethical orientation, ecological identity, sustainability action). For RQ4, codes were mapped across domains (curriculum, teaching practice, teacher beliefs, policy, assessment) to identify research gaps. In the third phase, the categorised data were synthesised

across studies to identify cross-cutting patterns, conceptual tensions, and underdeveloped areas in the literature, which informed the development of the typology and the proposed Deep Ecology Transformative Education Framework (DETEF).

Trustworthiness of Data

Trustworthiness was addressed using established criteria for qualitative systematic reviews. Credibility was supported by adhering to the PRISMA protocol and to explicit inclusion and exclusion criteria. Dependability was enhanced by the structured extraction form and iterative coding cycles, in which categories were refined as analysis progressed. Confirmability was maintained through an audit trail of search records, screening decisions, and coding, allowing the process to be traced from raw data to the final categories. Transferability was addressed by transparently reporting the search strategies, eligibility criteria, and analytical procedures. Finally, interpretive judgements were checked against the original studies to keep the codes grounded in the source material and reduce the risk of over-interpretation.

RESULTS

This section presents the findings in relation to the four research questions, with the intersection of deep ecology and Education for Sustainable Development (ESD) as the analytical focus. Across the 34 included studies, the synthesis identified four key findings: (i) four deep ecology orientations (explicit, implicit, normative, and philosophical–transformative); (ii) four pedagogical pathways (experiential, reflective–contemplative, critical–action, and systems-based); (iii) a three-level hierarchy of sustainability outcomes (ecological awareness and values, ecological identity, and sustainability action); and (iv) five literature gaps (curriculum, teaching practice, teacher beliefs, policy, and assessment). The findings are presented according to RQ1–RQ4 and culminate in the proposed Deep Ecology Transformative Education Framework (DETEF).

Findings for RQ1: How Deep Ecology is Conceptualized within Educational Literature Related to ESD

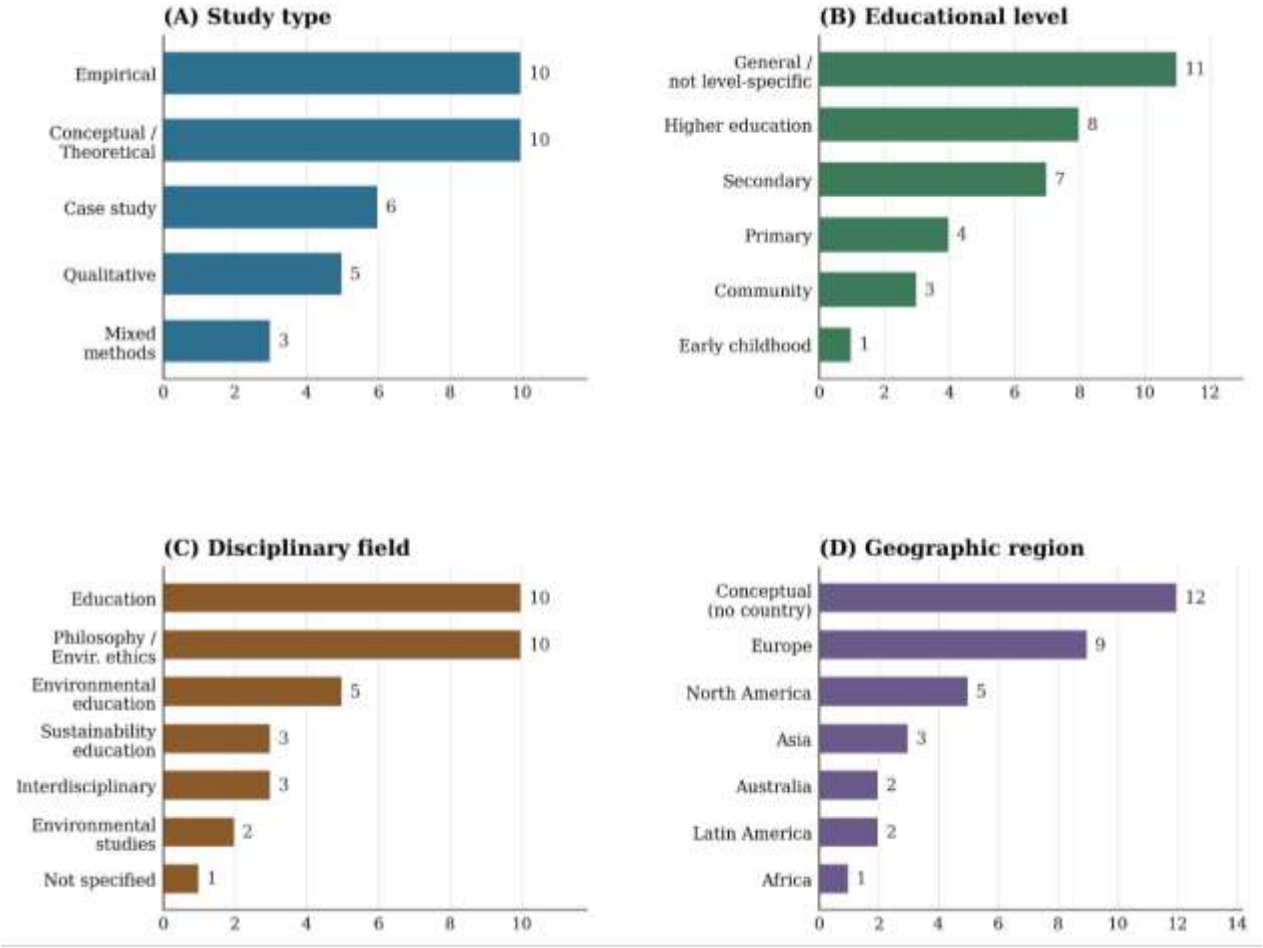
In response to RQ1, deep ecology is conceptualised across three interrelated levels: (a) an ecological ethical foundation, (b) a philosophical and ontological framework, and (c) a source of pedagogical inspiration unevenly represented, with the ethical and philosophical dimensions far more frequent than the pedagogical. Disciplinarily, the studies are strongly interdisciplinary but cluster in education and environmental education (pedagogy, curriculum, learning) and in environmental philosophy and ethics (deep ecology as a normative-ontological framework), with further contributions from sustainability studies. Thus, the field sits at the intersection of philosophy, pedagogy, and sustainability science, and shows a fragmentation in which philosophical debate is not consistently translated into concrete educational practice.

As shown in Figure 2, the 34 studies span Europe, North America, Asia, Africa, Australia, and Latin America, across all educational levels; however, they lean markedly toward conceptual, philosophical, and case-study designs rather than large-scale classroom or field

research. Figure 2 thus conveys breadth without depth: deep ecology appears across many contexts and levels, but in a scattered, predominantly theoretical way foreshadowing the philosophy-to-practice gap examined in subsequent research questions. Full study characteristics are presented in Table 2 in the Appendix.

Figure 2.

Characteristics of the included studies (N = 34).



Conceptualizing Deep Ecology in Education

In this review, deep ecology in education refers to integrating intrinsic value and interconnectedness into educational theory, curriculum, and practice. This approach seeks to fundamentally shift how learners perceive their relationship with nature, moving away from anthropocentrism (human-centeredness) toward an ecocentric or holistic worldview. Educationally, it is read as a normative ontological orientation that reframes the purpose of ESD from managing nature for human benefit to transforming how learners understand themselves in relation to the more-than-human world (Naess, 1973). Working from this definition, the analysis shows that deep ecology is not always explicitly named in educational research; it frequently operates implicitly, as underlying values or orientations. A few studies use the term and invoke its core principles: intrinsic value, biospheric egalitarianism, and critique of human domination, thereby positioning it as the philosophical foundation for reorienting sustainability

education (Foguesatto & Machado, 2022). The analysis identifies three levels of deep ecology conceptualisation:

1. The ecological–ethical foundation, in which deep ecology emphasizes the intrinsic value of nature and calls for an expansion of the moral community beyond humans to include the entire community of life (Holma et al., 2025).
2. The philosophical and ontological framework of deep ecology challenges entrenched human–nature dualisms and promotes a relational understanding of existence, positioning humans as embedded within, rather than separate from, ecological systems (Hategan, 2021).
3. Pedagogical inspiration, through which deep ecology informs educational practices such as experiential, nature-based learning, ecological self-reflection, and transformative approaches that aim to reshape learners' identities, values, and actions (Kopnina, 2016).

In brief, deep ecology is chiefly conceptualised as an ethical-philosophical foundation, less frequently as a pedagogical model, a gap that underpins the framework proposed below. Table 3 maps all 34 studies against three coordinates deep ecology orientation, pedagogy type, and reported outcome. Its message is clear: implicit and philosophical orientations paired with experiential pedagogies dominate, whereas transformative orientations linked to sustainability-agency outcomes remain rare. Table 3 visualises the central finding: deep ecology is predominantly characterised by ethical framing and experiential practice, while action-oriented, identity-transforming designs remain limited.

Findings for RQ2: Pedagogical Approaches Used to Translate Deep Ecology Principles into Educational Practice

In response to RQ2, the synthesis identified four pedagogical pathways: experience-based, reflective–contemplative, critical–action-oriented, and interdisciplinary–systems-based, but their distribution is strongly skewed toward the first. As Table 4 shows, most studies operationalise deep ecology through direct engagement with nature (outdoor, place-based, and immersive learning), treating experience rather than instruction as the primary route to ecological connectedness (Lefèvre et al., 2025; Melis et al., 2020; Şenocak & Koçsoy, 2024; Washington, 2018). Critical and action-oriented designs are far rarer and appear only as isolated cases (Kioupi & Giannopoulos, 2025; Mohanta, 2023; Ruiz-Ruano García & López Puga, 2016), while systemic, whole-curriculum integration is rarer still, surfacing as discrete projects rather than long-term, cross-subject models (Kostecka & Walat, 2023; Lalude et al., 2025; Macháčková et al., 2021).

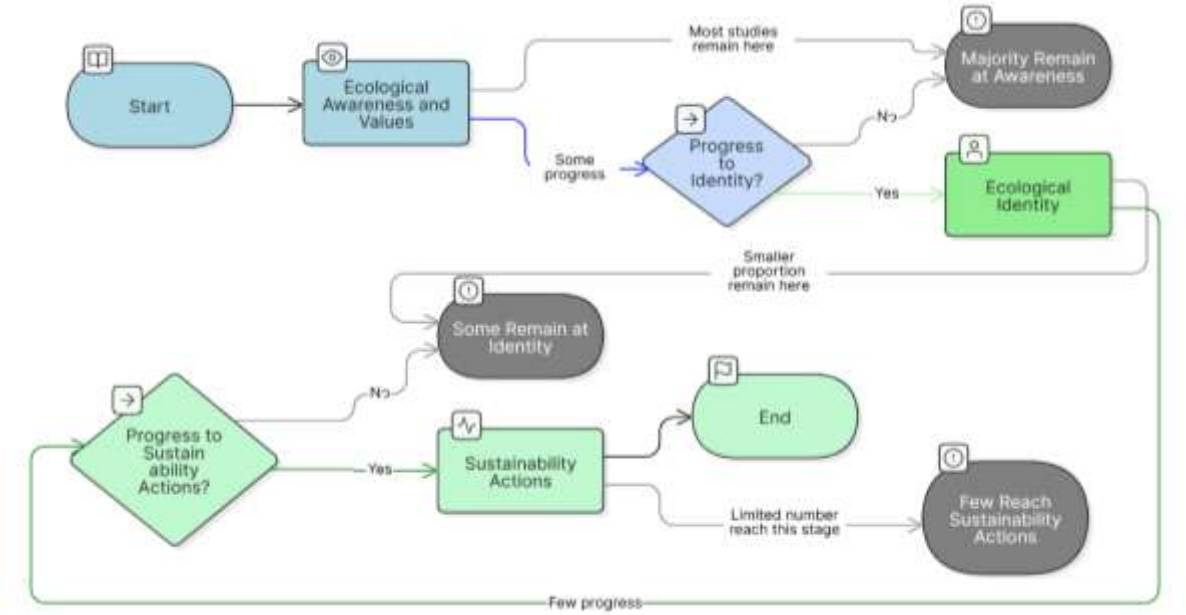
In brief (RQ2), deep-ecology pedagogy is dominated by experience-based and reflective contemplative learning, with critical and systemic designs least frequent; it has shaped the affective and reflective dimensions of learning but has not yet matured into a transformative pedagogy linking ecological identity to social action and systemic change.

Findings for RQ3: Sustainability Related Outcomes and How They Reflect Transformation in Learners' Consciousness, Identities, and Actions

In response to RQ3, the synthesis identified a three-level hierarchy of sustainability-related outcomes: (a) ecological awareness and value orientation, (b) ecological identity formation, and (c) sustainability-oriented action (Figure 4). Most studies report outcomes at the first level, demonstrating increased ecological awareness, recognition of interconnectedness, appreciation of nature, and stronger ethical responsibility toward the more-than-human world (Adow et al., 2024; Dudin et al., 2016; Holma et al., 2025; Lefèvre et al., 2025; Melis et al., 2020). The synthesis identified limited evidence of ecological identity formation, in which learners perceive themselves as part of the ecological community through reflective, contemplative, or immersive learning experiences (Frigo et al., 2024; Kopnina et al., 2024). Evidence of sustainability-oriented action was even more limited, appearing primarily in studies involving community-based projects or environmental initiatives (Kioupi & Giannopoulos, 2025; Mohanta, 2023; Ruiz-Ruano García & López Puga, 2016).

Figure 4.

Progression Outcome in Ecological Literature



Findings for RQ4: Research Gaps and the Proposed Conceptual Framework Bridging Deep Ecology and Transformative Education

In response to RQ4, the analysis identified five interrelated research gaps across the domains of curriculum, teaching practice, teacher beliefs, policy, and assessment. The findings further indicate that these gaps can be addressed through a synthesising conceptual framework, the Deep Ecology Transformative Education Framework (DETEF), which is proposed in this study as a coherent model linking deep ecology philosophy with transformative educational practice.

Research Gap in the Literature

These analytic gaps do not contradict but rather concretise the fragmentation identified at the outset: the scattered, non-systematic integration of deep ecology into ESD reappears here as

five specific deficits (Table 5). First, although studies affirm intrinsic value and ecological ethics (Adow et al., 2024; Holma et al., 2025; Martínez-Rodríguez & Fernández-Herrería, 2022), few move beyond ethics to comprehensive, deep-ecology-grounded curricula; reported practice remains thematic, outdoor, or stand-alone rather than cross-curricular (Washington, 2018). Second, while several studies gesture toward ecological identity (Kopnina & Cocis, 2017), robust indicators and instruments for assessing such transformation are largely absent, leaving claims of change on limited empirical evidence. Third, although deep ecology philosophically critiques exploitative socio-economic systems, most educational studies focus on the individual's relationship with nature rather than structural or collective dimensions; only a few connect learning to community action or social change (Kioupi & Giannopoulos, 2025). Fourth, teacher ecological identity and ecocentric policy discourse are seldom examined, and longitudinal evidence linking awareness to sustained behaviour is scarce.

In summary, deep ecology has enriched ESD's ethical and philosophical dimensions but lacks systematic translation into structured pedagogy, rigorous evaluation of identity transformation, or collective sustainability agency. Therefore, reframing is not the addition of more environmental content but the underlying orientation of ESD itself, a shift from an anthropocentric, competence-and-literacy logic toward an ecocentric, ontological one in which awareness, identity, and action are designed as a single transformative sequence. This provides a rationale for the framework proposed below.

Toward a Transformational Framework for Deep Ecology-Based Education

Building on the synthesis above, a clear imbalance emerges between the richness of deep ecology's philosophical reflection and the limited extent to which it has been translated into structured, and transformative practice. To address this, this review proposes the Deep Ecology Transformative Education Framework (DETEF). Rather than deriving from a single study, DETEF is constructed through a cross-pattern synthesis of the reviewed literature, integrating philosophical foundations, pedagogical pathways, and learning outcomes that have remained fragmented across studies. In doing so, it reframes deep ecology in ESD from a set of ethical exhortations and one-off nature experiences into a staged pedagogical architecture linking ethical reflection, relational understanding, ecological identity, experiential engagement, and sustainability action (Table 6).

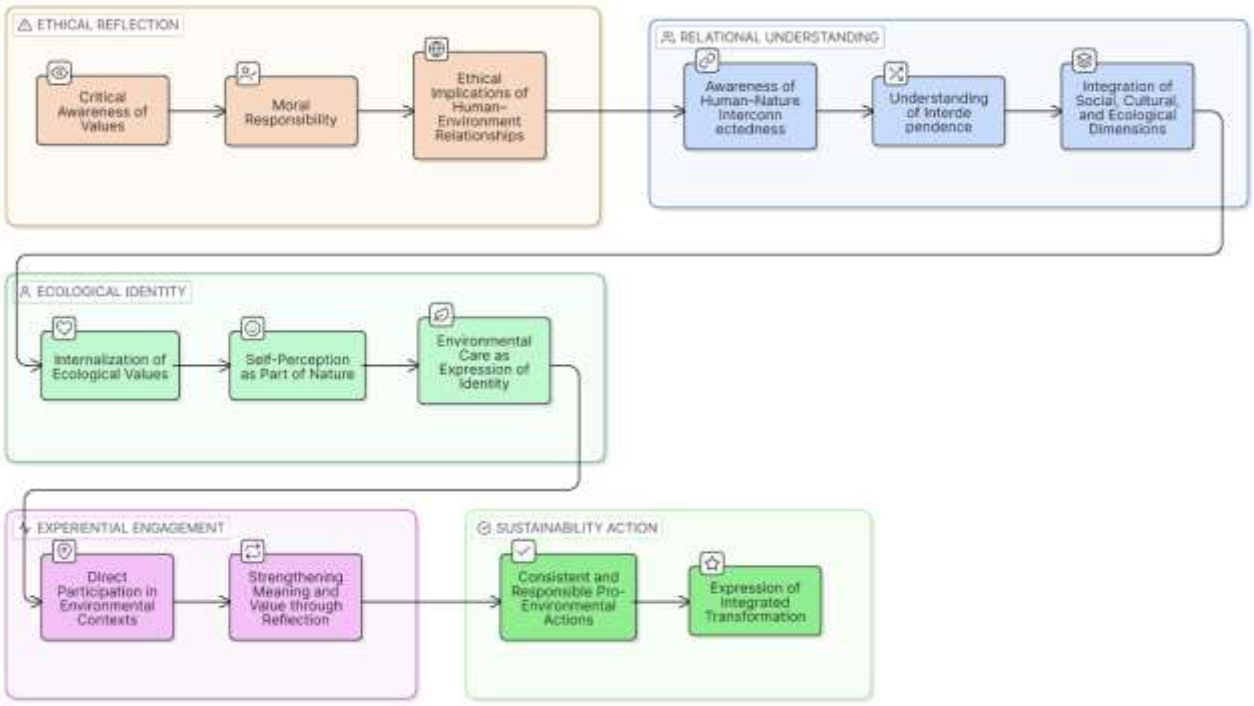
Drawing on the synthesis of the reviewed literature, the framework conceptualizes deep ecology-based education as a transformative process unfolding across five sequential stages, ranging from ethical reflection to the integration of sustainability-oriented action. Each stage represents a distinct yet interconnected form of transformation, progressing from awareness to practice. Together, DETEF delineates the following transformative pathways (Figure 5):

DETEF conceptualizes a staged pathway from internal to external change. It begins with ethical reflection and critical awareness of values, moral responsibility, and the ethical implications of human-environment relations, through which learners question anthropocentric paradigms and open themselves to ecologically grounded ethics that foreground sustainability

(Adow et al., 2024; Holma et al., 2025). As ethical reflection deepens, individuals move into the stage of relational understanding, where the relationship between humans and nature is no longer perceived as separate or hierarchical, but rather as an interconnected and interdependent system (Kostecka & Walat, 2023; Macháčková et al., 2021). This shift fosters the awareness that environmental issues are inseparable from broader social, cultural, and ecological contexts, encouraging more holistic ways of thinking and acting in relation to the environment. As relational understanding deepens, it gradually gives rise to an ecological identity. At this stage, ecological values are no longer held merely at a conceptual level but are internalised as part of the individual's sense of self (Kopnina et al., 2025; Kopnina & Cocis, 2017). Nature is perceived as an integral component of both personal and social identity, such that environmental concern is no longer experienced as an external obligation or normative demand, but as a fundamental dimension of how individuals understand themselves within the ecological world.

Figure 5.

Transformative Pathway of the DETEF Framework



This emerging ecological identity is subsequently expressed through experiential engagement, characterized by active participation in learning processes, field-based practices, and concrete activities that enable direct interaction with environmental issues and contexts (Şenocak & Koçsoy, 2024). This stage plays a critical bridge between awareness and identity on the one hand, and concrete practice on the other, while simultaneously reinforcing the personal significance of sustainability values through embodied, reflective experience. The sequence culminates in sustainability action, understood as concrete, consistent, and ethically grounded engagement (Kioupi & Giannopoulos, 2025; Mohanta, 2023), rather than as a reactive response, but as the outcome of integrated transformation across awareness, identity, and experience.

DETEF thus foregrounds behavioural change together with deeper shifts in how human–nature relationships are understood and enacted. It remains conceptual and has not yet been empirically implemented; its effectiveness requires further implementation-based and evaluative study of measurable changes in attitudes, ecological identity, and action. Nonetheless, it shows that deep ecology's educational potential extends well beyond awareness and, given that most current practice stops at early awareness and value formation, serves as a synthetic model bridging the ontological foundations of deep ecology with educational design to generate integrated transformations in awareness, identity, and action.

To render this conceptual pathway technically actionable for curriculum design, each stage of DETEF is further operationalized into three interrelated curricular components—the instructional purpose it serves, the content domain it draws upon, and the pedagogical method through which it is enacted (Table 7). This operational layer translates the philosophical architecture of DETEF into elements that can be directly incorporated into syllabus design, lesson planning, and teacher practice, while remaining grounded in the same body of reviewed literature underlying Table 6.

Based on Tables 6 and 7 position DETEF as both a conceptual pathway of transformation and a practical curriculum design template: the former specifies why and toward what outcome each stage moves learners, while the latter specifies what is taught and how it is taught at each stage, addressing the need for a more technically implementable model of deep ecology–based education.

Beyond specifying purpose, content, and method, a technically complete curriculum design also requires clarity on how learning is evaluated and how the syllabus itself is organized. Table 8 extends the operationalization of DETEF along these two remaining dimensions for each stage.

Tables 6-8 give DETEF a complete technical scaffold spanning purpose, content, method, assessment, and syllabus organization at every stage, moving the framework from a conceptual pathway toward a curriculum design that can be piloted and evaluated in practice. These findings provide a direct answer to RQ4: significant gaps remain in the literature across the domains of curriculum integration, longitudinal evaluation, teacher ecological identity, ecocentric policy discourse, and assessment of transformative learning outcomes. The Deep Ecology Transformative Education Framework (DETEF) proposed in this study addresses these gaps by articulating a five-stage transformative pathway from conceptual grounding through relational understanding, identity formation, and experiential engagement to action integration that bridges deep ecology philosophy and transformative education within ESD.

DISCUSSION

The findings indicate that the integration of deep ecology within ESD still remains at an early stage. Mainstream ESD literature has long been criticized for operating within anthropocentric and technocratic frameworks (Mijač et al., 2022). Deep ecology offers a more fundamental shift

by challenging prevailing ontological assumptions about humanity's position within the web of life (Akamani, 2020). However, in educational practice, this potential is most often translated into heightened ecological awareness rather than sustained identity transformation or collective action (Gal & Gan, 2020). The conceptual framework proposed in this study, the Deep Ecology Transformative Education Framework (DETEF), emerged as a direct response to the fragmentation identified in the literature review. Rather than merely adding an ecological perspective, DETEF articulates the mechanisms through which shifts in awareness can evolve into changes in identity and action (Wamsler, 2020).

The predominance of ethical-philosophical orientations over transformative ones suggests that deep ecology is often treated as a normative framework rather than a pedagogical one. This aligns with critiques that ESD remains largely theoretical (Desmarais, 2025) and echoes Sterling's (2001) call for paradigm shifts in educational practice. The scarcity of transformative orientations indicates that deep ecology's potential, particularly its challenge to anthropocentrism, is not yet fully realised in educational contexts. Beyond these conceptual gaps, the review also revealed inconsistencies in how deep ecology is interpreted and operationalised in practice. In several cases, ecocentric approaches are limited to nature-based activities without sustained philosophical reflection (Kopnina, 2016).

The dominance of experiential pedagogies reflects a broader trend in environmental education that privileges direct nature engagement (Kopnina, 2016). However, experience alone may be insufficient for fostering the ontological shifts that deep ecology advocates. The near-absence of critical and systemic pedagogies suggests that deep ecology is being 'domesticated' within existing educational structures, reducing its potential to individual consciousness-raising rather than collective socio-ecological change. This domestication reflects a broader tension between deep ecology's philosophical ambitions and the conservative tendencies of formal education systems, which tend to absorb and neutralise transformative ideas by translating them into manageable, non-threatening practices. This resonates with Lousley (1999) critique of environmental education that reduces environmentalism to 'eco-correct behaviours' compatible with institutional cultures. Structural dimensions, including education policy, national curriculum design, and assessment frameworks, are also largely absent from the reviewed studies, despite research emphasising the importance of curriculum reform, policy alignment, and interdisciplinary collaboration (Husamah et al., 2022).

This review has several limitations. The restriction to English-language, indexed journal articles may have excluded locally grounded or Indigenous educational practices informed by deep ecological principles, even though existing literature underscores the significance of local knowledge systems and spiritual traditions in cultivating profound ecological ethics (Druker-Ibáñez & Cáceres-Jensen, 2022). Moreover, the dominance of conceptual studies limits the ability to draw strong conclusions regarding the long-term empirical impacts on sustainability-related behaviour (Gorski et al., 2023). The scarcity of longitudinal and sustained evaluative studies echoes broader concerns within ESD and transformative sustainability education

scholarship (Pauw et al., 2015). While the thematic synthesis involved interpretive judgment, it was conducted systematically and transparently in accordance with SLR procedures, consistent with reflexive practices in sustainability education research (Aikens et al., 2016).

These findings have several implications for practice and policy. For educators, integrating deep ecology into ESD requires moving beyond environmental content toward designs that foster ontological reflection, ecological-identity formation, and collective action (Olsson et al., 2022). Experiential, place-based, contemplative, and relational pedagogies are promising but demand interdisciplinary and institutional support, including educator capacity-building and aligned policy (Greenall & Bailey, 2022). Longitudinal studies are needed on how deep-ecology learning shapes ecological identity and sustainability practice over time, alongside validated tools to assess ecological-identity transformation (Hallinger & Nguyen, 2020).

CONCLUSION

This systematic review demonstrates that integrating deep ecology into ESD opens space for a shift beyond environmental literacy toward education that engages the ontological dimensions of human nature relations. While existing studies frequently link deep ecology to experiential learning and the strengthening of ecological values, most reported practices remain concentrated on awareness-raising and ethical orientation. The transformations of ecological identity and sustained engagement in collective sustainability action remain comparatively limited. These patterns underscore a persistent gap between the transformative potential of deep ecology as a philosophical framework and its translation into systemic educational design. As a theoretical contribution, this study proposes the Deep Ecology Transformative Education Framework (DETEF), which maps a coherent pathway from ethical reflection to the integration of sustainability action. By synthesizing previously fragmented strands of the literature, DETEF offers a conceptual bridge between the ontological foundations of deep ecology and transformative educational practice within ESD. Thus, the study not only identifies critical gaps in current research but also provides a direction for future curriculum development, pedagogical innovation, and empirical inquiry aimed at fostering integrated transformations of awareness, identity, and sustainability action.

ACKNOWLEDGMENT

The authors gratefully acknowledge the financial support provided through the Indonesian Education Scholarship (Beasiswa Pendidikan Indonesia, BPI), administered by the Center for Higher Education Funding and Assessment (Pusat Pembiayaan dan Asesmen Pendidikan Tinggi, PPAPT) under the Ministry of Higher Education, Science, and Technology of the Republic of Indonesia, with funding from the Indonesia Endowment Fund for Education (LPDP). The scholarship recipients' BPI ID numbers are 202209092463 and 202231103682.

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APPENDIX

Table 2.

Characteristics Of Included Studies (N = 34)

Author (Year)	Country	Level of Education	Study Type	Discipline
(Nyberg et al., 2020)	Sweden & France	Primary & Secondary	Empirical – Survey	Education
(Rozmiarek et al., 2022)	Poland	Institutional / General	Empirical – Survey	Not specified
(Macháčková et al., 2021)	Not applicable (conceptual)	Higher Education	Mixed Methods	Environmental Education
(Hategan, 2021)	Not applicable (conceptual)	Higher Education	Qualitative	Philosophy / Ecology

Author (Year)	Country	Level of Education	Study Type	Discipline
(Melis et al., 2020)	Norway	Early Childhood	Qualitative – Interviews	Education
(Holma et al., 2025)	Not applicable (conceptual)	General Education	Conceptual Paper	Philosophy
(Frigo et al., 2024)	Australia	Secondary	Case Study	Environmental Education
(Allen et al., 2019)	USA	Higher Education	Empirical	Education
(Ruiz-Ruano García & López Puga, 2016)	Canada	Community Education	Qualitative	Interdisciplinary
(Gough, 2016)	Not applicable (conceptual)	General	Conceptual	Environmental Ethics
(Lefèvre et al., 2025)	UK	Secondary	Empirical	Education
(Kostecka & Walat, 2023)	Germany	Higher Education	Mixed Methods	Sustainability Education
(Kopnina, 2016)	Brazil	Primary	Case Study	Environmental Education
(Lu et al., 2023)	China	Not applicable (Community Stakeholders)	Empirical case study	Environmental management
(Pérez et al., 2021)	Not applicable	Not specified	Conceptual	Environmental education
(Kopnina et al., 2024)	Japan	Higher Education	Qualitative	Interdisciplinary
(Foguesatto & Machado, 2022)	Not applicable	General	Theoretical Framework	Philosophy
(Kioupi & Giannopoulos, 2025)	South Africa	Community	Case Study	Environmental Studies
(Dudin et al., 2016)	Spain	Primary	Empirical	Education
(Martínez-Rodríguez &	Not applicable	General	Conceptual	Environmental Ethics

Author (Year)	Country	Level of Education	Study Type	Discipline
Fernández-Herrería, 2022)				
(Suárez-López & Eugenio-Gozalbo, 2021)	USA	Higher Education	Empirical	Sustainability Education
(Raus, 2016)	India	Secondary	Qualitative	Education
(Molina-Motos, 2019)	Not applicable	General	Conceptual	Philosophy
(Washington, 2018)	Sweden	Primary	Case Study	Environmental Education
(Kopnina & Cocis, 2017)	Canada	Higher Education	Empirical	Education
(Kopnina et al., 2025)	Not applicable	General	Conceptual	Interdisciplinary
(Berning et al., 2024)	Australia	Secondary	Empirical	Education
(Mohanta, 2023)	Chile	Community	Case Study	Environmental Studies
(Smith, 2020)	Not applicable	General	Conceptual	Philosophy
(Lalude et al., 2025)	USA	Higher Education	Mixed Methods	Sustainability Education
(Sumarmi et al., 2020)	Indonesia	Community-based and traditional education	Qualitative descriptive study	Environmental Conservation and Community Education
(Quinn et al., 2016)	Not applicable	General	Theoretical	Philosophy
(Şenocak & Koçsoy, 2024)	Netherlands	Primary	Empirical	Education
(Adow et al., 2024)	Not applicable	General	Conceptual	Environmental Ethics

Figure 1.

SLR Flow Diagram

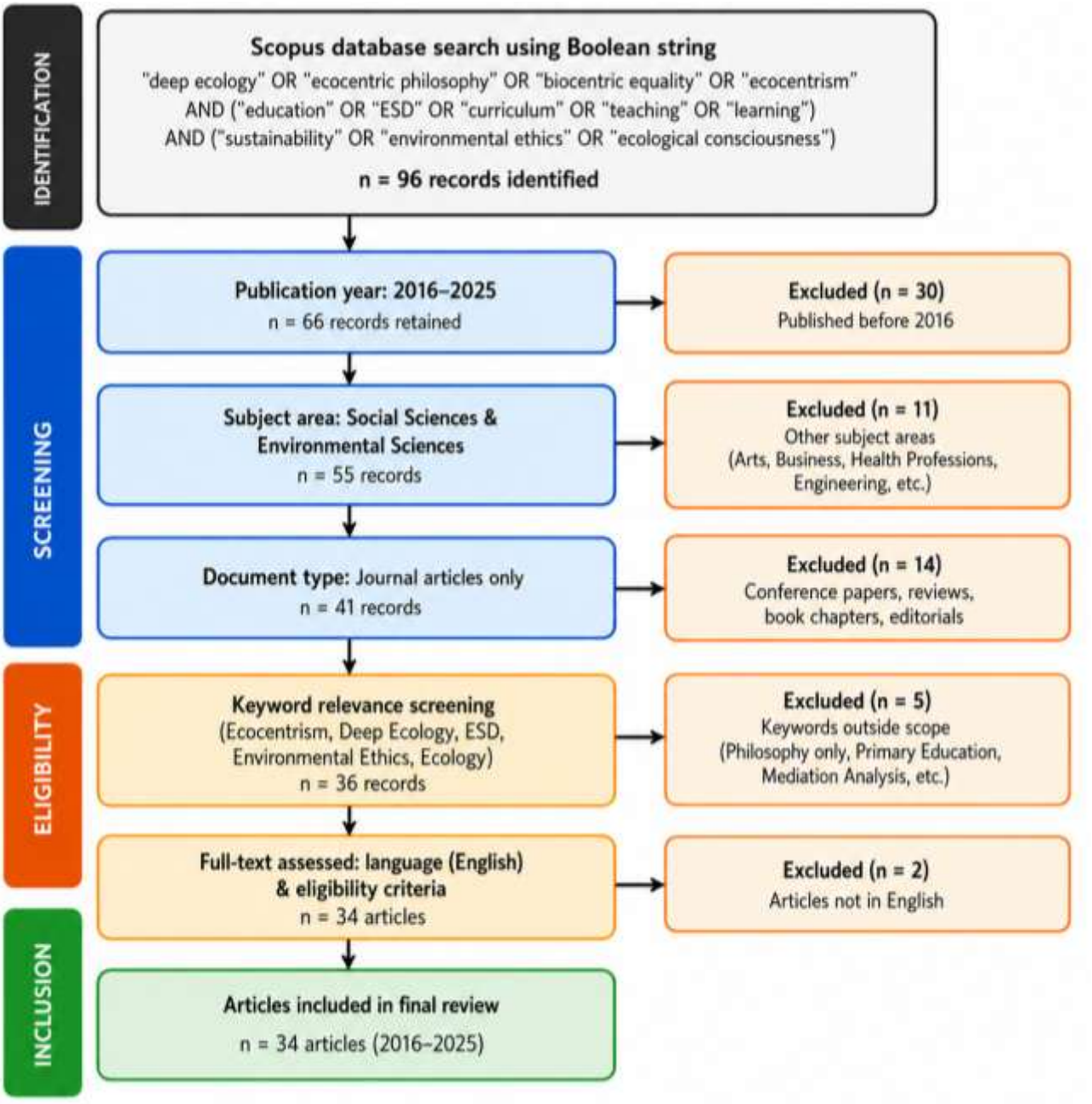


Table 3.

Deep Ecology Orientation, Pedagogy, Sustainability Outcomes

Study	DE Orientation	Pedagogy Type	Sustainability Outcome
(Nyberg et al., 2020)	Implicit	Attitude-based environmental learning	Ecological awareness
(Rozmiarek et al., 2022)	Implicit	Institutional sustainability practice	Sustainability awareness

Study	DE Orientation	Pedagogy Type	Sustainability Outcome
(Macháčková et al., 2021)	Philosophical	Forest/experiential pedagogy	Systems thinking
(Hategan, 2021)	Philosophical	Reflective pedagogy	Ecological consciousness
(Melis et al., 2020)	Implicit	Nature-based learning	Ecological awareness
(Holma et al., 2025)	Normative	Ethical dialogue	Environmental ethics
(Frigo et al., 2024)	Transformative	Place-based learning	Ecological identity
(Allen et al., 2019)	Implicit	Experiential learning	Pro-environmental behaviour
(Ruiz-Ruano García & López Puga, 2016)	Transformative	Community-based learning	Sustainability agency
(Gough, 2016)	Philosophical	Critical reflection	Ethical awareness
(Lefèvre et al., 2025)	Implicit	Outdoor learning	Ecological awareness
(Kostecka & Walat, 2023)	Transformative	Interdisciplinary learning	Systems thinking
(Kopnina, 2016) (Lu et al., 2023)	Implicit	Experiential Theoretical reflection	Environmental attitude
(Pérez et al., 2021)	Implicit	Conceptual discussion	Ecological restoration
(Kopnina et al., 2024)	Transformative	Contemplative learning	Ecological identity
(Foguesatto & Machado, 2022)	Philosophical	Conceptual discussion	Ontological shift
(Kioupi & Giannopoulos, 2025)	Transformative	Community activism	Sustainability agency
(Dudin et al., 2016)	Implicit	Nature immersion	Ecological awareness
(Martínez-Rodríguez & Fernández-Herrería, 2022)	Normative	Ethical discourse	Moral expansion
(Suárez-López & Eugenio-Gozalbo, 2021)	Transformative	Project-based learning	Behaviour change
(Raus, 2016)	Implicit	Experiential	Awareness
(Molina-Motos, 2019)	Philosophical	Conceptual	Ecological consciousness
(Washington, 2018)	Implicit	Outdoor/place-based	Ecological awareness
(Kopnina & Cocis, 2017)	Transformative	Reflective pedagogy	Ecological identity
(Kopnina et al., 2025)	Philosophical	Theoretical	Ethical shift

Study	DE Orientation	Pedagogy Type	Sustainability Outcome
(Berning et al., 2024)	Implicit	Experiential	Pro-environmental behaviour
(Mohanta, 2023)	Transformative	Community learning	Sustainability agency
(Smith, 2020)	Philosophical	Conceptual	Ontological awareness
(Lalude et al., 2025)	Transformative	Systems-based curriculum	Systems thinking
(Sumarmi et al., 2020)	Explicit	Traditional education	Transmission of knowledge and norms
(Quinn et al., 2016)	Philosophical	Theoretical	Ecological worldview
(Şenocak & Koçsoy, 2024)	Implicit	Experiential	Ecological awareness
(Adow et al., 2024)	Normative	Ethical education	Environmental ethics

Table 4.

Typology of Deep Ecology-Based Education

Typology Name	Philosophical Base	Pedagogical Features	Main Outcome	Key Studies
Eco-Ethical ESD	Ecocentrism/ intrinsic value	Ethical reflection, value dialogue	Moral expansion	(Adow et al., 2024; Gough, 2016; Holma et al., 2025; Martínez-Rodríguez & Fernández-Herrería, 2022)
Experiential Ecocentric Learning	Interconnectedness	Outdoor, nature immersion	Ecological awareness	(Dudin et al., 2016; Lefèvre et al., 2025; Melis et al., 2020; Nyberg et al., 2020; Şenocak & Koçsoy, 2024)
Transformative Identity ESD	Ecological self	Reflective & contemplative learning	Ecological identity	(Frigo et al., 2024; Kopnina et al., 2024; Kopnina & Cocis, 2017)

Typology Name	Philosophical Base	Pedagogical Features	Main Outcome	Key Studies
Critical Ecocentric Pedagogy	Deep ecology + critical theory	Critical pedagogy, activism	Sustainability agency	(Kioupi & Giannopoulos, 2025; Mohanta, 2023; Ruiz-Ruano García & López Puga, 2016)
Systems-Oriented Ecocentric ESD	Interdependence	Interdisciplinary & systems learning	Systems thinking	(Kostecka & Walat, 2023; Lalude et al., 2025; Macháčková et al., 2021)

Figure 3.

Pedagogical Pathways from Ecocentric Philosophy

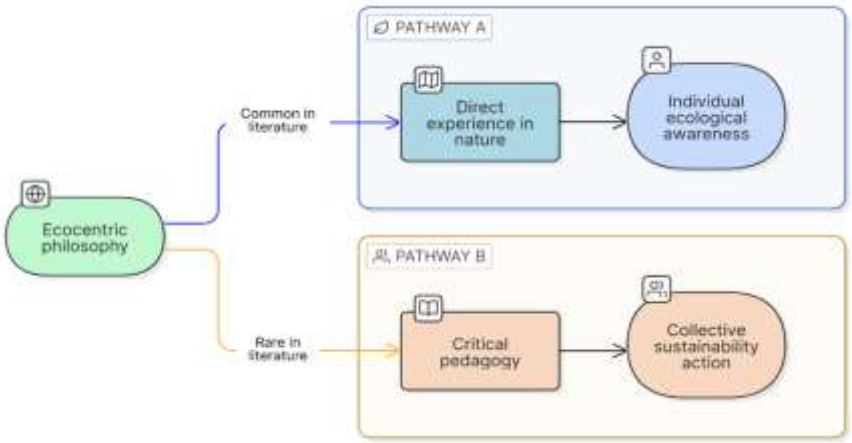


Table 5.

Gap Analysis

Area	Partially Addressed in Literature	Underexplored	Research Gap	Example Studies
Curriculum	Inclusion of environmental ethics and ecocentric values in specific units or thematic modules	Whole school ecocentric curriculum	Lack of systemic deep ecology curriculum models	(Kostecka & Walat, 2023; Lalude et al., 2025; Macháčková et al., 2021)

Area	Partially Addressed in Literature	Underexplored	Research Gap	Example Studies
Teaching Practice	Experiential and nature-based learning approaches that foster ecological awareness	Long-term impact studies	Few longitudinal evaluations	(Frigo et al., 2024; Lefèvre et al., 2025; Washington, 2018)
Teacher Beliefs	Studies examining teacher attitudes toward nature and environmental values in classroom contexts	Ontological/ecological identity	Deep ecology rarely linked to teacher self-identity	(Holma et al., 2025; Nyberg et al., 2020)
Policy	School-level sustainability initiatives and institutional environmental practices	Ecocentric policy discourse	Weak link between deep ecology and ESD policy	(Kioupi & Giannopoulos, 2025; Rozmiarek et al., 2022)
Assessment	Measurement of ecological awareness through attitude surveys and self-reports	Transformative learning metrics	No tools for measuring ecological identity	(Kopnina et al., 2024; Kopnina & Cocis, 2017)

Table 6.

Deep Ecology Transformative Education Framework (DETEF)

Framework Stage	Deep Ecology Concept	Educational Translation	Transformative Outcome	Supporting Studies
Conceptual Grounding	Intrinsic value of nature	Ethical & philosophical dialogue	Ethical transformation	(Adow et al., 2024; Gough, 2016; Holma et al., 2025)

Framework Stage	Deep Ecology Concept	Educational Translation	Transformative Outcome	Supporting Studies
Relational Understanding	Interconnectedness	Systems thinking pedagogy	Cognitive transformation	(Kostecka & Walat, 2023; Lalude et al., 2025; Macháčková et al., 2021)
Identity Formation	Ecological self	Reflective/contemplative practice	Ontological transformation	(Frigo et al., 2024; Kopnina et al., 2024; Kopnina & Cocis, 2017)
Experiential Engagement	Human–nature unity	Outdoor/place-based learning	Affective transformation	(Lefèvre et al., 2025; Melis et al., 2020; Washington, 2018)
Action Integration	Biocentric equality	Community & sustainability action	Behavioral transformation	(Kioupi & Giannopoulos, 2025; Mohanta, 2023; Ruiz-Ruano García & López Puga, 2016)

Table 7.

Operational Specification of DETEF: Purpose, Content Domain, and Instructional Method

Framework Stage	Purpose (Educational Objective)	Material / Content Domain	Method
Conceptual Grounding	Cultivate ecological consciousness and biocentric values by challenging anthropocentric assumptions about nature's worth	Environmental ethics and philosophy; intrinsic-value discourse; indigenous ecological wisdom	Ethical and philosophical dialogue; Socratic questioning; values-clarification discussion

Framework Stage	Purpose (Educational Objective)	Material / Content Domain	Method
Relational Understanding	Develop biocentric, systemic awareness of the interdependence between humans and ecosystems	Interdisciplinary systems content integrating biology, environmental ethics, and climate science	Systems-thinking pedagogy: concept mapping, interdisciplinary case analysis
Identity Formation	Foster ecological self-realization, internalizing nature as part of personal and social identity	Non-human perspectives habitats, life cycles, and ecosystems studied from the organism's own viewpoint; deep (geological/evolutionary) history of Earth	Reflective and contemplative practice: guided reflection, perspective-taking, meditative engagement
Experiential Engagement	Build affective, embodied bonds with nature through direct immersion	Local ecosystems (forests, parks, waterways) as living curriculum	Place-based learning; experiential immersion (sensory activity, wilderness engagement); storytelling and ritual
Action Integration	Translate ecological identity into consistent, biocentric-equality-grounded behavior	Community sustainability challenges; real-world socio-ecological issues	Community-based sustainability projects; collaborative action learning

Table 8.

Assessment and Organizational Specification of DETEF

Framework Stage	Assessment	Syllabus Organization
Conceptual Grounding	Holistic growth: dialogic and journal-based rubrics tracking shifts in ethical awareness and values rather than rote recall of ethical theory	Web-like structure: ethical reflection woven across subjects rather than taught as an isolated ethics unit

Framework Stage	Assessment	Syllabus Organization
Relational Understanding	Holistic growth: assessed through the depth of systems/concept maps demonstrating understanding of interdependence	Web-like structure: interdisciplinary units blending biology, culture, and environmental ethics
Identity Formation	Self-reflection: journals and peer discussions evaluating personal ecological identity and ecological footprint	Seasonal alignment: contemplative practice paced to seasonal and life-cycle rhythms; community integration through elders' shared wisdom
Experiential Engagement	Holistic growth: observation and portfolio evidence of empathy and ecological habits formed during field immersion	Seasonal alignment: place-based units matched to local seasonal change; community integration with local conservationists
Action Integration	Action-oriented projects: grading real-world conservation work, community gardening, or restoration efforts	Community integration: local elders, conservationists, and non-human stakeholders included in planning action-based units