NATURE-BASED EDUCATION AS A PATHWAY TO SUSTAINABLE AND TRANSFORMATIVE LEARNING: A THEORETICAL PERSPECTIVE

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ABSTRACT
This theoretical paper explores nature-based education as a catalyst for sustainable and transformative learning. By critically reviewing seminal and recent contributions in the fields of environmental education, sustainability, and transformative pedagogy, the paper proposes an integrated conceptual framework for embedding outdoor and environmental learning into both formal and informal contexts.

KEYWORDS
nature-based education; sustainable learning; transformative learning; inclusivity; synecology.

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Introduction

The escalating ecological crisis, coupled with growing concerns about human well-being, has prompted renewed interest in educational approaches which foster sustainability, social responsibility, and personal transformation (Murray, P. 2012). Nature-based education encompasses a broad set of pedagogical practices including situated learning experiences within natural environments, emphasizing the interdependence between humans and the biosphere (Folke et al 2011) . By reconnecting learners to the natural world, Nature - Based Education offers pathways in order to develop environmental literacy, strengthen community ties, and encourage reflective action toward sustainability (Southey, S. 2025). The present paper adopts a theoretical stance to integrate synecological principles—the study of interactions among organisms within ecosystems—with transformative learning theory (Mezirow, 1990) and inclusive pedagogy. This integration seeks to address how nature-based approaches can facilitate transformative shifts in perception and behaviour, with attention to diverse learner needs and contexts.

1. Theoretical Framework

As a theoretical contribution, this article does not present empirical data but instead relies on a critical literature review. Sources were selected based on the following criteria:

1. Foundational contributions in the fields of environmental and transformative education (e.g., Mezirow, 1990; Sterling, 2001).

2. Recent scholarly works on sustainability and inclusivity in education (e.g., UNESCO reports, peer-reviewed articles 2015–2023).

3. Relevance to the integration of nature-based pedagogies with broader social and ecological challenges.

According to Allport (1955), the notion of appropriateness emphasized the continuity between inner and outer worlds. In line with this theory, the Nature-based education has not to be considered in opposition to conventional approaches but as a complementary pathway which nurtures meaningful integration between individuals, communities, and ecosystems. Building on Allport's (1955) notion of appropriateness, synecological perspectives extend this idea by situating human learning within the ecological systems. Synecology, as a branch of ecology, provides an ecological systems perspective which recognizes the mutual dependencies between species and the role of humans within these systems (Hawley, A. H. 1986). This perspective challenges anthropocentric frame of mind and supports the cultivation of ecological identity (Thomashow, 1996). In line with transformative learning theory, critical reflection and discussion are crucial for empowering students to challenge and amend deeply held beliefs. These introspective processes may be especially potent when incorporated into nature-based experiences because interactions with living systems frequently produce perplexing conundrums that upset ingrained thought patterns. All students, regardless of ability, socioeconomic background, or cultural background, can take advantage of these life-changing opportunities thanks to inclusive pedagogy. Strategies such as multi-sensory engagement, differentiated instruction, and culturally responsive content remove barriers to participation, making Nature-Based Education equitable and inclusive.

2.Synecological, Biopsychosocial, and ICF Perspectives in Transformative Learning

Synecology is a branch of ecology focused on the interaction between species and their environment; it emphasizes the complexity of ecological networks, interdependence, and the balance that sustains ecosystems. Integrating synecological thinking into education encourages learners to perceive themselves as active participants in the maintenance of ecological balance. This can be operationalized through experiential activities such as biodiversity monitoring, habitat restoration, or permaculture projects (Lebo, N., & Eames, C. 2015). Transformative learning processes could also channel learners to reflectively assess their role in ecological systems and the sustainability of their own lifestyles (Blake, J. et al. 2013). This shift from passive knowledge acquisition into active engagement is essential in stimulating pro-environmental behaviour (Schultz, P. & Kaiser, F.G. 2012). The synergy of these approaches aligns cognitive, affective, and behavioural dimensions of learning, enabling a deeper, values-driven commitment to sustainability. The inclusion of synecological perspectives within educational contexts supports the idea that learners should view themselves as integral actors in sustaining ecological equilibrium. This perspective closely aligns with the biopsychosocial model, which underscores the interdependent effects of biological, psychological, and social factors on human health and development. Experiential methodologies—such as biodiversity assessments, ecological restoration initiatives, or permaculture projects—enhance ecological literacy while fostering social connectedness and psychological engagement, thereby exemplifying the holistic orientation of the biopsychosocial paradigm. This reflection encourages a shift from passive information consumption to active participation rooted in individual values and accountability. The integration of synecological and biopsychosocial perspectives creates a multifaceted approach to sustainability, aligning environmental stewardship with individual and communal well-being. The ICF (International Classification of Functioning, Disability and Health) created by the World Health Organization (2001) shows a similar way of thinking about these aspects of life. Rooted in a biopsychosocial paradigm, the ICF frames human functioning not simply as the result of biological conditions, but as the outcome of continuous interaction with individual and environmental variables, highlighting interdependence over isolation. Just as synecology stresses the interconnected nature of ecological systems, the ICF brings into focus the contextual and interactive determinants of human functioning. In the educational field, this alignment relies on a comprehensive and systemic vision in which learners perceive the dynamic balance of biological, psychological, social, and environmental components is the *conditio sine qua non* for the preservation of human health and ecological sustainability.

3. Nature-Based Education in Formal and Informal Contexts

Formal education settings integrate Nature- Based Education through interdisciplinary curricula, outdoor science labs, and project-based learning modules aligned with national educational standards. Informal contexts—such as nature clubs, urban community gardens, and citizen science projects—offer more flexible and self-directed opportunities for engagement. Emerging technologies, including augmented reality and mobile data collection apps, could enhance field-based learning while preserving the primacy of direct sensory experience (van Kraalingen, I. 2023). However, technology should be a complement, not a substitute, for authentic encounters with nature (Commoner,B. 2020). Rooted in the principle of biophilia—the innate human tendency to

seek connection with nature —these practices highlight the psychological and developmental benefits of sustained interaction with natural environments. As a pedagogical foundation, biophilia claims the role of natural settings in fostering socio-emotional well-being, intrinsic motivation, and ecological literacy, reinforcing the idea that the learning process in nature is not only cognitive but also relational and affective. Inclusive approaches are critical in both settings, ensuring accessibility for learners with disabilities through adapted trails, tactile materials, and alternative communication methods.

4. Challenges and Opportunities

Implementing Nature-based education in different contexts embraces a combination of systemic, logistical, and pedagogical challenges. One major barrier is limited access to natural environments, especially in densely urbanised areas where schoolyards and public green spaces are scarce (Falzon, D. et al., 2025). Even when access exists, risk management policies may restrict outdoor learning due to perceived safety concerns (Porsanger, L., & Sandseter, E. B. H., 2021). Curricular rigidity exacerbates the constraints on educators, as national education standards frequently prioritize test-driven performance indicators over experiential and context-based approaches to learning. Such a focus disregards the core principles of Universal Design for Learning (UDL), which emphasize flexibility as an essential foundation for equitable and inclusive educational practice (Rao, K. et al. 2023). Another set of challenges involves equity and inclusion: recent research highlights that children and young people, particularly from disadvantaged backgrounds, face significant structural, cultural, and individual barriers to engaging with nature outside school. These include financial constraints, limited access to quality green spaces, lack of cultural relevance in outdoor programmes, underrepresentation in provider organizations, and intergenerational absence of nature experiences. Such barriers often give the perceptions that nature-based activities are “not for people like us,” reinforcing exclusion. While young people value biodiversity, relaxation, and opportunities for choice in outdoor activities, current provision frequently reflects white, middle-class institutional norms. The study argues for more inclusive, community-driven approaches, improved local green spaces, and greater representation within outdoor organizations to ensure equitable access and foster meaningful connections with nature (Waite, S. et al. 2023). Equally, accessibility for disabled students cannot be reduced to pedagogical materials and must involve physical and social adaptations too. Inclusive education school studies out of Ghana shed light on the means through which structural inequalities—such as inadequate illumination, ventilation, and lack of barrier-free building designs—undermine engagement with the learning process. These are symptomatic of the means through which the very physical space of school buildings and the wider societal fabric of societies either facilitates and accommodates, or delimits and inhibits, the potential for inclusive education at either school locations and outdoor spaces. Still, the potential is vast. Research shows that Nature Based Education would improve mental health outcomes, including reduced pressure and greater robustness (Hofman-Bergholm, M. 2023). Moreover, NBE cultivates community engagement through connection institutions with neighborhood environmental societies, fostering mutual commitment to ecological stewardship. In policy, increasing planetary awareness about climate breakdown and extinction of nature has created impetus for system-wide reform of education. National and transnational initiatives, particularly UNESCO’s Education for Sustainable Development (ESD) agenda, not merely lend credence to nature-based education (NBE) but identify Executive Plans for embedding sustainability ideals in national and continental curriculum requirements. Such instruments provide policymakers and educators with a clear argument for harmonizing education reform and sustainability goals and identify NBE as an indispensable

vehicle for equipping students with knowledge, competencies, and value sets capable of meeting twenty-first-century environmental requirements (UNESCO, 2017).

5. Agroecopedagogy as an Illustrative Case Study

An illustrative example of how nature-based education can be operationalized in higher education and community contexts is provided by the *Formações Muditas* developed within the Mutirão de Agroecologia e Permacultura (MUDA) project at the Federal University of Rio de Janeiro (UFRJ) (Gonçalves, A. B. N. et al. 2024). Rooted in the principles of agroecopedagogy, these trainings combine ecopedagogy, dialogical methods emphasized by Freire and permaculture design (Mollison, B. et al. 1991) to foster experiential and transformative learning. Through hands-on activities such as bioconstruction, agroforestry, and composting, participants engage in collaborative knowledge creation within living laboratories, where learning occurs through direct interaction with ecosystems (Ali, S.A. et al 2025). Over multiple editions since 2020, viewed as a learning process, the Formações Muditas nurture transformative education by fostering critical reflection, co-creation of knowledge, and participatory practices that strengthen both individual agency and community resilience. They have demonstrated not only the potential of agroecopedagogy to strengthen environmental literacy and ecological identity but also its capacity to build community resilience and social cohesion by bridging academic, traditional, and practical knowledge systems (Brandão, 2024). This case highlights how this method aligns with the core tenets of nature-based education by integrating synecological awareness, critical reflection, and inclusivity into transformative educational practices.

6. The role of Self-Awareness Techniques

Considering what has been discussed so far, it may be significant to explore the contribution offered by Self-Awareness techniques with a Mindfulness approach in education. This reflection concerns both the potential of such practices carried out in natural environments and the role they play in facilitating ethical, sustainable behaviour and the formation of responsible citizens. In recent years, this possibility has been strongly considered and presents itself as the natural evolution of numerous studies, research and scientific literature on the benefits of mindfulness, especially in light of the role they can play within the current social framework in view of the objectives of global citizenship and an inclusive society. The practice of mindfulness allows us to develop self-regulation of behaviour, positive psychological states (Brown & Ryan, 2003), resilience and an integrated perception of the self that can be preparatory to constructive behaviours and actions for the community. Through intentional attention (Shapiro et al., 2006) to feelings, movement and breathing, one observes one's thoughts and emotional states with kindness, rather than obstructing or neglecting them, promoting peaceful and conscious contact with the bodily and emotional perceptions of the present moment (Kabat-Zinn, 1993) and promoting empathy, communication and relational satisfaction (Gentilozzi et al., 2024). Thus, self-awareness activities can promote ethical and sustainable behaviour, and to this end, it is important to practise techniques continuously and in a structured manner in order to consolidate results. Training aimed at bringing awareness into daily life can increase the propensity towards ethical behaviour thanks to greater control of reactions and harmony with others (Riskin, 2009). Repeated practice interrupts dysfunctional thought patterns that generate automatic emotional reactions, promoting the growth of one's inner world and neuroplasticity in order to generate new patterns of brain activity and transform temporary states of the individual into more lasting traits (Siegel, 2007), capable of conveying conscious personal and social choices and actions. The Psychosomatic Mindfulness Protocol (PMP) developed in Italy by the Global Village of Bagni di

Lucca (LU), through the Humanistic Psychocorporeal Institute (IUP), is an example of a long-term structured project monitored over the years, which uses Self-Awareness Techniques, including in nature, not only to promote emotional, bodily and relational awareness, but also the development of scientific, ethical and ecological awareness in support of global citizenship (Montecucco, 2023) . The PMP is aimed in particular at Italian schools of all levels through the Gaia Project, a transdisciplinary educational programme for global awareness and health of the Self and the Planet, with the aim of preventing and reducing anxiety, aggression and depression in young people, and promoting emotional and behavioural skills related to empathy, collaboration, ethical and social values (Ghiroldi et al., 2020) . Further potential emerges from Mindfulness programmes developed in natural settings, parks, gardens and woods, which promote a meaningful multisensory experience. Here, physical activity is integrated into the environment, prolonging the benefits, while the act of focusing attention on natural stimuli reduces the mind's tendency to become distracted, promoting the objectives of self-awareness practice (Djernis et al., 2019) . Leaving the classroom, finding oneself in an open environment with a more relaxed pace, and connecting with it deeply through mindfulness practices can help even more to interrupt dysfunctional and automatic cognitive patterns, benefiting new mental models for self-regulation of behaviour and the expression of one's uniqueness. It can convey a sense of community, the added value of sharing, and even a genuine understanding of our interdependence with nature and the importance of protecting it for a better quality of life now and in the future. The article Biofilia Sperimentale (Berto et al., 2012) presents a detailed study of how primary school children perceive and benefit from natural environments. It assesses their ability to recognise the regenerative value of nature and their personal relationship with it through various activities, including the conscious practice of active silence (Mindful Silence, MS) and guided walks in the woods. The experiment and data collection showed that nature was a significant source of regeneration for children, who demonstrated a preference for the woods over gardens or parks. Furthermore, the positive effects on physiological, emotional and cognitive well-being were quickly observable, even within a few minutes of the start of the activities. Through mindfulness practices in nature, it is also possible to connect with very deep values, as observed in a Danish study involving university students with moderate to severe stress during a mindfulness retreat. The activity involved immersion in nature and self-awareness practices for several consecutive days, maintaining silence and without the use of smartphones or social networks, thus allowing participants to escape from the automatisms and hyperstimulation of everyday life. The experience led the students to a meaningful connection with themselves, others and the environment, which allowed them to access positive emotions and their own vital energy. It also led to the development of a state of acceptance that helped them overcome difficulties, promoting calm, relaxation and improved attention, and strengthening emotional and behavioural self-regulation, self-compassion and empathy (Djernis et al., 2023). Finally, an example of an application that can offer ideas and reflections is the *Musica nella Natura* (Music in Nature) project carried out in 2018 in a school in a village hit by an earthquake two years earlier. The experience, aimed at primary school children, integrated mindfulness, music and creative activities in a natural setting, showing how multisensory practices such as conscious breathing, body scans, body percussion, symbolic exercises related to trees and seasons, combined with recycling workshops and musical activities, promoted children's psychological and physical well-being, body awareness and ecological sensitivity, culminating in the collective creation of a performance dedicated to respect for oneself, others and nature. The experience, aimed at primary school children, integrated mindfulness, music and creative activities in a natural setting, demonstrating how multisensory practices such as conscious breathing, body scans, body percussion, symbolic exercises related to trees and seasons, combined with recycling workshops

and musical activities, promoted children's psychological and physical well-being, body awareness and ecological sensitivity, culminating in the collective creation of a performance dedicated to respect for oneself, others and nature. The children built their own musical instruments from recycled materials at a local organic farm and educational farm, in order to use them during the project and for the creation of the show. In particular, they were used on several occasions after Body Awareness practice to play together with nature, expressing their feelings through sound and movement, leading to the creation of melodies, songs, images and choreography performed in the end-of-year recital in front of families and the community. This project does not offer empirical data of great significance, but it can be a virtuous example of inclusion and active educational community, raising interesting questions and reflections for further research and experimental development. This evidence gives rise to the hope that students will be able to enjoy more and more structured, consistent and continuous activities using Self-Awareness Techniques designed for natural contexts, which could prove to be an important support both for transformative learning and for the development of environmental and civic literacy for the future as well as for the present we are living in.

7. Conclusions

Nature-based education offers a holistic pathway for adopting sustainable and transformative learning. By blending synecological perspectives, transformative learning theory, and inclusive pedagogy, educators could be the real designer of learning experiences engaging the cognitive, emotional, and behavioural dimensions of learners. Research consistently shows that well-structured nature-based education (NBE) not only enhances environmental literacy but also fosters well-being, social cohesion, and civic engagement. The mind, body and senses all work together to form a deeper understanding of the world around us (Gomez P., 2013). However, to get the most out of this process, we need to address issues like unequal access to education, rigid curricula and policies that don't allow for any risk-taking. Well-known research has yet to show what kind of impact Nature Based Education has on the way we think, behave and feel, and scaling up successful ideas to different countries and cultures is still on the horizon, so more research is needed. One of the best ways to bring about the kind of sustainable learning, community cohesion, and educational equity we want is by embedding Nature Based Education into both formal and informal education systems, and to train teachers and education policymakers to work together to address the barriers that we're faced with. In urban areas, where we don't have much space for outdoor activities, making the most of what we have is really important, and that's why the thoughtful design of our education systems is critical. It is not just physically and mentally good for kids, but also sets us on the path to sustainable learning, inclusion, and closing the educational gap. Taking the initiative to create learning environments that encourage curiosity, creativity and care for the planet is basically the key to achieving the UN's Sustainable Development Goals by 2030.

Author Contributions

Paolo Creati wrote the first draft of the manuscript. Paola Pela contributed to the manuscript. Antonio Cuccaro and Chiara Gentilozzi contributed to the final writing and revision, read, and approved the submitted version. All authors contributed to the article and approved the submitted version.

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