



Exploring green pedagogy for eco-centric praxis-based learning in higher education

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Abstract

In the wake of climate change affecting all aspects of global sustainable development, the imperative for greening education as a tool to help address its impacts has become increasingly pressing. Facing this challenge requires global adoption of more sustainable practices, coordination of efforts, and recognizing the pivotal role that education must play. Green pedagogy can help foster a sense of agency among individuals to acquire the skills and the right attitude to catalyse the transition towards a greener future. For an eco-centric praxis-based education system to be applicable, the interconnectedness of climate change should be recognized, and a holistic perspective should be adopted. This paper proposes a systems-based approach to eco-pedagogy and the greening of curricula. Systems thinking recognizes the interconnected and interdependent relationships that exist within an emergent ecosystem. This approach can also aid an understanding of eco-pedagogy that supports and integrates an interdisciplinary conceptualization of pedagogical approaches. To effectively engage with green pedagogy, both the inherent possibilities and challenges of an eco-centric praxis-based education must be explored.

In doing so, we argue that to improve the quality and the delivery of education responses to climate crisis, the integration of *project-based*, *learner centred*, *experiential learning*, *reflective/critical learning*, *problem-based*, and *collaborative learning* pedagogies can empower learners to become agents of change and contribute effectively to a more sustainable future. The proposed study aims to provide guidance on how to develop relevant, research-based curricula, increase educators' preparation and enhance institutional capacity to provide greening education and engage with a more eco-centric praxis-based education system. By elucidating best practices, this paper seeks to contribute to the advancement of applicability of green pedagogy in higher education and its role in building Education for Sustainable Development (ESD) competence among learners developing an eco-centric consciousness.

Introduction

This research inquiry stems from the academic struggle and challenges faced by many educators and educational institutions in integrating an eco-centric praxis-based education system to address climate change affecting all aspects of global sustainable development (GSD). Climate change affects all aspects of GSD, with its repercussions threatening the survival of humans, terrestrial and aquatic creatures. Addressing these challenges calls for an urgent profound shift in behaviour and requires global adoption of more sustainable practices, international coordination of efforts, and recognizing the pivotal role of education at all levels. Even though Education for Sustainable Development (ESD) has been promoted as part of the global agenda in Sustainable Development Goal (SDG), aiming to equip learners with the knowledge, skills, and values to contribute to the sustainable development of societies (UNESCO, 2021), the complexity of the climate crisis calls for a more holistic approach. Green pedagogy can cultivate a sense of agency among learners to acquire the skills and the right attitude to catalyse the transition towards a greener future.

Therefore, in the context of our study we employ a systems thinking approach in developing a conceptual framework for greening the curricula in the higher education system. Firstly, we argue that to improve the quality and the delivery of education responses to climate crisis, the integration of systems thinking in teaching, systems thinking in learning, and systems thinking as holism in education should be promoted. Secondly, we analyse the integration of various pedagogies such as learner-centred, experiential learning, place-based, project based, problem based, critical and collaborative pedagogy to emphasize holism of the education system. Thirdly, we examine the necessity of developing an eco-centric consciousness by examining eco-spiritual pedagogy which will enhance gross national happiness and transcend any dualities establishing interconnectedness between self and the environment. Detailing a dynamic education system, we illustrate green education as a form of holism promoting transdisciplinary education.

Background

Prior to the emergence of state-controlled education systems, learning tended to be localized to communities' needs and practices (Green, 1990; Tyack, 1974). Tyack (1974) has tied the centralization and standardization of education to industrialization, and the requirements of an industrial society to train efficient and disciplined labourers who could perform work in a structured, linear manner and within an established hierarchy. The industrialization of knowledge is also intrinsically tied to the colonial project and its control of epistemology. Colonization disrupted local education systems and replaced them with Eurocentric models to perpetuate cultural hegemony, serve the economic interests of the colonizer, and produce a workforce that would be dependent on the colonizing power (Altbach & Kelly, 1978). Dey (2023) notes that to Indigenous communities around the globe prior to colonization, "nature was never alienated from the developmental patterns of human civilization" (p. 2). Knowledge arose organically from the ways in which

humans interacted with the natural world around them, from knowledge of how materials could be changed to make clothing and how different herbs interacted to treat illness, to how crops could best be rotated and how the destructive impact of wildfires on local biodiversity could be minimized. Colonialism has disempowered Indigenous knowledge systems through its systemic relocation of communities from their traditional lands, its domination of cultural practices, and the exploitation of the same natural resources that were previously involved in Indigenous knowledge production. Dey (2023) has described this as a plundering of Indigenous knowledge and practice. As the colonizing Eurocentric viewpoint then inserts itself as the provider of knowledge and solutions, it effectively expropriates the extant knowledge system. Like industrialization alienated the worker from their labour, the colonial project alienated the human from the natural world.

Freire's (1970) critique of the traditional top-down teacher/learner 'banking model of education', where the teacher imparts state-approved discourse as knowledge and the learner is the tabula rasa that receives said knowledge, makes connection to how the modern system of education reflects, reinforces, and maintains the enduring oppressive dichotomy of colonizer/colonized. Bernier (2018) also explains that the pervasive linear construction of thinking in education "perpetuates the idea that knowledge and life happen in isolation" (p.4). Orr (2011) has critiqued modern liberal education for its devotion to increasing specialization, contributing to the siloing of knowledge and fragmented, narrow fields of study. Institutions continue to operate disciplinary silos and utilize didactic pedagogies that stand opposed to sustainability's need for transdisciplinary and holistic learning. These academic silos typically perpetuate due to the logistical difficulties in merging academic practices within traditional structures (Hilger & Keil, 2021). Although the benefits of transdisciplinary approaches are widely acknowledged, implementing these approaches in education has been slow (da Rocha et al., 2020). The continued adherence to Cartesian reductionism in liberal education has slowed efforts to modernize learning in step with the ecological changes that have rapidly taken place on the planet and the urgency to reformulate to non-linear modes of thinking and living. Therefore, the enhancement of climate literacy is essential.

Why Green Education?

Orr (2004) argues that the value of education should be assessed based on the criteria of human decency and survival. Now, two decades later, seeking an education system that teaches students to live more responsibly is more important than ever. Climate literacy is essential for empowering learners to make informed decisions and be more engaged in sustainable practices. Kwauk and Casey (2022) state that the complexity of climate issues is beyond the confines of subject areas, and it is only by engaging in cognitive, socio-emotional, and behavioural skills that more actionable understanding of climate change can occur. This approach is also in line with the guiding principles of ESD. Young people are calling for climate change education to be included in various subjects. According to UNESCO (2023),

climate change education is mainly delivered within natural sciences (50%), and only 25% of young people reported it to be integrated in other subjects. Interestingly, as the age bracket of the respondents increased, the likelihood of climate change being taught as a stand-alone subject decreased (UNESCO, 2023).

A green holistic education model can integrate disciplines with adaptive strategies that can mitigate the effects of climate change through training resilience-building and critical thinking skills (UNESCO, 2023). Green education is helpful in addressing eco-anxiety as well. Clayton (2020) shares how prevalent the chronic fear of environmental doom is. Through agency and action, learners can mitigate their feelings of helplessness and feel better equipped to contribute (UNESCO, 2022). Green holistic education also promotes equity and justice. Familiarizing students about the socio-economic and historical factors that have been contributing to the climate crisis, can prepare students to demand and advocate for more equitable, and inclusive policies (Youth4Climate, 2021). For the interconnectedness of climate action, nature, and social progress to be reinforced, a systematic change in education models is a necessity.

Defining systems thinking

Systems thinking emphasizes interconnectedness and interdependence within a complex network of relationships (Capra & Luisi, 2014). This necessitates looking at the entirety of the system, where there are emergent properties that are not evident from component parts alone. This can be elucidated through the maxim: “the totality is not, as it were, a mere heap, but the whole is something besides the parts” (Aristotle, 1924). Systems are also dynamic and adaptable, operating through feedback mechanisms that can change the behaviour of the overall system.

Capra (1996) has identified holism, relationships, processes, and the individual construction of reality as the paradigm shift in thinking that occurs in applying systems-based thinking to the world. Within a system, Meadows (2008) elucidated the notion of leverage points, where smaller-scale changes might facilitate a larger, overarching change to the system. She identifies rules as a high leverage point, holding significant power over the entire system. Within education, these rules might relate to where the funding for education comes from, who has the decision-making power, or even the purpose of education itself. For example, if the purpose of education is to train young people to join the workforce and participate in the economy, the rest of the system may respond through the commercialization of education, focusing on academic programs with the closest links to industry and emphasis on the development of networking skills. On the other hand, if the purpose of education is the social and cognitive development of the whole individual, the rest of the system may align towards that through integration between disciplines, teacher-learner relationships founded on an ethics of care, and emphasis on developing collaborative skills. Hence, deeper aspects of the system impact how the entire system functions and unfolds over time.

Like knowledge and life can no longer be viewed from a Cartesian reductionism, education itself needs a paradigm shift where educators, learners, curricula, and pedagogies operate as an interconnected network. While this means that learners need to be given the tools to identify systems, understand systems, and apply this knowledge in novel ways to understand larger relationships of systems, it also means that educators must likewise develop this skillset to appropriately translate the concepts alongside learners. However, research into systems thinking has primarily focused on the students’ systems thinking competence, rather than teachers’ systems thinking competence (York et al., 2019). This demonstrates a misalignment in priority as systems thinking has nonetheless been identified as a key competence of teachers within the ESD framework (UNECE, 2012).

We will begin by examining systems thinking as a holistic framework that can enhance an understanding of green education by targeting competencies in several dimensions: Firstly, informing curriculum design and professional development; secondly, integrating learning that engages systems thinking in the classroom; and thirdly, thinking of eco-centric education as part of a whole system that considers institutional and social structures.

Systems thinking teaching competence

Andreoni and Ruiz Vargas (2020) have noted several challenges in the incorporation of eco-centric learning into the curriculum for the furthering of the SDGs. Among these challenges are the need for sustainability education to include the development of a wide variety of creative, problem solving, and holistic skills in learners, as well as the entrenched dependence on operating in disciplinary silos as opposed to a transdisciplinary building of curricula. Even when disciplines intersect, courses are at times institutionally offered only as electives and not as a core part of the curriculum, such as business ethics, or law and sustainability courses within a business curriculum (Bagley et al., 2020).

To address these challenges and emancipate curricula from their silos, we need to look at how educators can become better equipped to understand holism and systems pedagogy themselves. Systems thinking has been proposed as a methodology that can improve the development of curricula by its potential to tilt the scales toward a deeper ecology (Spain, 2019). Gilisen et al. (2020) suggest that teachers need to be provided with the tools to instruct students in systems thinking, but that there is currently a dearth of clear guidance from institutions on how to effectively utilize systems thinking in the classroom. Owens et al. (2023) have also raised the issue of instructor agency and ability to enact sustainability teaching in the classroom. Participating in eco-pedagogy workshops has had positive effects in terms of improving teacher participants’ higher-order thinking skills and organization of eco-pedagogical concepts, alongside being recognized by participants as important to their development as teaching professionals (Asli et al., 2024). To convey systems thinking to students, teachers must therefore be equipped to develop the skills to think in a systems-based way and understand systems

as a pedagogical approach. The use of systems thinking in teacher education has been found to enhance pedagogical content knowledge (PCK) through the integration of multiple technologies (Niess & Gillow-Wiles, 2017). Yet, the acquisition of PCK by student-teachers seems to be more effective when a technical course has didactical elements compared to when it does not (Rosenkränzer et al., 2017), signifying a need for at least a partly instructional rather than wholly heuristic approach to teacher education in understanding systems as a pedagogy.

It is important to note that one potential barrier to multidisciplinary teaching in higher education is instructors' reluctance to speak in areas outside of their expertise. For instance, an instructor teaching a case in a tort law class where a vulnerable community has filed a lawsuit against a toxic polluter may resist incorporating a discussion of colonialism, extractivism, and ecological apartheid if they see these as areas outside their expertise, even though they may be pertinent issues to a full multidisciplinary contextualization of the harm caused. In looking at the discipline of business where educators may avoid deeper explorations of ethics, Bagley et al. (2020) thus propose collaborating across disciplines to create instructional materials and engaging in team-teaching to deliver a course that intersects disciplinary knowledge. Team-teaching also contributes to heightened engagement and a construction of knowledge from multiple perspectives, involving students and several teachers, rather than mono-teaching from the convergent perspective of a single educator (Gono & de Moraes, 2023).

A transdisciplinary curriculum design for an eco-centric education that connects and cross-connects across disciplines requires thinking that understands holism. Providing training supports for educators and fostering their own ability to think in terms of systems is essential to building a curriculum that leverages pedagogical approaches that empower educators to facilitate these skills in learners.

Systems thinking learner competence

Understanding sustainable development necessitates an understanding of the dynamic relationship between the natural world, the social world, and the economic world. Yet, a review by Amorós Molina et al. (2023) has found that higher-income countries tended to prioritize more formal pedagogical approaches and pedagogies when incorporating SDGs into their curriculum, whereas lower-income countries preferred more engagement with pedagogies that leverage real-world applications of the SDGs. This reinforces the notion that the Western and Eurocentric educational sphere has decoupled itself from the natural world. Under ESD, UNESCO (2014) has identified the comprehension of complex systems and decision-making abilities to act as important competencies for learners to acquire. Rieckmann's (2018) review of key competencies for learners in sustainability has also identified the critical role of systems thinking. The possibility of systems thinking to enhance educational outcomes for students has already been noted in multiple disciplines, including chemistry (Pazicni & Flynn, 2019; York et al., 2019), biology (Gilissen et al., 2020; Riess & Mischo, 2010; Verhoeff et al., 2018),

engineering (Mehalik et al., 2008), business (Marcos-Sánchez et al., 2022), and emergent technologies (Fowler et al., 2019). Applying systems thinking in the classroom has empowered students to observe and analyse real-world problems and provide solutions. Pedagogies that involve a bottom-up approach where learners can engage with authentic scenarios are linked to the development of the ability to solve problems and understand relationships between systems (Andreoni & Ruiz Vargas, 2020). If higher education is to green its curricula and develop an eco-centric ethos, this process also cannot begin when students enter higher education, and it ought to instead consider a learner's entire educational trajectory. In one case, by integrating systems thinking through a project-based pedagogy, teachers facilitated second-grade students addressing an ecological issue of a state-wide drought (Curwen et al., 2018). In engaging with non-linear and interdisciplinary cognition, second-grade students were not only able to propose solutions but were also able to identify key points of leverage within the system where a minor action can result in a significant change to the system. Curwen et al. (2018) found students were also able to creatively think of ways to motivate others to also act upon identified leverage points. This engaged not only their own autonomy but promoted the autonomy of others to act as agents of change. In such a case, students take disciplinary knowledge about a system and bridge it to new disciplines to complete a project. Likewise, the students bridge their understanding of a system to a real-world observable scenario. This is not taking place in a tailored way but rather is occurring by asking students to organically engage with the whole system. Mehalik et al. (2008) showed that students who designed a system performed better when tested on central concepts than those who constructed a system by following a scripted set of steps. Engaging in hands-on learning and being involved in the whole system as a learner appear to be important for establishing systems thinking as a learner competence.

Studies of higher education students have also shown success when real-world applications are introduced. A study by Demssie et al. (2023) found that combining integrated learning pedagogies with real-world, collaborative applications demonstrated improvements in systems thinking competence. In its application in the classroom, systems thinking can also enhance a learner's sense of self-efficacy (Maina & González, 2016; Spain, 2019). The learner has the potential and the tools to become the co-pilot of knowledge, rather than the assumed blank slate upon which discourse is imparted. Winter-Simat et al. (2017) discuss whole systems thinking as a way of engaging students on a multidisciplinary level, visualizing their path through different disciplines as a web. This stands in sharp contrast to the way that academic and career options are often presented to learners as a fork in the road, where they often must make life-long decisions between STEM and the liberal arts.

Systems thinking education competence

Eco-centric education can be imagined as an interconnected system arising emergently from component parts that are not completely isolated means of knowledge production. Educators, students, curricula, and pedagogies interact dynamically and in a network of relationships that has leverage points and feedback loops regulating its behaviour. Rieckmann (2018) has emphasized the importance of a whole-institution approach to ESD. Systems have been acknowledged to also be constituent parts of a larger system (Meadows, 2008). An individual becomes part of their classroom system, which is part of the system of their institution, which exists within a provincial or state-regulated system of education. These systems within systems act like a Matryoshka doll, nested inside one another. In this way, education can be conceptualized as a system nested within the macro-level cultural, political, economic, and social forces that direct knowledge production. These forces have historically been advanced by imperialist epistemology.

Yet, an eco-centric education seeks to create a new model for a socially just, biophilic, and sustainable world. Tan et al. (2023) have suggested that governmental policies that promote eco-pedagogy for sustainability will require collaboration between stakeholders within educational institutions to facilitate the adoption and integration of such policies. Further, for educational institutions to fulfil the role of change agents, the internal system of eco-centric education would need to also provide feedback outward, effecting an epistemological decolonization of the neoliberal cultural, political, economic, and social structural forces. Owens et al. (2023) have identified confronting these prevailing sources of power in education and in the overarching system as fundamental to accessing the tools necessary to change how sustainability is taught. Unlike the Matryoshka doll, the inner system of education must in turn also provide feedback to the larger social, economic, and ecological system that defines sustainability. Hence, systems thinking as a matter of educational competence in eco-centric education necessitates looking beyond linear, top-down, unilateral relationships and instead to how all systems and levels of systems interact with and affect each other, both horizontally and vertically within a systems web. We can thus think of the holistic systems framework to eco-centric education as emphasizing teacher competence in systems thinking, student competence in systems thinking, and institutional and societal competence in systems thinking.

Through facilitating the integration of eco-awareness into curricula, the professional development and acquisition of PCK by teachers, empowering students and learners to connect academic learning to real-world problems, systems thinking provides a framework for understanding how an eco-centric education could be implemented. Examining whole systems allows us to understand how eco-centric education itself functions as a system and is also situated within broader societal forces.

In the next sections, we discuss the integration of praxis-based pedagogies to provide guidance on best practices for empowering learners to become agents for sustainable

Table 1. Systems thinking competencies and identified dimensions.

Competence for Eco-Centric Education	Identified Dimensions
1) <i>Systems Thinking Teaching</i>	Curriculum building Professional development Pedagogical content knowledge
2) <i>Systems Thinking Learning</i>	Conceptualizing systems Bridging across disciplines Bridging to observable world
3) <i>Systems Thinking Education</i>	Whole systems

change and explore the development of an eco-centric consciousness that transcends dualism. These serve as important aspects of conceptualizing systems thinking in relation to eco-centric education as emphasizing holism.

Integration of pedagogies

Over the past decades, educators have been striving to integrate transdisciplinary curricula to enable the students to become sustainability leaders which has revolutionized how educators teach and evaluate their students. Even though fostering skills that help students use their knowledge in the real world can be applicable to all topics, integrating pedagogies seem particularly relevant to environmental education and sustainability literacy as they equip students to synthesize information and apply knowledge to critically and collaboratively problem solve. Years of research show that an amalgamation of the pedagogies below can benefit climate change education:

Learner-centredness

This methodology focuses on learners' autonomy and active role in constructing knowledge, rather than being a passive receiver. The process begins with students' schemata and experiences, with educators acting as facilitators (Rieckmann, 2018). Studies value this approach, as students are entrusted with more responsibility for their learning which fosters critical thinking, and problem-solving skills and is also in line with inquiry-based learning. This approach prepares students to be proactive and promotes stewardship for the environment (Byrne, 2016).

Bremner (2021) conceptualizes Learner Centred Pedagogy (LCP) in six easy-to-adopt aspects. He believes active participation encourages learners to engage with both their peers and teachers through collaborative activities. Adapting to needs ensures that learning is tailored to students' prior knowledge and individual preferences. Autonomy fosters self-directed learning, where students take responsibility to develop lifelong learning skills. By focusing on providing meaningful content that is applicable to real-life situations, critical thinking and creativity can be emphasized. He also advocates for power-sharing to promote a more democratic classroom environment. Lastly, he views learning as a continuous process that can be enhanced by incorporating self and peer assessments.

Active/participatory/experiential learning

Experiential learning is inspired by Dewey's (1930) philosophy of "education is experience" and "learning by doing". Hands-on experiences can bridge the gap between knowledge and action (Brundiers et al., 2010). Experiential learning involves concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Huang (2001) identified the learning characteristics and ability traits of Kolb's model and suggested methods for the adoption of this learning cycle. He suggested hands-on experiences such as experiments or interviews alongside demonstrations to emphasize engagement, and small group discussions paired with thoughtful exploration and shared experiences to promote reflective learning. He proposes literature reviews and classifications to support understanding of abstract concepts, and small group problem-solving applied to real-life situations to emphasize active experimentation (Huang, 2001, as cited in Yu, 2024). This combination of methods and examples underscores the effectiveness of Kolb's model in fostering a comprehensive learning experience.

Place-based and project-based learning

Place-based education is a realistic form of education with the potential to tap into multiple disciplines while extending outside the classroom and linking learners with society (Elbaz, 2023). As students get actively involved in planning, project-based and place-based pedagogies can develop pro-sustainability skills in learners (Cincera et al., 2019). Research suggests that these approaches can immensely improve pro-sustainability learning outcomes (Khadka et al., 2020). Vander Ark et al.'s (2020) research also found how the 6 principles of place-based learning (community as classroom, learner-centred, inquiry-based, local to global, design thinking, and interdisciplinary) align well with the principles of learning sciences (cognition, motivation, identity, individual variability).

Though some may argue that the interconnectedness of the world is causing the notion of locality to lose significance, Stevenson (2008) finds this notion to be an oxymoron and proposes that place-based and critical pedagogies can productively complement each other.

Critical pedagogy

The causes, effects, and solutions to climate change go beyond particular disciplines. Oberman and Sainz (2021) believe in education that supports students in considering both scientific and social aspects of decision makings. They believe critical thinking to be the cornerstone skill in green education as it enables students to analyse evidence, explore links, and evaluate solutions. Hofman (2015), and Chiba et al. (2021) advocate that with exposure to different perspectives, critical pedagogy has the potential to change students' way of thinking which can lead to reflective actions, and consequently global changes. This pedagogy aims to critique the status quo and demands change.

Problem-based learning

This approach encourages independent learning and deeper critical thinking by applying knowledge to authentic scenarios (Savin-Baden, 2020). By organizing learning around problems, encouraging formulating the right questions, and involving learners in real-world problems, students become better equipped to tackle environmental issues (Karpudewan & Roth, 2018).

Collaborative learning

The transformative aspect of education for sustainable development can only be strengthened by the participation of different stakeholders and social engagement (Schnitzler, 2019). This approach requires a learning environment in which community members can devise solutions to achieve common goals collaboratively. A study conducted by Namaziandost et al. (2024) illustrates that working with peers in a collaborative and team approach leads to enhanced academic enjoyment and better academic performance. In this study, building relationships with peers improved motivation and contributed to a positive learning environment.

Application in higher education

Many universities have already integrated learner-centred pedagogies to some degree, and there is an increasing desire to adopt pedagogical approaches that provide students with learning opportunities outside of the traditional classroom model to promote SDGs. Some universities have turned to technology-based tools like Riipen to connect learners with business partners on the platform, including a partnership with ECO Canada (Riipen, 2024). This can promote students' ability to work in teams and provided them with career preparedness skills (Palatnik & Blaber, 2021). The University of Toronto's Sandbox partners students with organizations that are facing a persistent challenge and are looking for innovative solutions. For instance, one project involved students from the disciplines of environmental chemistry, geography, and writing to work together for a project by the Toronto District School Board to raise awareness of bicycling or walking to the university as a more sustainable option that driving or even taking transit (University of Toronto, 2024). The Global Immersion Guarantee program in education at Monash University, Australia, connects students from diverse backgrounds with community leaders to address local issues (Monash University, 2024). In such collaborative and project-based learning, students work across disciplines and are exposed to various stakeholders to complete concrete tasks. In a sustainability context, Living Labs have been identified as engaging with both experiential learning and collaborative learning processes (van der Wee et al., 2024). The University of Waterloo's Sustainability Living Lab applies problem-based and experiential learning by providing students with the opportunity to address real-world engineering challenges in a way that also promotes sustainability, such as designing solutions to a potential flooding issue on campus caused by the existing storm water drainage system (University of Waterloo, 2024). The

University of British Columbia (UBC) has a Green Labs Program that allows students to engage with experiential, problem-based, and collaborative learning in greening research spaces and laboratories (University of British Columbia, 2024a). One successful Green Labs project had fourth-year UBC mechanical engineering students tasked with creating a shredding machine to solve a foam recycling problem for the Museum of Anthropology (University of British Columbia, 2024b). Van der Wee et al. (2024) have identified that institutions approach the opportunities provided by Living Labs as dual places of learning where students are presented with both *"authentic learning environments and engagement with the real-world"* (p. 262).

Additionally, a study on place-conscious pedagogy by Fraser (2016) focused on the experience of students enrolled in a course on "place matters". The results indicated a strong inclination towards engaging with alternative learning environments. Engaging with diverse spaces and places creates a conscious ecological dimension to a holistic development. Another study examined the outcomes of the Green Ambassador course at Holon Institute of Technology (HIT). HIT's initiative of Green Ambassador is an illustration of how this institution is empowering young adults as conscious beings to safeguard our planet. On completion of the program, the participants demonstrated enhanced environmental literacy and awareness promoting sustainable practices (Friman et al., 2024). The Green Ambassador program focuses on "eco-friendly projects, nature excursions and collaborative strategies" (Friman et al., 2024, p. 3) in the community.

The integration of the aforementioned pedagogies places learners as self-determining and empowered agents of change. Along with amalgamating these pedagogical approaches into curricula, developing eco-conscious beings as a part of greening the curriculum is crucial for reinforcing eco-conscious awareness.

Eco-centric consciousness

As an endeavour to cultivate and explore green pedagogy for eco-centric praxis-based learning in higher education, establishing a holistic perspective is crucial. To leverage the systems thinking approach, integrating student-empowering pedagogies can be further enhanced by developing eco-centric or ecological consciousness as an attempt for greening the curricula.

Ecological consciousness is a deeper awareness of self as an entangled being with the environment. Along with the integration of project-based, experiential, reflective/critical, problem-based, and collaborative learning, creating a relationship with the environment needs to be formulated through a cultural transfiguration. Due to a fast-paced digital world, the pursuit of being a spiritual educator as a part of a systems-based approach of greening the curricula, provides a trajectory to deconstruct self and realize one's potential to the fullest. To corroborate an eco-centric consciousness amongst learners, enhancing their self-agency will lead to a continuous process of recognizing self as an interconnected being with the environment. As the

youth is the future generation, educators must work in sync with them and establish a collective effort to ingrain a sense of environmental consciousness (Saputri, 2018).

Environmental consciousness reflects humans' relationship with nature which constitutes an intertwined contemplation of cognitive, ethical, and emotional aspects (Panov, 2013). Therefore, to further enhance sustainable development education, we examine the role of eco-consciousness attainment through the following suggestive model:



Figure 1. Framework for developing eco-centric consciousness.

Eco-spiritual pedagogy

Adapting a spiritual pedagogy is to focus on 'self-making' and 'self-creating'. According to Tagore (1906), decoding spirituality in education can be illustrated as establishing a non-hierarchal, flat structure with collaboration. (Recognizing self as an entangled being with the ecosystem intertwines eco-pedagogy and spiritual intelligence, providing a dimension for eco-spiritual pedagogical practices. To address the changing effects of GSD, fostering a sense of agency among individuals is to harmonize self with the environment. This harmonization with self and the environment requires an amalgamation of ecological and spiritual values (Dhungana & Neupene, 2021). Eco-spiritual pedagogy as a part of greening the curricula is an initiative to provide learners a trajectory to promote eco-consciousness, which is to recognize self as a co-existent entity interweaved with all phenomenal beings.

We classify some of the praxis-based learning aspects of eco-spiritual pedagogy into the following dimensions:

Engaging with ecotherapy approaches

For spiritual evolvment of self, one of the major components is to blur the boundaries between self and the environment. Ecotherapy, also known as nature-based learning, is a restorative approach which focuses on using outdoor spaces for people's wellness (Corazon et al., 2018). It is a systematic approach of healing self and the earth, including spirituality in education. As ecotherapy is an umbrella term for healing and growing by interacting with nature (Clinebell, 1996), for the purpose of greening the curricula, we analyse this approach by encouraging educational institutes to utilize outdoor spaces for learning. This can be developed by physically using outdoor spaces or by promoting more

experiential learning, or project-based approaches.

Additionally, educators may encourage activities such as gardening and nature walks. Nature walks can lessen stress and can be a remedy to calm oneself amidst nature. Nature activities are a great source for relaxation providing a positive connection with the ecosystem. Therefore, ecotherapy includes developing self in the lap of nature. For an educative praxis, ecotherapy can be interpreted as an intertwined aspect of healing ourselves (educators and the learners) by healing the earth. As a process, it will help the endangered human species to minimize or subsist productively the unparallel challenge of saving the earth for today and for future generations (Clinebell, 1996). Further, it may lessen the increasing climate anxiousness amongst youth. Therefore, eco-centric education must consider nature as a co-educator because nature can be utilized for therapeutic educative purposes (Pedretti-Burls, 2007). Some of these projects may focus on physical, psychological, social, and cultural well-being, developing a sense of freedom in outdoor spaces. Pedretti-Burls (2007) highlights that the therapeutic approach of nature may enhance human well-being at the following three levels:

- Physical well-being: enhance mobility and build stamina
- Psychological well-being: enhance concentration, focus memory, reduce anxiety
- Social well-being: enhance social skills and relationship awareness

Adapting biophilia hypothesis

Along with ecotherapy approaches in education, we further highlight the theoretical model of the Biophilia hypothesis. The Biophilia hypothesis, propounded by Wilson (1984), highlights that the innate nature of humans is to co-exist with the environment. This hypothesis provides a theoretical and pragmatic approach to support the co-existence of humans and nature. Additionally, it highlights the importance of nature for both the survival and well-being of humans. Kellert and Calabrese (2015) further build on the Biophilia principle by categorizing environmentalism into three components:

Firstly, Kellert and Calabrese (2015) underline the essentiality of being directly present in nature. Secondly, the indirect experiences of nature could be created by focusing on activities such as photography, paintings, or various other artworks, which depict nature or utilize eco-friendly natural products. Thirdly, they highlight the importance of human perception, related to cognitive responses such as human experiences of various spaces and places that help to recognize cultural and ecological reverences.

Correspondingly, to enhance eco-spiritual consciousness as a part of eco-pedagogy, Kellert and Calabrese's (2015) model on the Biophilia principle can be applied in the educative model. Firstly, to establish a direct connection with nature, classroom spaces need to be redefined. Secondly, to initiate indirect experiences with nature, students may be

vicariously made to connect with the environment. Some of the examples include creating virtual labs, focusing on experiential learning, and projects such as visual essays, which may also deepen indigenous knowledge and cultures. Additionally, case studies may focus on sustainable development while fostering cultural relationship with local indigenous communities. While courses may have different topics, the integration of case studies based on environmental aspects may be encouraged. Thirdly, to stimulate our cognitive processes about the perceptions of nature, more outdoor activities, experiential learning, and field projects should be reinvigorated. More outdoor activities will establish memories for the learners in natural spaces. Educational institutions provide a platform for students to not only develop content knowledge but also provide a space for creating lifetime memories that become a crucial part of their educational journey. Therefore, the biophilia threefold principle or approach will provide a roadmap for its implementation.

Comprehensively, spirituality in education as elucidated by Souza et al. (2009) focuses on the spiritual dimensions of the human life journey as a continued process of 'becoming'. It includes fostering compassion, empathy, and developing one's identity by promoting "body, mind and spirit" evolvement. This approach of eco-spiritual pedagogy will create a holistic being who grows as a conscious entity, realizing the essentiality of creating meaning and interconnectedness with the ecosystem.

Thereby, a green curriculum does not limit its understanding to environmental studies but rather it widens its horizon to cultivate a holistic perspective creating eco-conscious beings. This will augment humans to enhance their capabilities to perceive the current situation of climate wakefulness and focus on a positive transitional future (Dhungana & Neupane, 2021).

Focusing on achieving Gross National Happiness (GNH)

Adapting an eco-spiritual pedagogy (eco-pedagogy + spiritual pedagogy) by focusing on ecotherapy and by embracing the Biophilia hypothesis, may form a trajectory to magnify happiness. Gross national happiness (GNH) is not a novel paradigm; rather, it is a concept which needs to be reinforced in the curricula. The country of Bhutan aims to foster education to achieve GNH for their citizens. One of the initiatives for achieving GNH is to emphasize greening the curricula. The missing dimension in human identity formation is the cultivation of happiness amongst the youth. To address the increasing eco-anxiety and digital anxiousness, the approach of adopting an eco-spiritual pedagogy will lead to stimulating GNH. Achieving GNH, will further augment the youth to transcend dualities by promoting interconnectedness of self and the ecosystem.

"Happiness is the meaning and purpose of life, the whole aim and end of human existence." (Aristotle, 1924, as cited in Diener & Kesebir, 2008, p.69). Therefore, Bhutan's initiative to achieve GNH elucidates its importance over Gross National Product (Hayward & Colman, 2010). Hayward and Colman (2010) illustrate that to achieve GNH, the country of Bhutan

focuses on sustainable development, promotion of culture and positive governance. These initiatives in the education sector highlight the importance of a curriculum infused with emphasis on critical thinking and creative thinking, along with developing ecological literacy. In addition to familiarizing learners with the content knowledge of the subject matter, a great deal of attention should be given to instilling values amongst learners. Bhutan's Ministry of Education (2012) launched a plan to enhance nationwide happiness by focusing on greening the environment, intellect, aesthetic, academic, social, and cultural aspects. The complete blend of spirituality and content knowledge is illustrated by introducing meditation prior to the commencement of each class. This not only increases focus but also reduces anxiety amongst learners. Similarly, Brooks (2008) suggests that GNH in America may be enhanced by bridging the gap between social and cultural values.

Correspondingly, Tagore's (1961) educational mission of Visva-Bharati highlights the multifaceted development of self, which includes aesthetic, intellectual, physical, and spiritual development. Aesthetic development is to connect with art, music, and literature to enrich the soul. Intellectual development is inclusive of creating lifelong learners so that they may continue to enhance their knowledge with an organic sense of curiosity. Physical development focuses on games, sports, outdoor activities such as yoga, meditation, and immersing oneself with nature. Spiritual development provides a trajectory for self-liberation, finding peace and solace amidst self and nature. This four-dimensional educative praxis will encourage transformative pedagogies to illuminate self in the lap of nature (Lesar, 2015). Therefore, it will create a pathway for holistic education. Despite Tagore's first school commencement which dates to 1901, the pursuit of education to recognize self as an entangled entity with the universe remain relevant in today's digital era. He identified that the trajectory of education should cultivate and enhance the arts of life such as diverse forms of creative expressions (Lesser, 2015), while developing a conscious relationship with nature (Gupta, 2004) to create a sustainable future. To stimulate conscious experiences, learners should indulge in music, literature, dance, meditation, and other forms of experiential learning, which remain human attributes of self-reflection and self-expression in today's digitally enhanced era.

Transcending dualities and establishing interconnectedness

As we argue that education cannot be viewed from the Cartesian philosophical approach of reductionism and dualism, eco-spiritual pedagogy as a component of holism will augment the paradigm shift of education. Holistic development should be perceived from a non-dualistic attitude that promotes interconnectedness. Posthuman approaches also focus on human and non-human issues (Braidotti, 2016) and post-anthropocentric approaches displace humans from being the centre of the universe (Ferrando, 2019). Future research may explore these alongside the systems framework. Due to the current climate challenges, the interconnectedness of human life with non-human entities (Herzogenrath, 2009) should be encouraged to develop a keen sense of deeper ecological

awareness. The eco-centric conscious being is one who transcends any dualities and establishes interconnections by developing a deeper awareness of self and its surroundings. The "ecologization" of education will support creating an environmental consciousness and a cultural transformation of educators and learners both personally and professionally. The philosophical transcendental approach of nature examines humanity, nature, and the universe as one single being contributing to sustainable development (Panov, 2013). Wilson (2002) raises concerns over the "Ereozoic age" which he calls the "age of loneliness". He highlights the importance of biodiversity without which humans may face immense psychological deficiency leading to loneliness and alienation. Overall, by forming an ethical ecological well-being, heightened awareness is experienced when learning is applied in real-world contexts (Herbert, 1996).

Eco-centric consciousness will thus further the greening of curricula. Transcendence of self may be achieved through eco-pedagogies and spiritual pedagogies in education. This philosophical discourse will actualize through educative measures where learners and educators collaboratively feel empowered to be lifelong learners. Egri (1999) thus proposes the implications of spiritual discourses at a global level. Ecological education as holism reconnects humans and nature, developing an eco-bonding (Pedretti-Burls, 2007). The eco-bonding will transcend any dualities between humans and nature which will further reduce eco-alienation. This spiritual enrichment will transcend self in nature, leading to a more responsible nourishing of nature (Clinebell, 1996).

Challenges

Education for sustainable development can significantly affect the pace at which countries are moving towards a more sustainable future. However, the adoption of holistic approaches and integration of these pedagogies has been slow.

Cebrián et al. (2021) state that often educators believe ESD to be more relevant to content rather than pedagogy and may lack confidence to adopt them in their teaching practices. This issue can be addressed in teacher education programs in which student-teachers develop curriculum with environmental considerations. Another challenge faced by instructors is the "perceived need to cover" content (Kober, 2015) which makes integrating holistic breadth of knowledge seem less feasible. Other logistical challenges can be classroom configurations, availability of resources (Byrne, 2016), large enrolments (Walker et al., 2008), and shorter time blocks which do not lend themselves well to rigorous, collaborative engagements.

These challenges, individually or collectively, can hinder the transformations of traditional teaching practices. Access to easy-to-adopt-and-adapt resources can pave the way for the integration of the innovative pedagogies by instructors. UNESCO's (2024) Greening Curriculum Guidance is a notable resource towards mainstreaming ESD in national curricula. Additionally, challenges in adapting eco-spiritual pedagogies begin from the problematic nature of defining spirituality as an intrinsic value in the ecological system.

According to Chomsky, climate upheaval currently poses one of the biggest existential threats (Samphir, 2019). The eco-conscious beings, who are concerned about climate wakefulness are also unable to act due to ecological paralysis (Lertzman, 2015). Additionally, the “ecological guilt, grief and anxiety remains under-theorised” as it is less explored and defined (Bryan, 2020, p. 12). While the need to address these challenges is increasing, significant efforts must be established as a part of the education system. An aspiration to improvise and ecologize education may not be adequate. The willingness to engross in addressing the climate issues is often restricted by families or societies (Bryan, 2020). A collective effort may be necessary to bridge the aspiration, knowledge, and action plan or behavioural aspects. Learners must be encouraged to develop emotional responses towards the environment by embedding ‘personal reflexivity’, ‘emotional clarity’, and awareness to realize self as an identity which is enmeshed with the environment.

Conclusion

Applying a systems approach, the proposed conceptual framework of positioning education to focus on holistic development, reinforces the LCP approach. While being conscious of the limitations, we urge educators to enable eco-consciousness by focusing on eco-spiritual pedagogy praxis-based learning.

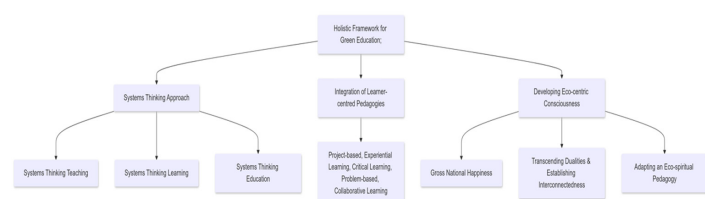


Figure 2. Holistic framework for Green Education.

To save our present, future selves, and the planet, education needs to be revamped with a systematic approach of rethinking human and environmental relationships. The exploration of green pedagogy for eco-centric praxis-based learning in higher education demands an urgent need for reform across existing educational structures. This paper highlights that despite the emerging recognition of the importance of sustainability in education, the integration of systems thinking, transdisciplinary curricula, and eco-centric learning remains inadequate. This inadequacy can be attributed to disciplinary silos, a lack of teacher preparedness, limited institutional support, ambiguity surrounding eco-spirituality, ecological paralysis, and societal reluctance to change. Collaborative efforts among educators, learners, and policymakers are critical in overcoming these hurdles. Bridging aspirations with actionable plans calls for a cultural shift that fosters emotional clarity and environmental advocacy among learners. It is only by breaking free of reductionist paradigms that a holistic education model which fosters sustainable development and ecological harmony can evolve.

References

- Altbach, P. G., & Kelly, G. P. (1978). *Education and colonialism*. Longman.
- Amorós Molina, A., Helldén, D., Alfvén, T., Niemi, M., Leander, K., Nordenstedt, H., Rehn, C., Ndejjo, R., Wanyenze R., & Biermann, O. (2023). Integrating the United Nations sustainable development goals into higher educational globally: A scoping review. *Global Health Action*, 16, 2190649. <https://doi.org/10.1080/16549716.2023.2190649>
- Andreoni, V., & Ruiz Vargas, V. (2020). Tracking the interlinkages across SDGs: The case of hill centered education network in Bogota, Colombia. *Sustainability*, 12(19), 7924. <https://doi.org/10.3390/su12197924>
- Aristotle. (1924). *Metaphysics: Book VIII*. (W. D. Ross, Trans.) *The internet classics archive*. (Original work published ca. 350 B.C.E.). <https://classics.mit.edu/Aristotle/metaphysics.8.viii.html>
- Asli, S., Abu-Alhiga, R., Teti, T., Algmal, S., Hofstein, A., Shehadeh-Nasser, A., & Hugerat, M. (2024). How participation in a teachers' eco-pedagogy workshop affects the promotion of teachers' environmental education and organizational concepts. *European Journal of Educational Research*, 13(1), 341-352. <https://doi.org/10.12973/eu-jer.13.1.341>
- Bagley, C. E., Sulkowski, A. J., Nelson, J. S., Waddock, S., & Shrivastava, P. (2020). A path to developing more insightful business school graduates: A systems-based, experimental approach to integrating law, strategy, and sustainability. *Academy of Management Learning and Education*, 19(4), 541–568. <https://doi.org/10.5465/amle.2018.0036>
- Bernier, A. (2018). How matching systems thinking with critical pedagogy may help resist the industrialization of sustainability education. *Journal of Sustainability Education*, 18(1). https://www.susted.com/wordpress/content/how-matching-systems-thinking-with-critical-pedagogy-may-help-resist-the-industrialization-of-sustainability-education_2018_09
- Bhutan Ministry of Education. (2012). *Cultivating the grace of our mind: 30th education policy guidelines and instructions*. Policy and Planning Division Ministry of Education Royal Government of Bhutan. <http://www.education.gov.bt/wpcontent/uploads/2021/09/EPGI-2012.pdf>
- Braidotti, R. (2016). Posthuman critical theory. In D. Banerji & M. R. Paranjape (Eds.), *Critical posthumanism and planetary futures* (pp. 13–32). Springer.
- Bremner, N. (2021). The multiple meanings of 'student-centred' or 'learner-centred' education, and the case for a more flexible approach to defining it. *Comparative Education*, 57(2), 159–186. <https://doi.org/10.1080/03050068.2020.1805863>
- Brooks, A. C. (2008). *Gross national happiness: Why happiness matters for America – and how we can get more of it*. Basic

Brundiers, K., Wiek, A., & Redman, C. L. (2010). Real-world learning opportunities in sustainability: From classroom into the real world. *International Journal of Sustainability in Higher Education*, 11(4), 308–324. <https://doi.org/10.1108/14676371011077540>

Bryan, A. (2020). Affective pedagogies: Foregrounding emotion in climate change education. *Policy and Practice: A Development Education Review*, 30, 8–30. <https://www.developmenteducationreview.com/issue/issue-30/affective-pedagogies-foregrounding-emotion-climate-change-education>

Byrne, L. B. (2016). Learner-centered teaching for environmental and sustainability studies. In L. B. Byrne (Ed.), *Learner-centered teaching activities for environmental and sustainability studies* (pp.1–28). Springer. https://doi.org/10.1007/978-3-319-28543-6_1

Capra, F. (1996). *The web of life: A new scientific understanding of living systems*. Anchor Press.

Capra, F., & Luisi, P. L. (2014). *The systems view of life: A unifying vision*. Cambridge University Press. <https://doi.org/10.1017/cbo9780511895555>

Cebrián, G., Junyent, M., & Mulà, I. (2021). Current practices and future pathways towards competencies in education for sustainable development. *Sustainability*, 13(16), 8733. <https://doi.org/10.3390/su13168733>

Chiba, M., Sustarsic, M., Perriton, S., and Edwards, D. B., (2021). Investigating effective teaching and learning for sustainable development and global citizenship: Implications from a systematic review of the literature. *International Journal of Educational Development*, 81, 102337. <https://doi.org/10.1016/j.ijedudev.2020.102337>

Cincera, J., Valesova, B., Křepelková, Š., Šimonová, P., & Kroufek, R. (2019). Place-based education from three perspectives. *Environmental Education Research*, 25(1), 1-14. <https://doi.org/10.1080/13504622.2019.1651826>

Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders*, 74, 102263. <https://doi.org/10.1016/j.janxdis.2020.102263>

Clinebell, H. (1996). *Ecotherapy: Healing ourselves, healing the earth*. Routledge. <https://doi.org/10.4324/9781315799773>

Corazon, S. S., Nyed, P. K., Sidenius, U., Poulsen, D. V., & Stigsdotter, U. K. (2018). A long-term follow-up of the efficacy of nature-based therapy for adults suffering from stress-related illnesses on levels of healthcare consumption and sick-leave absence: A randomized controlled trial. *International Journal of Environmental Research and Public Health*, 15(1), 137. <https://doi.org/10.3390/ijerph15010137>

Curwen, M. S., Ardell, A., MacGillivray, L., & Lambert, R. (2018). Systems thinking in a second grade curriculum: Students engaged to address a statewide drought. *Frontiers in*

Education, 3, 90. <https://doi.org/10.3389/feduc.2018.00090>

da Rocha, P. L. B., Pardini, R., Viana, B. F., El-Hani, C. N. (2020). Fostering inter- and transdisciplinarity in discipline-oriented universities to improve sustainability science and practice. *Sustainability Science*, 15(1), 717–728. <https://doi.org/10.1007/s11625-019-00761-1>

Demssie, Y. N., Biemans, H. J. A., Wesselink, R., & Mulder, M. (2023). Fostering students' systems thinking competence for sustainability by using multiple real-world learning approaches. *Environmental Education Research*, 29(2), 261–286. <https://doi.org/10.1080/13504622.2022.2141692>

Dewey, J. (1930). From absolutism to experimentalism. In G. P. Adams & W. Pepperell Montague (Eds.), *Contemporary American philosophy: Personal statements* (pp. 13–27). Russell and Russell.

Dey, S. (2023). *Green academia: Towards eco-friendly education systems*. Routledge India.

Dhungana, S., & Neupane, B. (2021). Ecospiritual pedagogy: A learning centric educational practice. *Research in English Language Pedagogy*, 9(1), 200. <https://doi.org/10.30486/relp.2021.1911490.1228>

Diener, E., & Kesebir, P. (2008). In defence of happiness: Why policymakers should care about subjective well-being. In Bruni, L. F. Comim & M. Pugno (Eds.), *Capabilities and happiness* (pp. 60-80). Oxford University Press. <https://doi.org/10.1093/oso/9780199532148.003.0004>

Elbaz, M. M. (2023). Place-based education: Community as a multidisciplinary learning environment. *Port Said Journal of Educational Research*, 2(1), 59-74. <https://doi.org/10.21608/psjer.2023.178248.1009>

Egri, C. (1999). Nature in spiritual traditions: Social and cultural implications for environmental change. In F. Fischer & M. Hajer (Eds.), *Living with nature: Environmental politics as cultural discourse* (pp. 58-80). Oxford Academic. <https://doi.org/10.1093/019829509X.001.0001>

Ferrando, F. (2019). *Philosophical posthumanism*. Bloomsbury.

Fowler, W., Ting, J., Meng, S., Li, L., & Tirrell, M. (2019). Integrating systems thinking into teaching emerging technologies. *Journal of Chemical Education*, 96(12), 2805–2813. <https://doi.org/10.1021/acs.jchemed.9b00280>

Fraser, E. W. (2016). Place-conscious pedagogy and Sackville, New Brunswick, as a learning community. *Journal of New Brunswick Studies*, 7(1). <https://journals.lib.unb.ca/index.php/JNBS/article/view/25200/29174>

Freire, P. (1970). *Pedagogy of the oppressed*. Seabury Press. Friman, H., Banner, I., Sitbon, Y., Sahar-Inbar, L., & Shaked, N. (2024). Experiential learning for sustainability: A catalyst for global change. *Educational Administration: Theory and Practice*, 30(5), 8508-8514. <https://kuvey.net/index.php/kuvey/article/view/4404/2939>

- Gilissen, M., Knippels, M., & Joolingen, W. (2020). Bringing systems thinking into the classroom. *International Journal of Science Education*, 42, 1253–1280. <https://doi.org/10.1080/09500693.2020.1755741>
- Gono, S., & de Moraes, A. J. (2023). Student appraisals of collaborative team teaching: A quest for student engagement. *Journal of Applied Learning and Teaching*, 6(1), 222–233. <https://doi.org/10.37074/jalt.2023.6.1.26>
- Green, A. (1990). *Education and state formation: The rise of education systems in England, France, and the U.S.A.* MacMillan.
- Gupta, U. D. (2004). Rabindranath Tagore: A biography. Oxford University Press. Hayward, K., & Colman, R. (2010). *Educating for GNH*. Thimphu Bhutan. GPI Atlantic. http://www.gpiatlantic.org/pdf/educatingforgnh/educating_for_gnh_proceedings.pdf
- Herbert, J. T. (1996). Use of adventure-based counseling programs for persons with disabilities. *Journal of Rehabilitation*, 62(4), 3–9. Use of adventure-based counseling programs for persons with disabilities
- Herzogenrath, B. (Ed.). (2009). *An [un]-likely alliance: Thinking environment[s] with Deleuze/Guattari*. Cambridge Scholars Publishing.
- Hilger, A., & Keil, A. (2021). Education for sustainable development with transdisciplinary-oriented courses – experiences and recommendations for future collaborations in higher education teaching. *Journal of Geography in Higher Education*, 46(3), 427–446. <https://doi.org/10.1080/03098265.2021.1946765>
- Hofman, M., (2015). What is an education for sustainable development supposed to achieve—a question of what, how and why. *Journal of Education for Sustainable Development*, 9(2), 213–228. <https://doi.org/10.1177/09734082155882>
- Karpudewan, M., & Roth, W. (2018). Changes in primary students' informal reasoning during an environment-related curriculum on socio-scientific issues. *International Journal of Science and Mathematics Education*, 16, 401–419. <https://doi.org/10.1007/s10763-016-9787-x>
- Kellert, S., & Calabrese, E. (2015). The practice of biophilic design. *London: Terrapin Bright LLC*, 3(21). https://biophilicdesign.umn.edu/sites/biophilic-net-positive.umn.edu/files/2021-09/2015_Kellert%20The_Practice_of_Biophilic_Design.pdf
- Khadka, A., Li, C. J., Stanis, S. W., & Morgan, M. (2020). Unpacking the power of place-based education in climate change communication. *Applied Environmental Education & Communication*, 20(1), 77–91. <https://doi.org/10.1080/1533015X.2020.1719238>
- Kober, N. (2015). *Reaching students: What research says about effective instruction in undergraduate science and engineering*. The National Academies Press.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. FT Press.
- Kwauk, C. & Casey, O., (2022). A green skills framework for climate action, gender empowerment, and climate justice. *Development Policy Review*, 40(Suppl. 2), 1–19. <https://doi.org/10.1111/dpr.12624>
- Lertzman, R. (2015) *Environmental melancholia: Psychoanalytic dimensions of engagement*. Routledge.
- Lesar, I. (2015). The role of the arts in Tagore's concept of schooling. *CEPS Journal*, 5(3), 111–128. <https://files.eric.ed.gov/fulltext/EJ1128974.pdf>
- Maina, M. F., & González, I. G. (2015). Articulating personal pedagogies through learning ecologies. In R. Huang, Kinshuk, M. Jemni, N-S. Chen, J.M. Spector (Eds.), *Lecture notes in educational technology* (pp. 73–94). https://doi.org/10.1007/978-3-662-47724-3_5
- Marcos-Sánchez, R., Ferrández, D., & Morón, C. (2022). Systems thinking for sustainability education in building and business administration and management degrees. *Sustainability*, 14, 11812. <https://doi.org/10.3390/su141911812>
- Meadows, D. (2008). *Thinking in systems: A primer*. Chelsea Green Publishing.
- Mehalik, M. M., Doppelt Y., & Schunn, C. D. (2008). Middle-school science through design-based learning versus scripted inquiry: Better overall science concept learning and equity gap reduction. *Journal of Engineering Education*, 97(1), 71–85. <https://doi.org/10.1002/j.2168-9830.2008.tb00955.x>
- Monash University. (2024). *Global immersion guarantee*. <https://www.monash.edu/flagship-rich-experiences/gig>
- Namaziandost, E., Behbahani, H. K., & Naserpour, A. (2024). Peer support in language learning: Mitigating anxiety, enhancing achievement, cultivating growth mindsets, and increasing enjoyment. *Journal of Applied Learning and Teaching*, 7(2), 296–313. <https://doi.org/10.37074/jalt.2024.7.2.40>
- Niess, M., & Gillow-Wiles, H. (2017). Expanding teachers' technological pedagogical reasoning with a systems pedagogical approach. *Australasian Journal of Educational Technology*, 33(3). <https://doi.org/10.14742/AJET.3473>
- Oberman, R., & Martinez Sainz, G. (2021). Critical thinking, critical pedagogy and climate change education. In A.M. Kavanagh, F. Waldron, & B. Mallon (Eds.), *Teaching for social justice and sustainable development across the primary curriculum* (pp. 69–83). Routledge. <https://doi.org/10.4324/9781003003021>
- Orr, D. W. (2004). *Earth in mind: On education, environment, and the human prospect* (2nd ed.). Island Press.
- Orr, D. W. (2011). *Hope is an imperative: The essential David Orr*. Island Press.

- Owens, J., Greer K., King H. & Glackin M. (2023). Conceptualising HE educators' capabilities to teach the crisis: Towards critical and transformative environmental pedagogies. *Frontiers in Education*, 8, 1193498. <https://doi.org/10.3389/feduc.2023.1193498>
- Palatnik, B., & Blaber, Z. (2021). RIIPEN.com as a platform for experiential learning in accounting and business education. *Proceedings of the Northeast Business & Economics Association 2021, Eastchester*, 206.
- Panov, V. I. (2013). Ecological thinking, consciousness, responsibility. *Procedia-Social and Behavioral Sciences*, 86, 379–383. <https://doi.org/10.1016/j.sbspro.2013.08.583>
- Pazicni, S., & Flynn, A. (2019). Systems thinking in chemistry education: Theoretical challenges and opportunities. *Journal of Chemical Education*, 96(12), 2752–2763. <https://doi.org/10.1021/acs.jchemed.9b00416>
- Pedretti-Burls, A. (2007). Ecotherapy: A therapeutic and educative model. *Journal of Mediterranean Ecology*, 8, 19–25. <http://www.jmecology.com/wp-content/uploads/2014/03/19-25-Pedretti-Burls.pdf>
- Rieckmann, M. (2018). Learning to transform the world: Key competencies in education for sustainable development. In A. Leicht, J. Heiss, & W.J. Byun (Eds.), *Issues and trends in education for sustainable development* (pp. 39–59). UNESCO Publishing. <https://doi.org/10.54675/YELO2332>
- Riess, W., & Mischo, C. (2010). Promoting systems thinking through biology lessons. *International Journal of Science Education*, 32(6), 705–725. <https://doi.org/10.1080/09500690902769946>
- Riipen. (2024). *Partners*. <https://www.riipen.com/partners>
- Rosenkränzer, F., Hörsch, C., Schuler, S., & Riess, W. (2017). Student teachers' pedagogical content knowledge for teaching systems thinking: Effects of different interventions. *International Journal of Science Education*, 39(14), 1932–1951. <https://doi.org/10.1080/09500693.2017.1362603>
- Samphir, H. (2019, December 7). *Noam Chomsky: "The task ahead is enormous and there is not much time."* Jacobin. <https://jacobin.com/2019/07/noam-chomsky-interview-climate-change-imperialism>
- Saputri, D. A. (2018). Ecological consciousness in J. C. George's *The talking earth: An ecocritical study*. *English Language & Literature Journal*, 7(1), 31–45.
- Savin-Baden, M. (2020). What are problem-based pedagogies? *Journal of Problem-Based Learning*, 7(1), 3–10. <https://doi.org/10.24313/jpbl.2020.00199>
- Schnitzler, T. (2019). The bridge between education for sustainable development and transformative learning: Towards new collaborative learning spaces. *Journal of Education for Sustainable Development*, 13(2), 242–253. <https://doi.org/10.1177/0973408219873827>
- Souza, M., Francis, L. J., O'Higgins-Norman, J., & Scott, D. G. (Eds.). (2009). *International handbook of education for spirituality, care and wellbeing* (Vol. 3.) Springer Science & Business Media.
- Spain, S. (2019). Systems thinking applied to curriculum and pedagogy: A review of the literature. *Curriculum Perspectives*, 39(2), 135–145. <https://doi.org/10.1007/s41297-019-00085-1>
- Stevenson, R. B. (2008). A critical pedagogy of place and the critical place(s) of pedagogy. *Environmental Education Research*, 14(3), 353–360. <https://doi.org/10.1080/13504620802190727>
- Tagore, R. (1961). *Towards universal man*. Asia Publishing House. (Original work published in 1906).
- Tan, E., Wanganoo, L., & Mathur, M. (2023). Generation Z, sustainability orientation and higher education implications: An ecopedagogical conceptual framework. *Journal of Applied Learning and Teaching*, 6(1), 314–323. <https://doi.org/10.37074/jalt.2023.6.1.ss2>
- Tyack, D. B. (1974). *The one best system: A history of American urban education*. Harvard University Press.
- UNECE. (2012). *Learning for the future: Competences in education for sustainable development*. United Nations Economic Commission for Europe. https://unece.org/DAM/env/esd/ESD_Publications/Competences_Publication.pdf
- UNESCO. (2014). *UNESCO roadmap for implementing the global action programme on education for sustainable development*. <https://unesdoc.unesco.org/ark:/48223/pf0000230514>
- UNESCO. (2021). *Getting every school climate-ready. How countries are integrating climate change issues in education*. <https://unesdoc.unesco.org/ark:/48223/pf0000379591>
- UNESCO. (2022). *Youth demands for quality climate change education*. <https://unesdoc.unesco.org/ark:/48223/pf0000383615>
- UNESCO. (2023). *Greening the future: Education for sustainable development*. <https://www.unesco.org/en/sustainable-development/education/greening-future>
- UNESCO. (2024). *Green School Quality Standard: Greening every learning environment*. https://unesdoc.unesco.org/ark:/48223/pf0000390028_eng
- University of British Columbia. (2024a). *Green labs program*. <https://sustain.ubc.ca/green-labs>
- University of British Columbia. (2024b). *Laboratories of tomorrow – foam recycling at the Museum of Anthropology*. <https://sustain.ubc.ca/laboratories-tomorrow-%E2%80%93-foam-recycling-museum-anthropology-0>
- University of Toronto. (2024). *The sandbox*. <https://www.artsci.utoronto.ca/faculty-staff/experiential-learning/>

University of Waterloo. (2024). *Sustainability living lab*. <https://uwaterloo.ca/sustainability-living-lab/get-inspired>

Vander Ark, T., Liebttag, E., & McClennen, N. (2020). *The power of place: Authentic learning through place-based education*. Association for Supervision & Curriculum Development.

van der Wee, M. L. E., Tassone, V. C., Wals, A. E. J., & Troxler, P. (2024). Characteristics and challenges of teaching and learning sustainability-oriented Living Labs within higher education: A literature review. *International Journal of Sustainability in Higher Education*. <https://doi.org/10.1108/ijshe-10-2023-0465>.

Verhoeff, R. P., Knippels, M.-C. P. J., Gilissen, M. G. R., & Boersma, K. T. (2018). The theoretical nature of systems thinking: Perspectives on systems thinking in biology education. *Frontiers in Education*, 3. <https://doi.org/10.3389/educ.2018.00040>

Walker, J. D., Cotner, S. H., Baepler, P. M., & Decker, M. D. (2008). A delicate balance: Integrating active learning into a large lecture course. *CBE—Life Sciences Education*, 7(4), 361-367. <https://doi.org/10.1187/cbe.08-02-0004>

Wilson, E. O. (1984). *Biophilia*. Harvard University Press.

Wilson, E. O. (2002). *The future of life: ALA notable books for adults*. Vintage.

Winter-Simat, N., Wright, N., & Choi, J. H. (2017). Creating 21st century global citizens. A design-led systems approach to transformative secondary education for sustainability. *The Design Journal*, 20(Suppl. 1), 1651–1661. <https://doi.org/10.1080/14606925.2017.1352688>

York, S., Lavi, R., Dori, Y., & Orgill, M. (2019). Applications of systems thinking in STEM education. *Journal of Chemical Education*, 96(12), 2742–2751. <https://doi.org/10.1021/ACS.JCHEMED.9B00261>

Youth4Climate. (2021). *Youth4Climate manifesto*. <https://unfccc.int/sites/default/files/resource/Youth4Climate-Manifesto.pdf>

Yu, C. Y. (2024). Experiential learning for applying green patents in sustainable education. *Sustainability*, 16(15), 6591. <https://doi.org/10.3390/su16156591>.