Developing Ecologically Conscious Macro-Models Embedded in Gandhi's Educational Philosophy for Indian K12 Schooling: A Teacher's Handbook

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Suphala Chandorkar

Lakehead University

Faculty of Education

Dr. T. Puk (Supervisor)

Dr. E. Field (Committee Member)

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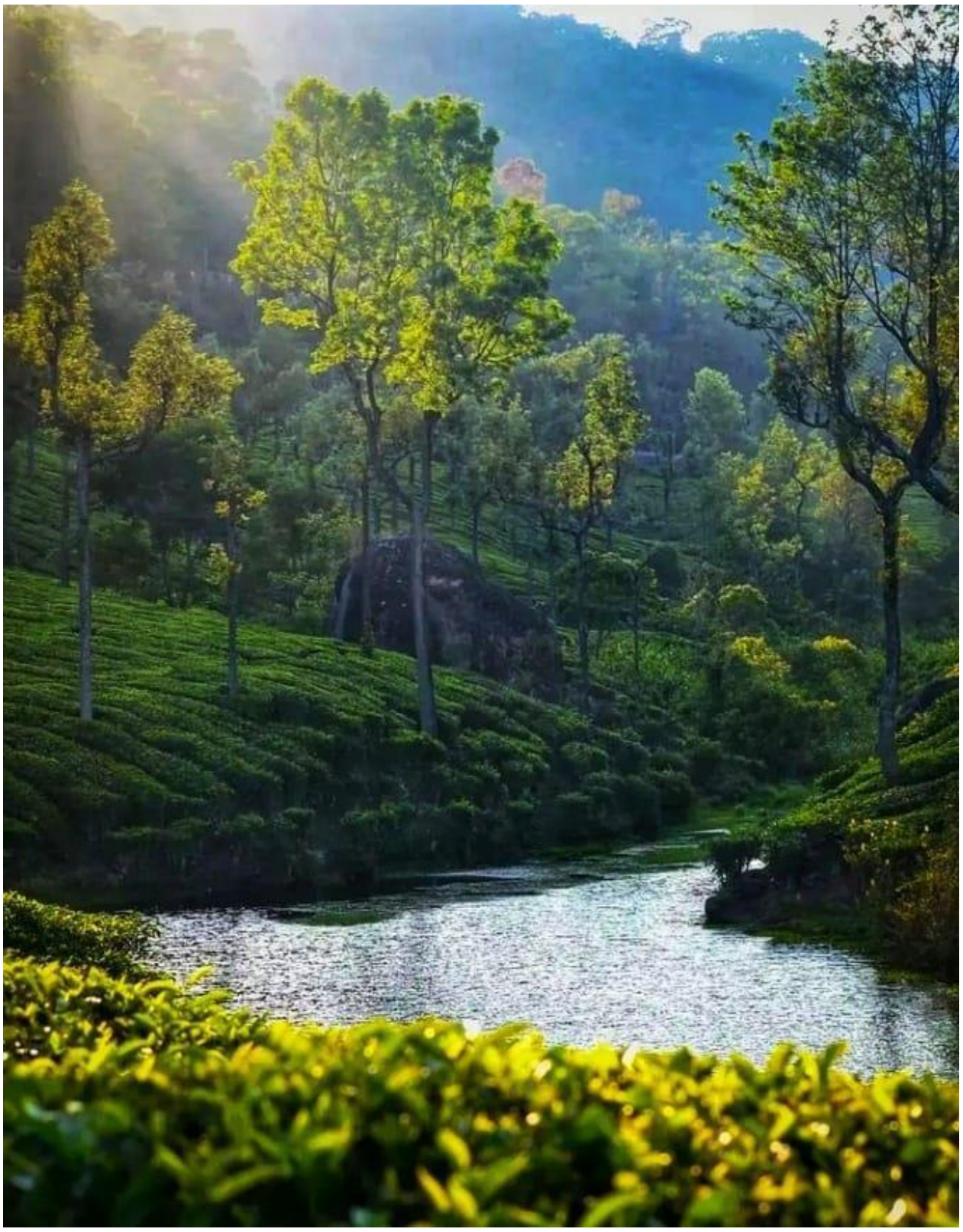

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Acknowledgment

I would like to begin by expressing my heartfelt gratitude to all the teachers and faculty members whose courses I had the privilege of taking throughout this program. Each course has contributed significantly to shaping my understanding and has provided the foundational knowledge needed to bring this portfolio to fruition. The diverse perspectives and insights shared during these classes have enriched my thinking and influenced the direction of this work.

I sincerely thank my committee member, Dr. E. Field, for their encouragement and assistance in completing this portfolio. I am especially grateful to my supervisor, Dr. Tom Puk, for his unwavering support, trust, and faith in my abilities. His willingness to grant me the autonomy to explore and pursue my topic in my own way has been invaluable, allowing me to navigate this project with a sense of ownership and creativity. Moreover, I am thankful to my friends, whose support and fresh perspective as outsiders provided invaluable insights. Their willingness to engage in discussions, test the ecological macro-models, and offer honest feedback helped me refine the activities and make them more effective and engaging.

Lastly, I would like to express my gratitude to the natural landscape of Thunder Bay. Many of my best ideas emerged during peaceful trail walks, where the tranquility of the surroundings offered clarity and inspiration for this project. This work would not have been possible without the support of the people and places that nurtured my creativity and vision.

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Nirvana Beach, Karnataka, India

Abstract

The need for a transformative approach to environmental education has become more pressing as traditional teaching methods often fail to foster deep ecological understanding and sustainable behaviors among students. This handbook was developed to address the disconnect between environmental knowledge and meaningful, action-oriented learning in Indian K-12 education. Drawing on Gandhian educational philosophy, the specific objective of this work is to create immersive, nature-based instructional activities that cultivate ecological consciousness, ecological literacy, and a kinship with nature (ecophily).

This handbook not only emphasizes the importance of integrating nature-based pedagogy into the curriculum but also provides practical instructional activities and guidelines. Thus, ensuring that nature becomes an active participant in the learning process, moving beyond being a mere backdrop to serving as a central element of experiential education. The handbook employs ecological macro-models, which are interactive, experiential representations of natural systems. These models engage students directly, allowing them to experience and internalize ecological processes through embodied learning. The design of these activities aligns with the National Education Policy (NEP 2020) of India and the National Curriculum Framework (NCF) of India, aiming to provide educators with practical tools that overcome challenges like fragmented integration of environmental education and a reliance on rote learning. This work concludes with guidelines and exemplars for incorporating ecological macro-models in the curriculum to foster lifelong environmental stewardship and holistic education.

Keywords: experiential learning, nai talim, ecological consciousness, ecological literacy, ecophily, ecological macro-model, nature-based pedagogy

Chapter I: Genesis

Through this portfolio, I intend to develop a handbook for Indian K-12 teachers, aiding them to harmonize ecological consciousness by drawing on Gandhi's (Nai Talim's) emphasis on the engagement of the head, hands, and heart. In particular, I have designed ecological macro-models that propose nature-based embodied instructional activities that scaffold ecological consciousness, empathy, kinship towards nature, and critical thinking among students while simplifying the abstract nature of scientific concepts.

The inspiration to develop this portfolio stems from a desire to equip myself with the skills to design instructional activities that place ecophily (Puk, 2021b) at the center. This is crucial for reducing the dissonance between climate change knowledge and an ecologically conscious lifestyle (Collado, Rosa, & Corraliza, 2020; Field et al., 2023; Gienger et al., 2024; Mackay & Schmitt, 2019; Puk, 2011; Spiropoulos et al., 2024; Stibbards & Puk, 2011). Moreover, implications of the Fourth Industrial Revolution, which has ushered in AI and virtual reality (Ahiaku & Muyambi, 2024; Ally & Perris, 2022), has led to learning in classrooms increasingly using technology and less learning occurring outdoors (Puk 2021b) which has negative implications on students' overall well-being. By designing these instructional activities, I aim to restore educational philosophies of Gandhi, Dewey, Freire, and Orr, who view the purpose of education as cultivating responsible citizenry. Gandhi (Shah, 2017) emphasized ethical and social responsibility, Dewey (1938) advocated learning through experience to engage with real-world issues, and Orr's (1991) idea that 'all education is environmental education' (p. 55) underscores the need for ecological awareness. Together, these perspectives highlight the importance of fostering environmentally engaged citizens to address the climate crisis. The concepts central to my portfolio are as follows: Gandhian approach to education, ecological literacy, ecological consciousness, ecophily, ecological macro-models, climate emotions, and anxiety (see Appendix for definitions). This portfolio

will provide practical examples that teachers can implement in a K- 12 setup, along with a guide on how to engage with the ecological macro-models. I am interested in designing five ecological macro-models for grades between 1-12.

My literature review exemplifies my inquiry process from ontology to praxis, supporting my research question: How can I develop instructional activities that offer real-world engagements fostering ecological consciousness and holistic development in students for both intrinsic and extrinsic reasons (with extrinsic being co-benefits such as preserving earth for the future)?

Brief Outline of the Handbook

This handbook is designed to serve as a practical guide for teachers in Indian K12 schools, equipping them with tools, strategies, and frameworks to integrate ecological consciousness into their pedagogy. It is crafted to support educators from various language mediums, focusing on science teachers who can easily adopt the ecological macro-models presented. Grounded in Gandhian educational philosophy, it emphasizes holistic, experiential learning that engages the head, hands, and heart of students. The aim is to bridge the gap between theoretical knowledge and real-world ecological practices, fostering a deeper connection between students and nature.

The handbook consists of the following four parts.

Chapter I: Genesis

This chapter introduces the handbook, created as part of the portfolio route of my Master's in Education program. It explains the origins of the project, emphasizing my motivation to address the gap in ecological education within Indian K12 schools. It also provides an overview of my background, including experiences and inspirations that shaped the development of this handbook. The chapter outlines key concepts central to the work, such as ecological literacy, Gandhian educational philosophy, and nature- based pedagogy. It sets the stage for the handbook's purpose: to offer practical tools for fostering ecological consciousness and experiential learning in school settings.

Chapter II: Literature Review

This chapter provides a review of educational philosophies and empirical research supporting the need for ecological literacy. It highlights Gandhi's Nai Talim and Dewey's experiential learning, both advocating for hands-on, student-centered approaches. The chapter discusses the importance of embedding ecological consciousness within school curricula, especially considering climate change. It explores the role of nature-based pedagogy in

enhancing critical thinking and fostering a deeper connection to the environment. These insights lay the groundwork for the instructional models presented in the handbook, aligning theory with the practical application of ecological concepts.

Chapter III: Ecological Macro-Models – Guidelines and Exemplars

This chapter begins by offering comprehensive guidelines for teachers on how to integrate ecological macro-models into their existing curricula effectively. The focus is on flexibility and adaptability, providing strategies tailored for diverse classroom contexts and varying student abilities across Indian K12 schools. Teachers are guided on how to customize, facilitate, and debrief the models to maximize student engagement and critical thinking. Following the guidelines, the chapter introduces five exemplar ecological macro-models designed to simplify complex scientific concepts through hands-on, immersive activities.

Chapter IV: Self Reflections

This final chapter reflects on the development process of the handbook, addressing both successes and challenges. It offers insights into the limitations and suggests areas for future refinement. Personal reflections are shared, highlighting the growth experienced throughout the project and the importance of adaptable, reflective teaching practices. The chapter concludes by emphasizing the ongoing need for ecological literacy in education and encourages teachers to evolve their approaches continuously. It serves as a call to action, urging educators to nurture an ecologically conscious mindset among students through consistent, nature-based engagement.

About the Author

"Cease conceiving of education as mere preparation for later life, and make of it the full meaning of the present life". (Dewey, 1893, p. 660). This quote by John Dewey has served as my guiding beacon, shaping the way I aspire to make meaningful contributions to the field of education. Growing up, I often felt out of place, as though I didn't belong to the rat race my school and society were preparing me for. In India, becoming a doctor or engineer was seen as the ultimate aspiration and the education system seemed geared exclusively toward that end. I always felt like a misfit in this narrow view of success, and that's how I found myself resonating with the field of social work. This realization led me to pursue a Bachelor's in Social Work (2013-2016). Through this program, I was exposed to diverse social work paradigms and approaches, and I quickly realized that education was the key to enacting the systemic change I aspired to see. Consequently, I pursued a Master of Arts in Education (2016-2018), where I deepened my understanding of global and Indian educational theories, child development, and various pedagogical methods.

It was during this time that I truly recognized the transformative power of education. Yet, coming from India—a land of immense cultural richness but also stark inequalities—I witnessed firsthand how quality education remains a distant dream for many. Despite progressive policy documents, the educational landscape often struggles with basic infrastructure and is entrenched in a colonial legacy of rote learning. Schools are frequently reduced to factories focused on churning out graduates for the job market, sidelining the holistic development of young minds.

This disconnect fueled my desire to challenge the prevailing "banking model of education," as Paulo Freire (1970) aptly described—a system where students are treated as passive recipients rather than active participants. I envision an alternative learning environment, one that honors local culture and prioritizes hands-on, experiential activities

such as farming, pottery, and traditional crafts. My aim is to cultivate a space where simplicity and contextual relevance take precedence over superficial technological fixes, and where students can engage deeply with their learning. This space would foster not only cognitive growth but also a sense of place, identity, and ecological consciousness.

Despite my academic experiences and fieldwork, I still consider myself a learner, continually refining my vision. This led me to Lakehead University's MEd program in Education for Change with a specialization in Environmental and Sustainability Education, where I found a mentor in Professor Tom Puk. His approach to environmental education was transformative, framing ecological consciousness not as a duty or crisis response, but as an intrinsic good—a natural, joyful way of being. Inspired by this perspective, I decided to focus on developing ecological macro-models: immersive, systems-based learning experiences designed to connect students with nature and foster a deep understanding of our interconnected world (more details will be featured in the following chapters).

As I continue on this path, I embrace the uncertainty and growth that come with exploring new ideas. My hope is to contribute to an educational landscape that views students not merely as future workers but as present, conscious beings capable of empathy, creativity, and ecological mindfulness. This portfolio reflects my experiences, aspirations, and commitment to creating an educational experience where, as Dewey envisioned, learning is not just preparation for life but life itself.

Figure 2

Kaziranga National Park, Assam, India

Chapter II: Literature Review

Embarking on this journey of examining the role of instructional activities in developing ecological consciousness has been deeply personal and transformative for me. My passion for education and commitment to fostering a more sustainable and conscious world have guided this exploration. Inspired by the philosophies of Gandhi and Dewey, I have come to appreciate the importance of integrating intellectual, emotional, and spiritual growth in education. Their collective wisdom underscores the need for a more integrated, meaningful, and contextually relevant educational paradigm.

In this literature review, I aim to weave together the insights from these visionary thinkers, exploring how their ideas can inform contemporary educational practices. By examining the intersections of their philosophies, I hope to illuminate pathways for developing instructional activities that foster ecological consciousness and holistic development in students for intrinsic and extrinsic reasons. This journey is not just an academic endeavor for me. It reflects my passion towards the disciple and love for the innate beauty it possesses. The literature sections are fluid and might not follow a sequential flow. The sections include Philosophical Underpinnings, Nature as a Pedagogical Tool, Ontology in Praxis, and Conclusion.

Philosophical Underpinnings

In this section, I try to lay out my ontology and the guiding principles that pushed me to examine the role of instructional activities in developing ecological consciousness. But before we even unravel these complex terminologies, such as ecology, ecological consciousness, and instructional activities, I want the readers to immerse themselves in the educational paradigm I conform to. why is it pertinent to examine the educational paradigm?

In my opinion, educational paradigms impact curriculum content, curriculum values, and how pupils are taught and evaluated. They dictate the roles that learners and educators play, and most importantly, they inform the goal of education. Hence, it is imperative to introspect about the purpose of education to substantiate why ecologically conscious instructional activities exist and how to do justice in designing them. Therefore, the works of Dewey and Gandhi will be discussed, leading to an understanding of embodied learning.

While discussing the goals of education and educational paradigms at large, it is imperial to start with Dewey's philosophy of education. In his early works entitled Self-Realization as the Moral Ideal, Dewey (1893) stated that:

> … and if I were asked to name the most needed of all reforms in the spirit of education, I should say: " Cease conceiving of education as mere preparation for later life, and make of it the full meaning of the present life". (p. 660)

Dewey mentions a significant paradox in his discussion of education; he highlights that focusing on the full meaning of the present life becomes the best preparation for future life, contrary to the conventional view that education should primarily prepare students for future stages of life. Gandhi also viewed education on similar lines, stating, "By education I mean all-round drawing out of the best in child's and man's body, mind and spirit. Literacy is neither the beginning nor the end of education. This is only a means through which man or woman can be educated." (Gandhi, 1937, p. 197).

Further expanding on education emphasizing extrinsic goals, Dewey (1938) contends that traditional education's rote memorization and rigid structures hinder students' moral and intellectual growth. Conventional education frequently disregards the active and dynamic character of learning by experience in favour of imposing information and discipline over the former. The educational philosophies of Gandhi and Dewey share several overlapping ideas.

Despite their distinct contexts and emphases, their thoughts converge on key principles regarding holistic education, experiential learning, and integrating moral and social values in education (Dewey, 1893, 1938; Shah, 2017). Interestingly, these authors also address a critical aspect of the education system - fragmentation. Gandhi criticizes the education system for its emphasis on rote learning and lack of integration, promoting an approach that combines intellectual, manual, and moral education (Tandon, n.d). Similarly, Dewey critiques the traditional education system for its rigid and disconnected structure, emphasizing the need for continuity and interaction in learning experiences (Dewey, 1938). Similarly, in *The Beautiful Risk of Education*, Biesta (2013) challenges the dominant perception of education as a system for producing predefined learning outcomes and identities, which he terms a "strong" view of education. Instead, Biesta advocates for a "weak" conception of education that embraces uncertainty, unpredictability, and the potential for events of "subjectification," where individuals resist pre-existing identities (p. 2). The book explores seven themes related to this idea of weak education: creativity, communication, teaching, learning, emancipation, democracy, and virtuosity. Biesta argues that subjectivity is not an essence but an event, making education inherently risky. Collectively, these thinkers argue for educational philosophies that foster interconnectedness, wholeness, and meaningful learning experiences.

Gandhi and Dewey advocate for pedagogical approaches emphasizing experiential, holistic, and integrative learning. Dewey (1938) champions experiential learning where education is rooted in real-world experiences, encouraging active engagement and reflective thinking to connect theoretical knowledge with practical applications. We see parallels between Dewey and Gandhi as Gandhi promotes his "Nai Talim" or "Basic Education" philosophy, integrating intellectual development with manual work and moral education, aiming for the overall development of the individual in a practical and relevant context (Shah,

2017). This approach underscores the importance of a balanced education that nurtures intellectual growth (head), emotional and moral development (heart), and practical skills (hands). Gandhi believed that intellectual development should be practical and connected to real-life activities. He emphasized that education should foster critical thinking and creativity rather than rote memorization. This intellectual component is essential for developing a person's reasoning and understanding the world. Moral and emotional development was crucial for Gandhi. He insisted that education should inculcate values such as truth, non-violence, empathy, and compassion. This aspect of education aims to build character and develop a sense of social responsibility and ethical behavior (Gandhi, 1937; Hindustani Talimi Sangh, 1938; Shah, 2017; Geethika, 2021).

His conceptualization of real-world experience, or, as Dewey would state, learning by doing, manifested through practical skills and manual labor, wherein he suggested engaging in physical work not only developed practical skills but also fostered dignity of labor and self-reliance (Shah, 2017). Activities like gardening, weaving, and carpentry were seen as essential parts of the curriculum, helping students connect their learning, with their community and environment. It is critical to note that Gandhi's educational philosophy was placed in the pre-independence British Raj era. His independence movements strongly circled around self-reliance and freedom. Thus, Gandhi's emphasis on practical, hands-on learning was a reaction to the inadequacies he perceived in the British educational system. He argued that true education should not only impart literacy and numeracy but also instill values of truth, non-violence, and self-reliance (Shah, 2017). In addition, Nail Talim advocates for "control over the mind" (Patil & Sinha, 2022, p. 45) as part of the principle of Swaraj—or self-rule—that fosters ecological empathy and self-restraint. In contrast to industrial education's exploitative nature, Gandhi's ideas promote simplicity and sustainable living,

aligning with the portfolio's ecological macro-models, which aim to cultivate ecological empathy and community responsibility through immersive activities.

According to Geethika (2021), "Gandhi firmly believed that only an inclusive and experiential educational system could help the young and the marginalized in freeing themselves to imbibe the true spirit of truth and non-violence" (p. 74). This idea, while rooted in moral values, holds great resemblance to what Dewey asserted, "It is a cardinal precept of the newer school of education that the beginning of instruction shall be made with the experience learners already have" (Dewey, 1938, as cited in Grady, 2003, p. 5). Therefore, positing that knowledge is socially constructed and that learning occurs through interactions within a social environment. Furthermore, while Miller (2007) uses terminology such as holistic education, he too addresses the mind, body, and spirit, fostering a sense of wholeness and well-being through experiential learning that connects different aspects of students' lives.

It would not be an overstatement to say that the discussed philosophies shared a common belief in the transformative power of embodied learning, emphasizing the importance of connecting education to real-life experiences, fostering holistic development, and promoting social responsibility. Their critiques of traditional education systems highlight the need for pedagogical approaches that are flexible, student-centered, and contextually relevant. These principles continue to inform contemporary educational practices, advocating for systems that prepare individuals not just for future careers but for meaningful and engaged lives.

Several modern educational theories have also explored the connections between physical activity and cognitive development. This leads us to embodied learning, which emphasizes engaging students' physical, emotional, and social aspects in the learning process, rather than relying solely on cognitive activities. In embodied learning, "students who consciously use their bodies to learn are more engaged than those who are at a desk or a

computer" (Paniagua & Istance, 2018, p. 118). This approach highlights that the brain, while important, is not the only source of behavior and cognition, situated cognition necessitates the inclusion of physical, emotional, and social elements in the learning environment (Paniagua & Istance, 2018). 'Embodiment' connects with 'lived experience' as the outcome of sensory engagement with the environment, suggesting that cognition is situated in the constant feedback between the person and their surroundings (Paniagua & Istance, 2018, p. 118).

Nevertheless, the above interpretation of embodied learning only scratches the surface of 'true' embodiment, highlighting the idea of 'absolute embodiment' rooted in the philosophies discussed so far.

Embodied learning, as defined by Puk (2023), is a pedagogical approach that emphasizes the importance of the body and sensory experiences in the learning process. This method suggests that learning is most effective when it involves the whole body and mind interacting with the natural world rather than relying solely on traditional, desk-bound methods (Puk, 2023). Puk (2023) argues that embodied learning integrates the physical, emotional, and social aspects of cognition, facilitating a more profound and engaging learning experience. Puk's definition corroborates the OECD's definition offered by Paniagua and Istance (2018). However, Puk (2023) further extends the scope of embodied learning by focusing on nurturing students' ecological consciousness and resilience by fostering a deeper connection with the natural world through active, sensory-rich engagement. He asserts that "multiple levels of brain and body appear to continuously interact in cognition," and that natural surroundings provide a rich context for this interaction, fostering a growth continuum through embodied experiences (Stephen et al. 2009, as cited in Puk, 2023, p. 205).

Moreover, Puk's concept of embodied learning builds on Dewey's principle that education should be based on continuity and interaction, where experiences build upon each

other and engage learners with their environment (Dewey, 1938). It also resonates with Gandhi's educational philosophy, which integrates intellectual, manual, and moral development, emphasizing the education of the head, heart, and hands to bring about civic consciousness (Hindustani Talimi Sangh, 1938)

Additionally, Puk's approach parallels Raboteau's (1995) call for re-enchantment in education, advocating for learning processes that reconnect students with a sense of wonder and the profound interconnectedness of life through engagement with nature.

Nature as a Pedagogical Tool

In this section, we examine how nature-based pedagogical practices manifest the educational philosophy of Gandhi and Dewey and embodied learning and its relevance in Indian Education. While one can contend that Gandhi does not explicitly promote nature-based pedagogy, it is vital to remind oneself that his philosophy for life underpinned his educational philosophy. Gandhi's idea of Swaraj (self-rule) pre-independence emphasized the perils of industrialization and consumerism (Tiwari, 2019, p. 141). While he addressed these issues through the lens of economics and the dignity of labor, he also critiqued environmental degradation caused by so-called modernization (Tiwari, 2019). Similarly, Tiwari (2019) also elaborates that Gandhi's Sarvodaya (universal upliftment) is an idea that is related to sustainable development and falls under the category of environmental ethics (p. 142).

Gandhi's concept of Sarvodaya suggests a "healthy development" that man might bring about to guarantee his coexistence in harmony with the natural world and other living things (p.142). Gandhi did not see distinct laws for distinct domains of human existence but rather viewed all domains as interwoven. His teachings and lifestyle align with modern eco-friendly practices and living in balance with the environment. Thus, unravelling this interconnectedness across his ideologies backed by his several educational flagships, one being Anand Niketan (home of happiness), a school immersed in Nai Talim philosophy,

imparts education through farming and gardening to foster the growth of a responsible citizenry, development of compassion, humility, respect for all living things, nonviolence, and reverence for mother earth. The school harnesses the surrounding environment and society as pedagogies and teaching-learning materials. Thus, India, being a 70 percent agrarian society, it offers education through farming, wherein concepts of science, mathematics, and geography are covered (Anand Niketan School, 2017).

Exposure to alternative schooling rooted in Gandhian philosophy developed a profound intrinsic motivation in me to explore learning through nature. While exploring the same, I got acquainted with pedagogical practices such as place-based pedagogy, nature-based pedagogy, and, most importantly, ecological literacy and ecological consciousness.

These latter two terms are pivotal to the portfolio and are discussed in this section. The intention of this section is to acquaint the reader with the inquiry process I underwent while engaging with the central themes of this portfolio. The ontology of learning by doing led me to embodied learning, wherein learning through head, hand, and heart is manifested through engaging with natural settings. This led to examining nature-based pedagogy, the need for ecological literacy, and ecological consciousness for being at the center of the said pedagogy from a micro (teaching-learning) to macro (climate crisis) perspective.

Nature-based pedagogy is an educational approach that integrates natural environments and outdoor activities into the learning process. This method emphasizes experiential learning through direct interaction with nature, fostering an understanding and appreciation of ecological systems. It integrates concepts from place-based education, which connects learning to local environments and communities, enhancing students' sense of place and ecological consciousness (Eryaman et al., 2010; Ardoin, 2006). Puk (2021b) argues that modern humans, particularly those frequently using digital screens, are increasingly disconnected from their ancestral connection with natural processes. This disconnection may

lead to a distorted understanding of the world, limited to two-dimensional experiences provided by screens. In contrast, embodied experiences in nature involve three-dimensional, dynamic interactions that foster a deeper ecological consciousness and holistic development (Puk, 2021b).

Further, nature-based pedagogy fosters meaningful learning by providing students with hands-on experiences that bridge theoretical knowledge and practical application (Puk, 2012; Tozer, 2010). This approach enhances students' comprehension and retention of ecological concepts by immersing them in real-world contexts. Greenwood (as cited in Tozer, 2010) underscores the importance of place in education, noting that learning experiences grounded in local environments allow students to see the interconnectedness of their surroundings' ecological, cultural, and historical aspects, reflecting congruence with Gandhi. This holistic understanding is crucial for developing ecological literacy and critical thinking skills.

By connecting classroom learning with outdoor experiences, nature-based pedagogy creates a more dynamic and interactive learning environment that promotes deeper understanding and retention of knowledge (Ardoin, 2006). Puk (2012) further highlights the role of neurobiology in enhancing lifelong ecological literacy, suggesting that direct, embodied experiences with nature positively influence brain functions related to learning and memory.

> The body acts as both a filter of experiences coming from one's surroundings, affecting and altering neural development and cognitive processing as well as an instrument with which the mind reaches out and manipulates the external surroundings (one's environment) in order to affect the experiences which affect learning. (Puk, 2012, p. 4).

These experiences make learning more engaging and impactful, as students can observe and interact with natural phenomena firsthand. This direct engagement with nature fosters a deeper and more lasting understanding of ecological principles, as students are able to witness the complexities and interdependencies of natural systems (Tozer, 2010; Puk, 2012).

Puk (2021b) discusses how these emotional connections are essential for promoting sustainable behaviors and fostering a sense of ecological identity. He argues:

> *Ecophily* (Puk 2020; Puk and Stibbards 2011a) is the identifying and embracing kinship and connection with natural processes that humans feel as small processes within much larger processes. This feeling of kinship is towards other lifeforms (not just animalia but also plants, fungi, protist, bacteria and archea) and also more broadly, the feeling of connection with our sensory and emotional relationship with the abiotic components of earth (e.g the smells, touch, and sounds of rock and earth, valleys and rivers, photons and wind) (Puk, 2021b, p. 60)

Maki reinforces the significance of emotional connections to nature in fostering eco-consciousness. Maki (2020) highlights that an emotional bond with nature is crucial for developing a sense of responsibility and commitment to environmental stewardship.

This integrated perspective of Greenwood (as cited in Tozer, 2010) and of Puk, reinforced by Maki, underscores the multifaceted nature of cultivating ecological consciousness through nature-based pedagogy. Together, they suggest that fostering ecological consciousness requires a holistic approach that combines cognitive understanding with deep emotional engagement (Maki, 2020; Puk, 2012, 2021a, 2021b, 2023; Puk & Stibbards, 2011; Tozer, 2010).

By creating educational experiences that are rooted in local environments and emphasize direct, embodied interactions with nature, educators can cultivate a deep sense of ecological consciousness in students. Moreover, according to Puk (2023), nature-based learning offers numerous benefits, including developing resilience, adaptability, and self-regulation in children. Findings suggested that nature also provides restorative effects, promoting mental and emotional well-being by reducing stress and enhancing physical health (Puk, 2023). Additionally, socially, outdoor play encourages collaboration and reduces competitiveness (Puk, 2023). Lastly, nature-based learning brings joy and excitement, enhancing overall happiness and engagement (Puk, 2023). Therefore, this approach not only enhances academic learning but also promotes environmental stewardship, social-emotional development, and a lifelong commitment to sustainability.

In conclusion, nature-based pedagogy embodies the educational philosophies of Gandhi and Dewey by emphasizing experiential, holistic, and integrative learning. Gandhi's integration of intellectual, manual, and moral development, incorporates body and sensory experiences in the learning process. Dewey's principles of continuity and experience are also reflected in embodied learning, therefore converging ontology into practice. Further, by fostering deep ecological consciousness, emotional connections, and holistic development, nature-based pedagogy represents a profound shift from traditional education, nurturing well-rounded, environmentally conscious learners in harmony with their natural surroundings, who are cognitively, physically and emotionally engaged during learning process.

Need for Education Embedded in Ecological Literacy and Ecological Consciousness

D'Souza, Brahme, and Babu (2020) argue that the curriculum in Indian education often treats environmental topics as peripheral, reinforcing an "anthropocentric bias" that distances students from a deeper ecological connection (p. 176). Such an approach is counterproductive for developing ecological consciousness and empathy. Instead, Ehrenzeller

and Patel's (2024) eco-peace education model advocates for a shift from anthropocentrism to "eco-centered epistemologies" that promote learning with and within nature, aligning with Gandhi's emphasis on interconnectedness and ecological ethics (p. 2). This eco-centered approach fosters relational and empathetic learning, treating students as integral parts of ecosystems rather than mere observers. Similarly, Puk and Makin (2006) emphasize the importance of fostering ecological literacy through daily engagement with ecological systems, particularly in outdoor settings. They argue that traditional indoor learning limits students' ability to develop a meaningful ecological consciousness, as ecological topics often receive "a minimum of watered-down attention" in classrooms, despite their global importance (p. 274). The current National Curriculum Framework Draft 2023 (NCF) of India addresses the challenge of watering down the learning experience by suggesting a more direct experience approach. However, the National Curriculum Framework of 2005 also emphasized environmental sustainability; despite that, there were several implementation challenges that did not mitigate to date. Hence there is a likelihood that the integration of environmental education within the NCF 2023 is likely to be hindered by critical challenges. For example - teachers might struggle to synthesize environmental content meaningfully, which leads to fragmented learning experiences as environmental themes are spread across multiple subjects without cohesive instructional strategies (Shin & Akula, 2021, p. 279). This approach's effectiveness depends on teacher preparedness and pedagogical capacity; however, many teachers lack the specialized training and ecological knowledge required to integrate environmental concepts effectively (Shin & Akula, 2021, p. 283). Consequently, environmental education risks being treated as an add-on activity rather than a fully integrated subject within the curriculum. Additionally, while students participate in practical activities, such as tree planting or waste segregation, these often emphasize individual actions over systemic ecological issues like climate change, biodiversity loss, and sustainable

development, resulting in a conceptually shallow understanding of environmental challenges (NCERT, 2023, p. 38). The disjointed learning progression within the NCF also poses a risk; inconsistent implementation across schools can lead to uneven exposure to environmental topics, resulting in a patchwork approach to learning rather than a structured progression (Shin & Akula, 2021, p. 286). Ecological macro-models present a comprehensive solution to these limitations, offering immersive, systems-based learning experiences.

Ecological consciousness is a concept championed by various scholars, notably Puk and Stibbards, who emphasize the significance of experiential and embodied learning in fostering this deep-seated ecological awareness among students and educators alike. Puk (2021a) stated, "Ecological literacy will not occur by having these activities "integrated" and "infused" into other subject matter" (p. 39). Puk propels ecological literacy in his work as a first imperative in education. It involves understanding the intricate interconnections between natural and human systems and the implications of these connections for sustaining life on Earth. Puk (2021a) emphasizes that ecological literacy is more than just knowledge. Rather it encompasses the capacity to make informed decisions supporting the health of ecosystems and human communities. He defines:

> the capacity to make informed decisions about the future of life based on a comprehensive, gestalt-like understanding of the reciprocal relationship between natural systems and human systems. (Puk, 2021a, p. 132).

Ecological literacy for Puk (2021a) is the stepping stone toward ecological integrity and a stage along the way of ecological consciousness, the former being "… the act to make a commitment to preserve the resilience of natural systems and their capacity to assimilate and rejuvenate as they continue to change…"(p. 132).

Puk (2021a) defines *ecological consciousness* as "a world-view and a lifestyle" characterized by a "connecting presence with natural processes." This holistic approach

means that ecological consciousness influences daily decision-making and encourages behaviors that sustain and protect environmental quality (Puk, 2021a, p. 6). Puk and Stibbards (2011) advocate for educational frameworks that integrate ecological macro-models to achieve this. These macro-models provide immersive, hands-on learning experiences, helping students develop a tangible and emotional connection to ecological processes.

Furthermore, having an emotional connection with nature, or ecophily also supports in dealing with climate anxiety. According to Kelsey, "children are suffering emotional and psychological anguish not always from their direct lived experiences but in anticipation of an apocalyptic future they think is inevitable" (Kelsey, 2020, as cited in Field et al., 2023, p. 157).

> *Climate anxiety*, can be understood as heightened distress related to the climate crisis that is characterised by a constellation of strong and interconnected emotions such as worry, fear, sadness, anger, and powerlessness… Climate anxiety is future-oriented and related to eco-anxiety more broadly…The lived experiences of climate emotions and climate anxiety are influenced by numerous factors including geographic and social location, experiences of climate impacts, sense of agency and efficacy, and knowledge of climate change and climate injustice (Galway & Field, 2023, p. 1).

Ecological Literacy – First Imperative. Climate change refers to significant global temperature and weather changes primarily due to human activities such as burning fossil fuels, deforestation, and industrial processes (Field et al., 2023). The systemic impacts of climate change are profound, including ocean acidification, melting glaciers, rising sea levels, biodiversity loss, and increased frequency of extreme weather events (Field et al., 2023). These changes threaten food security, health, and the stability of ecosystems worldwide, highlighting the urgent need for comprehensive educational approaches to address these issues.

Consumerism, driven by industrialization and the pursuit of material wealth, significantly contributes to environmental degradation. Gandhi critiqued this model of development for its unsustainable exploitation of natural resources and emphasized the need for a simpler, self-sufficient lifestyle that respects natural limits (Pathak, 2004; Pande, 2023). As Gandhi articulated, "True development should enhance human well-being without depleting natural resources or harming the environment" (Pande, 2023, p. 19). His philosophy of non-violence, self-reliance, and sustainable development provides a framework for addressing the root causes of the environmental crisis.

Education plays a crucial role in mitigating the climate crisis by increasing awareness and understanding of environmental issues. Integrating climate change education into the core curriculum empowers students to take informed actions towards mitigation and adaptation. As Shashidhara (2019) notes, "Education can equip students with the knowledge and skills necessary to address environmental challenges effectively" (p. 1026). Field and Spiropoulos (2023) emphasize that climate change education within Canada's regional context has been instrumental in shaping environmental policies and fostering public awareness. They argue that "ecological literacy must be prioritized in educational agendas to effectively combat the climate crisis" (Field et al., 2023, p. 87).

Developing ecological literacy through education is essential for preparing future generations to address the climate crisis. Place-based education can help support children's emotional connection to nature, fostering a sense of environmental stewardship and responsibility. As Ardoin (2006) highlights, "A sense of place is lauded as critical to developing an environmentally conscious and responsive citizenry" (p. 112). By integrating place-based and experiential learning approaches, and drawing on Gandhian principles of sustainability and self-reliance, education can cultivate a profound ecological consciousness and drive meaningful environmental action. Furthermore, Puk's (2012) findings also suggest

that in order to be able to accept and promote change as a meta-value—especially when dealing with change involving the reciprocal relationship between natural systems and human systems—we can hopefully influence the development of neural networks and cognitive representations during the early years, and in particular in the years leading up to puberty. Hopefully, once adulthood is reached, those meta-values will kick in naturally (p. 8).

In summary, addressing ecological literacy in education is crucial for equipping students with the knowledge and skills necessary to tackle the climate crisis effectively. By fostering deep ecological consciousness, emotional connections, and holistic development, nature-based pedagogy represents a profound shift from traditional education, nurturing well-rounded, environmentally conscious learners in harmony with their natural surroundings, while being physically, cognitively, emotionally, socially engaged and enchanted in the learning process.

Ontology in Praxis – Adopting a Meta Perspective

It is pivotal to draw congruence between ontology and curriculum, as in educational systems, curriculum acts as a directive principle to establish the learning objectives, syllabus, role of teachers and students, and assessment. As the heading suggests, this section discusses how the stated ontology and pedagogy can be manifested into instructional activities. Further, elaborating on fundamentals for designing instructional activities to truly embody theories discussed up until now. This portfolio's ontological framework emphasizes education as an interconnected system, where ecological, social, and individual dimensions are intertwined.

Therefore, hereon, I will indulge the readers into the basics of Transformative Ecological Education and Ecological Macro-Models, their definitions, significance, and steps on how to develop them. This section ties up the entire portfolio literature by providing axiology i.e. what to value, and methodology i.e. how to execute instructional designs that engage head, hands, and heart, while immersing in nature-based learning activities that create

systemic impacts, ranging from academic concept clarity, overall well-being, environmental stewardship, deeper appreciation for nature and responsible citizenry.

Gandhi and Dewey discuss fragmentation in their respective time's educational systems. This fragmentation was also noted in the Indian curriculum, which still unfortunately prevails. Gandhi asserted that different subjects should be in the form of correlated knowledge and not in the form of separate subjects (Hindustani Talim Sangh, 1938).

Similarly, Grady (2003) explains, "Dewey argued that organizing content into isolated subjects gives students difficulties in integrating their knowledge into real-life situations" (p. 4). Nature-based pedagogy caters to these concerns when addressed from an ecological consciousness standpoint, as suggested by Puk (2021a), wherein he designed a "continuous ecological curriculum that contains sequenced lessons" (p. 39). Secondly, he recommends utilizing ecological education not just as a base but also serving as a context for connecting with other subjects (Puk, 2021a, p. 119), through Transformative Ecological Education (TEE), a comprehensive approach designed to cultivate ecological consciousness by integrating various academic disciplines. TEE aims to replace traditional environmental education, studies, and science with a more holistic and integrated meta-perspective encompassing sciences, history, arts, mathematics, language, economics, health, philosophy, aesthetics, and ethics. This integration is intended to provide a broad and interconnected understanding of ecological concepts and their relationships, focusing on both the "big picture and the details" (Puk, 2021a, p. 115). Further, TEE emphasizes that the environment should not be seen as a separate physical space but as an integral part of human existence. Human beings are part of the natural order, sharing the same elements as all other entities on Earth. Therefore, TEE involves the study of the transfer and use of solar energy and the basic elements affecting all aspects of life (Puk, 2021a, p. 115). This approach encourages students

to understand and respect the complex relationships within the ecosphere and to recognize their role in maintaining ecological balance. What is intriguing here are the principles guiding TEE, while not mentioned explicitly they corroborate with the worldviews of Gandhi as described in Nai Talim. The following are the principles as stated by Puk (2021a):

Reciprocal Relationships: At the core of TEE is the emphasis on reciprocal relationships between natural processes and human systems. This principle shifts the focus from traditional outdoor education or physical pursuits to understanding the interconnectedness of all life. TEE integrates various disciplines to highlight these relationships, ensuring that ecological education is not just about studying flora and fauna but recognizing humans as integral components of ecological systems (Puk, 2021a, p. 115).

Humans as Part of Ecological Systems: TEE emphasizes that humans are a subset of fauna, inherently part of ecological systems rather than separate entities. This perspective encourages a holistic view of the environment, where human activities and natural processes are seen as interconnected and interdependent. This approach contrasts with traditional environmental education, which often isolates human activities from natural systems (Puk, 2021a, p. 115).

Function Before Issues (FBI): A critical principle of TEE is the concept of "Function Before Issues" (FBI), which prioritizes understanding the functioning of ecological systems before addressing the problems associated with them. This approach helps prevent the feelings of helplessness and depression that can arise from confronting the overwhelming negative aspects of environmental issues. Instead, TEE emphasizes the beauty, complexity, and functionality of natural systems, engaging learners in fun and exciting activities that build ecological literacy through nature-embedded, embodied experiences (Puk, 2021a, p. 115).

TEE advocates for presenting ecological education in a manner that highlights the beauty and complexity of natural functions before introducing heavy issues. This strategy

ensures that learners, particularly children, do not become disheartened by the severity of environmental challenges. By first appreciating how natural systems work, learners develop a sense of awe and respect for these systems. This foundational understanding provides the context for later discussing more serious ecological issues, always with a focus on viable solutions rather than problems alone (Puk, 2021a, p. 115).

Sensitive Curriculum Development: Developing a sensitive curriculum is essential in TEE, particularly in navigating the vulnerable transitional space between function and issue. This curriculum must be carefully designed to foster emotional stability and hope in the face of ecological challenges. By building ecological consciousness through communal and experiential learning, TEE aims to empower individuals with the knowledge, skills, and values needed to make informed decisions about the future of life on Earth. This approach ensures that ecological literacy and consciousness are not only educational goals but also sources of empowerment and hope (Puk, 2021a, p. 115).

TEE, in practice, is visualized by Puk (2021b) through macro-models. *Ecological Macro-Models* are "analogous representations of natural processes and human systems" where learners actively participate to better understand and internalize these systems (Puk, 2021a, p. 155). The primary purposes of ecological macro- models are to create a rich context for conceptual understanding and to develop lasting internal "mental emotional image" of the systems being studied (Puk, 2021a, p. 155). These models allow learners to use multiple senses and develop emotional responses, making the learning experience more meaningful and memorable compared to passive methods such as lectures or media consumption (Puk, 2021a, p. 155).

The ecological macro-model approach is based on three main foci: complexity, emergent properties, and embodied cognition. They describe this approach as transformative, noting that it goes beyond traditional information-transmission methods by engaging students

in active, experiential learning. This method encourages students to explore and internalize ecological principles through direct interaction with their environment. They state that "Ecological macro-models are analogous representations of ecological and human systems or components of these systems in which the learner actively plays a role in order to better understand and internalize how these systems work" (Puk & Stibbards, 2011, p. 195).

> Waste, entropy, fossil fuels, hydrogen fuel cells, photosynthesis, nuclear energy, and organochlorines are a few examples of these macro-models. A conceptual shift that encourages the creation of "mental organisational structure that facilitates the retrieval and effective application of [the learner's] knowledge" is made possible by these embodied and emergent macro-models (Puk & Stibbards, 2011, p. 195).

The methodology of ecological macro- models involves placing learners in outdoor settings to take advantage of naturally stimulating contexts. This approach reduces the reliance on technology, thereby avoiding the numbing effects described by McLuhan, where new media can detach individuals from direct, embodied experiences with natural systems (Puk, 2021a, p. 155). By engaging in these ecological macro- models, learners participate in movement-based, fun-filled activities that enhance their understanding of ecological systems and foster community building and teamwork (Puk, 2021a, p. 155).

Ecological macro- models also function as emergent, non-linear, self-organizing learning experiences. They are designed to mimic natural systems, where diversity and complexity lead to optimal resilience and conceptual understanding (Puk, 2021a, p. 155). These models are not rigidly controlled by instructors but are influenced by the parameters set for the activity, allowing for spontaneous and diverse learning experiences. This approach helps learners synthesize meaning from ever-changing stimuli and develop adaptability and problem-solving skills (Puk, 2021a, p. 156). Ecological macro-models place learners in unfamiliar, dynamic environments that challenge their usual ways of thinking and encourage

the development of adaptability and creative problem-solving skills. This rich context, devoid of written text and electronic images, stimulates imagination and internal image creation, fostering deeper conceptual understanding and emotional development. The outcomes of participating in ecological macro-models include a deeper understanding of ecological systems, improved self-efficacy, enhanced teamwork, and a strengthened sense of community (Puk, 2021a, p. 156). He further provides detailed guidelines on the process of developing macro-models (Puk, 2021a, pp. 159- 160):

i. Inspiration and Introspection to Identify Topics

   Employing Unconscious Radar: Continuously look for ideas that are critical to ecological literacy and can be transformed into experiential learning activities.

   Observing Others: Watch how others interact with ecological systems and ask questions to determine their level of ecological literacy.

   Examining Personal Lifestyle: Reflect on one's own behaviors and lifestyle choices that impact the environment, fostering curiosity to understand and explain ecological complexity.

ii. Types of Ecological Macro-Models

   Type A: Created from existing textual sources, such as industry texts, where content can be expanded into experiential learning activities.

   Type B: Developed from general ecological knowledge, such as water contamination or interconnections within ecosystems.

   Type C: Inspired by previous activities used for other purposes, combined with new information to create a comprehensive learning model.

iii. Model-Building

Initial Rational Internal Images: Sketch initial ideas on paper using processes like the Extrarational Learning Sequence to create a vivid representation of complex processes.

Directed Playfulness and Incubation: Use playful thinking to refine the model, allowing for several drafts before finalizing the design on a computer.

iv. Level of Complexity

Simplicity and Gradual Complexity: Start with simple rules and gradually introduce complexity, ensuring the core meaning of the model is not lost.

v. Parameters of Playing Area

Realistic Visualization: Visualize the area where the macro-model will be played, ensuring it fits within real parameters and can influence the model's development.

Ambiguous Boundaries: Use flexible boundaries and rules that are not overly complex, enabling the model to fit various situations.

vi. Audience Consideration

Age and Education Level: Tailor the model to the specific age and education level of the audience, such as preservice teachers, secondary students, or community members.

vii. Style

Unique Movement Styles: Avoid repeating styles of movement, creating unique and contextually appropriate activities for each model.

viii. Priority Topics

Understandable and Critical Topics: Begin with topics that are easily understood, such as water usage or photosynthesis, then move to more complex issues like nuclear effects or interconnections.

ix. Balance

Active and Passive Models: Balance active models with less physically demanding ones to cater to different learning styles and preferences.

x. Inclusiveness

Non-Competitive: Ensure all macro-models are inclusive, avoiding overly competitive elements that might exclude participants.

xi. Resources

Simple and Sustainable: Design models that use simple, sustainable resources, minimizing waste and environmental impact.

xii. Refinement

Mental Visualization: Continuously visualize the macro-model, anticipating potential problems and outcomes to refine the experience.

Directed Incubation: Engage in relaxing or aesthetically pleasing activities to allow the subconscious to refine the model.

xiii. Re-Examining Previous Models

Thought Process Analysis: Review previous model drafts to observe thought progression and improve the design process.

Conclusion

In conclusion, the current literature underscores the necessity of education, as Gandhi and Dewey advocated. These educational philosophies collectively emphasize lifelong learning, civic responsibility, immersive and contextual education, and the comprehensive development of the head, heart, and hands. The purpose of education, as synthesized from these philosophies, is to foster all-around development, reflective practices, and an awareness of the interconnectedness of life, thus preparing students to address contemporary challenges and thrive in a complex world. Gandhi's Nai Talim integrates intellectual development with manual work and moral education, emphasizing the containment of needs and being aware of

the ramifications of modernization (Pathak, 2004; Pande, 2023). Dewey emphasized experiential learning, where education is rooted in real-world experiences that encourage active engagement and reflective thinking (Dewey, 1938). In the Indian Education context, Shin and Akula (2021) highlight systemic challenges in environmental education, noting that the fragmented approach often leaves teachers feeling unprepared to teach ecological literacy deeply. They emphasize that limited professional development and curricular support restrict teachers' ability to foster "depth and linkages" in ecological education (p. 278). Puk and Makin's (2006) research in Ontario further reveals the need for comprehensive training for teachers in ecological literacy, as a lack of preparation often limits their confidence and effectiveness in teaching these topics (p. 272).

Further, the literature amply signifies how TEE integrates these principles into a practical approach that addresses climate issues and promotes ecological consciousness (Puk, 2021a, p. 115). Puk's ecological macro-models create rich, experiential learning contexts that foster deep emotional and cognitive connections to nature through hands-on, sensory-rich experiences (Puk, 2021a, p. 155). These models emphasize the beauty, complexity, and resilience of natural systems while promoting emergent learning and reflective practices, helping learners understand ecological functions before addressing critical issues.

Transformative Ecological Education (TEE) addresses the purpose and pedagogical approaches laid out by Gandhi and Dewey by emphasizing reciprocal relationships between natural processes and human systems, viewing humans as integral parts of ecological systems, and prioritizing the understanding of ecological functions before addressing issues. TEE's focus on experiential, nature-embedded, and sensory-rich learning environments encapsulates the holistic, integrative, embodied, and reflective practices. TEE offered through ecological macro-models also effectively translates these ontological principles into

actionable praxis by immersing students from a young age in natural settings to foster their all-around development and civic modality while demystifying abstract scientific concepts.

Moreover, the portfolio also attempts to bridge these gaps by designing ecological macro-models, offering structured activities that support inquiry-based, immersive learning, and encouraging students to explore and engage with interconnected ecological systems. By aligning with Ehrenzeller and Patel's (2024) call for "eco-centered" (p. 2) learning or Puk's Ecophily to address today's ecological crises and advocating for education that fosters deep ecological empathy and sustainability. Therefore, preparing students to navigate and address the intricacies of our interconnected world with ecological literacy and consciousness without feeling bogged down by the severity of the issue.

Figure 3

Pichavaram Mangrove Forest, Tamil Nadu, India

Chapter III: Ecological Macro-Models – Guidelines and Exemplars

Part I: Implementation Guidelines

Consolidating the Indian National Education Policy 2020's recommendation that "[s]tudents will be taught at a young age the importance of 'doing what's right'… respect for environment…" (Ministry of Human Resource Development, 2020), the handbook utilizes nature-based embodied instructional activities. These activities offer a unique opportunity for students to develop ecophily, fostering a deep connection to nature while engaging with core academic concepts. Below are implementation guidelines on how to effectively use the ecological macro-models presented in the handbook.

1. Familiarize Yourself with Key Concepts: Start by reviewing the key concepts in the handbook, including ecological literacy, nature-based pedagogy, and experiential learning. This foundational understanding is crucial for delivering the activities with clarity and aligning them with the broader objectives of fostering ecological awareness in students.
2. Review the Sequence and Plan Ahead: Before starting the activity, thoroughly review the sequence of steps outlined in the macro-model. Understand the flow of the activity and ensure you have all the required materials and equipment ready. Familiarize yourself with each station (e.g., Sun, Cloud, Lake, Land) and the transitions between them. This preparation will help you provide clear and confident instructions to the students.
3. Time Management: Effective time management is crucial for implementing the ecological macro-model activities. Start with a brief 5-minute introduction, providing an overview of the key topic to capture students' interest. You can introduce the topic in the prior class if more time is needed. Follow with 8 minutes for instructions and group setup, clearly explaining the roles, sequence, and

stations involved . Consider a quick demonstration or trial round to clarify the flow. Dedicate the bulk of the time— 20 minutes—to the main activity. Conclude with a 7-minute debriefing session, asking reflective questions that help students connect the activity to the underlying scientific concepts. This balanced approach ensures a smooth, engaging experience while maximizing the limited class time.

4. Introduce the Topic While Leaving Room for Discovery: Before beginning the activity, provide a brief introduction to the topic, setting the stage without giving away all the answers. This initial context-building helps students understand the purpose of the activity while leaving space for self-discovery. By allowing students to explore and form their own conclusions, you foster curiosity and critical thinking.
5. Provide Clear and Concise Instructions: Gather the students and explain the activity step by step. Make sure to use simple, age-appropriate language to ensure all students understand.
6. Demonstrate the Layout and Run a Trial Round: Physically show the students where each station is located (e.g., outline the Sun, Cloud, Lake, and Land stations on the ground). Walk them through the sequence, explaining what they are expected to do at each stage of the activity. If needed, run a quick trial round with a small group of students first. This practice session will help clarify the steps and give students a chance to get comfortable with the roles and transitions.
7. Strategically Divide the Class: Divide the students into teams based on the roles required by the macro-model. Ensure that the group assignments are balanced and that students do not only stay with their close friends. Mixing the groups helps promote collaboration, active participation, and a more inclusive learning environment.

8. Embrace the Energy: Expect a lively atmosphere! Students may be laughing, cheering, or calling out to each other as they engage in the activity. This is a positive sign of their interest and enjoyment. Embrace the noise and enthusiasm as part of the learning experience, as it shows they are actively participating and engaged in the process.
9. Lead Reflective Debriefing Sessions: After the activity, facilitate a debriefing session using reflective questions from the handbook. This helps students consolidate their learning and connect the experience to broader ecological concepts. Use open-ended questions to encourage dialogue, critical thinking, and deeper reflection, allowing students to articulate their observations and learnings.
10. Summary of the Instructional Process: Implementing ecological macro-models (exemplars or self-created) is a three-stage process. First is to review the sequence of the ecological macro-models, brief students about the concept and the ecological macro-model, and demonstrate the flow of the ecological macro-model. Students can be re-directed if they make an error or seem confused during the immersive process. However, it is critical to design and implement an ecological macro-model in a self- organizing manner with the limited role of the teacher. This ensures that students are organically immersed and are present mentally, physically, and cognitively in the moment, i.e. conscious about the activity they are engaging in.

The user of the handbook can develop their own ecological macro-models. Here are some additional considerations to keep in mind when developing and implementing your own ecological macro-models:

1. Spend time in natural settings: Ecophily is not something that can be taught directly, but something that can be shared through our own delight for nature. Therefore, for

inspiration on designing ecological macro-models, go out in a natural setting, sit or walk for 10 minutes, and observe what catches your attention and what intrigues you, and you can build from there.

2. Adapt Models to Fit Your Classroom Context: The provided models are designed to be flexible. Teachers can adapt them based on:
    a. Class Size and Grade Level: Adjust the number of participants and complexity of the roles according to the students' age and understanding.
    b. Resource Availability: Use locally sourced materials or items already available in the classroom.
    c. Language Medium: Modify instructions and discussion prompts based on the language of instruction to ensure inclusivity and comprehension.
3. Identify the Core Topic: Choose a key ecological process or concept that aligns with your curriculum goals.
4. Focus on Key Components and Simplify the Model: Avoid overloading the macro- model with too many details. Break down complex topics into essential components, making sure each element contributes to the core learning objectives. Analyze why the topic is important and tailor the activity to emphasize those critical aspects. This focused approach makes the model more accessible and engaging for students.
5. Create Analogous Representations: Create simple, clear diagrams of the macro-model to help visualize the activity flow. These visuals are for your own understanding and preparation, aiding you in guiding the sequence of events effectively. Use the diagrams during planning and as a reference while facilitating the activity, but keep them straightforward to avoid overwhelming yourself or the students.

6. Choose Suitable Outdoor Locations: Engaging in nature enhances the authenticity of the learning experience. Depending on the topic, choose a natural setting that aligns well with the ecological concept being taught.
7. Ensure Sufficient Time and Simple Resources: Allocate enough time for setup, execution, and debriefing. Use simple, easy-to-find materials to keep the activity sustainable and accessible.
8. Promote Active Student Participation: Effective ecological macro-models require students to be active participants, not passive observers. Role-playing as elements like the sun, water droplets, or plants helps students embody the concepts, making the learning experience immersive and memorable. This nature-embedded, hands-on approach deepens their understanding and fosters a stronger connection to the topic.
9. Plan the Activity Sequence: Design a clear flow for the activity, breaking it into stages that are easy for students to follow and participate in.
10. Encourage Reflective Debriefing: After completing the macro-model activity, lead a debriefing session with reflective questions provided in the handbook. This helps students make sense of their experience, linking it back to scientific concepts and real- world ecological issues. Use open-ended questions to encourage critical thinking and dialogue, allowing students to share their observations and insights.

Part II: Ecological Macro-Models Exemplars

Ecological Macro-Model for Water Movement for Growth Sequence 2nd, 3rd and 8th Grade

Rationale

Water is the fundamental element that sustains life on Earth, driving the critical process known as the water cycle. This natural system circulates water through the atmosphere, land, and oceans, interconnecting clouds, rivers, and lakes and supporting the needs of ecosystems, plants, animals, and humans. However, the water cycle's delicate balance is vulnerable to disruption. The same water that nurtures life can also act as a carrier for pollutants introduced by human activities. When we pollute and over-extract water, harmful substances are reintroduced into the cycle, degrading soil quality, altering weather patterns, and posing risks to all living organisms. Despite its vital role, we often overlook the finite nature of water, jeopardizing the stability of this essential process.

Significance to Critical Picture

Understanding the water cycle is fundamental for building ecological literacy, as it highlights the natural processes that sustain life on Earth. However, recent studies show that the hydrological cycle is accelerating due to climate change, driven by increased greenhouse gas emissions. Evaporation rates are projected to rise by 5.2%, while precipitation may increase by 6.5% globally (Ehtasham et al., 2024). This intensification has led to more extreme weather events, including heavy rainfall, prolonged droughts, and frequent floods, severely disrupting water availability and quality (Ehtasham et al., 2024).

These disruptions are already evident, with several regions facing declining groundwater levels and increased salinity in water resources due to altered evaporation and precipitation patterns. For instance, flash floods have become more common, overwhelming local infrastructure and reducing the natural replenishment of groundwater reservoirs

(Ehtasham et al., 2024). Additionally, contamination from increased runoff carries pollutants into surface water, degrading water quality and harming both ecosystems and human health (Ehtasham et al., 2024). By being immersed in ecological macro-models, it is expected that students develop a kinship towards natural processes and eventually are more reflective and cognizant about their actions and their repercussions on the said processes.

Grade: **2**

Class size: **40**

Objective:

- To demonstrate water movement across natural systems
- To identify key elements in the process of the water cycle
- To identify stages involved in the process of the water cycle
- To identify the states of the water across the stages

Concepts:

Heat, Evaporation, Condensation, Precipitation

Equipment:

20 yellow-coloured balls and 10 green-coloured balls, chalk to draw/rope to outline stations on the ground/grass.

Sequence and Rules:

1. Draw 4 stations, namely the Sun, Clouds, Lake, and Land, on the ground with chalk or ropes as indicated in the diagram. Note: while the other stations can be as big or small, the cloud station should only be able to accommodate 6 members
2. 2 teams as follows:
    a. 25% of students as team Sun: 10
    b. 75% of students as team Lake: 30

3. Each member of team Sun stands in a straight line parallel to team Lake and Land
4. Each member of team Sun has all the balls divided equally
5. Lake team members stand in 6 rows of 5
6. The Sun members throw their energy (balls) into the Lake simultaneously.
7. The Lake members catch the ball and move to the Cloud station (representing evaporation). (Note: Instruct students to remember their ball colour)
8. Then they throw the ball inside the Sun station
9. After that, they stand inside the Cloud station holding hands together (representing condensation).
10. Once the Cloud station has 6 members, members move towards the last line of Lake station and land station as per the colour. (representing precipitation)
    a. Yellow: Lake
    b. Green: Land
11. Repeat the process until every member has travelled through the Cloud station once or twice, depending on class size. This is to depict the cyclical process of water movement.

Debriefing:

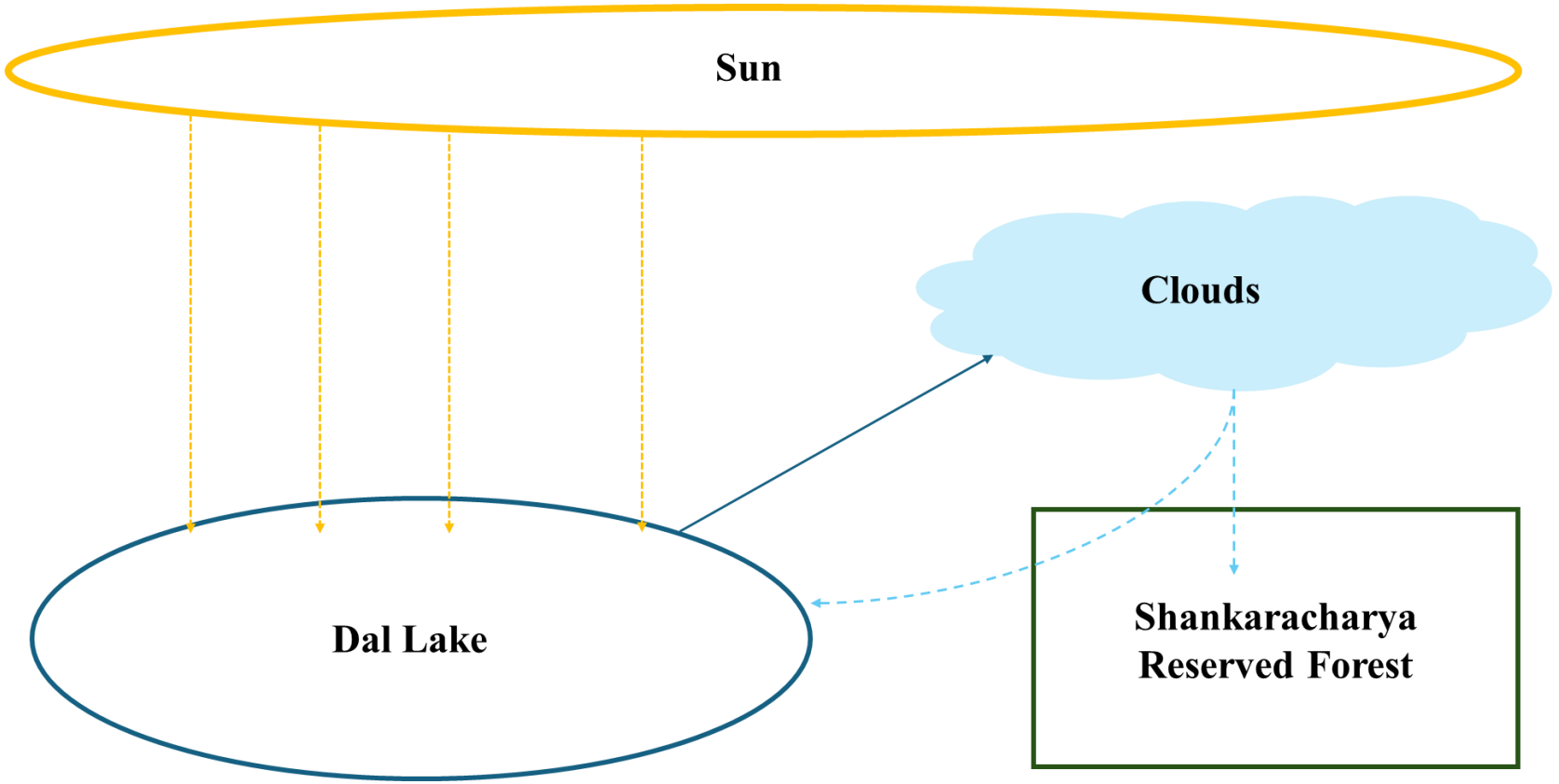
- What does the ball signify, irrespective of the colour?
- Where can you find water in natural surroundings?
- What makes the water in the lake move towards the clouds?
- How does water travel from the clouds to the lake or land?
- What forms can water take as it moves through the stations?

Intended Learnings:

- ✓ Students will understand the basic stages of the water cycle: evaporation, condensation, precipitation, and collection.
- ✓ Students will be able to visualize the movement of water.
- ✓ Students will develop a basic understanding of how water changes, forms, and moves through the natural surroundings.
- ✓ Students will develop an appreciation for the beauty of the water cycle.

Figure 4

Ecological Macro-model for Water Movement



Ecological Macro-Model for Transpiration

Grade: 3

Class size: 40

Objective:

- To demonstrate how plants obtain water for growth and survival

Concepts:

Infiltration, Transpiration

Equipment:

20 yellow-coloured yellow balls, 10 green-colour balls, chalk to draw/rope to outline stations on the ground/grass. Note: draw a distinct mark like a cross on 3 balls of each colour

Sequence and Rules:

1. Draw 5 stations, namely the Sun, Clouds, Lake, Land, and Underground water, on the ground with chalk or ropes as indicated in the diagram. Note: while the other stations can be as big or small, the cloud station should only be able to accommodate 6 members
2. 3 teams as follows
    a. 25% of students as team Sun: 10
    b. 50% of students as team Lake: 20
    c. 25% of students as team Plants: 10
3. Each member of team Sun stands in a straight line parallel to team Lake and Land
4. Each member of team Sun has all the balls divided equally
5. Lake team members stand in 6 rows of 5.
6. Plants stand in a single line facing lake station.
7. The Sun members throw their energy (balls) into the Lake simultaneously.
8. The Lake members catch the ball and move to the Cloud station (representing evaporation). (Note: Instruct students to remember their ball colour)
9. Then they throw the ball inside the Sun station

10. After that, they stand inside the Cloud station holding hands together (representing condensation).
11. Once the Cloud station has 6 members, members move towards the last line of the Lake station and Land station as per the colour of their ball. (representing precipitation)
    a. Yellow: Lake
    b. Green: Land
12. Once an entire row gets hit, the newly joined members in the Lake station who had a mark on their balls move to the Underground water station (representing infiltration)
13. The members that move towards land hold hands with plants (the hand that is facing team Sun)
14. Plants holding the hands of members with marks on their balls switch their hands and help them move to the Underground water station.
15. Once the Underground station has 10 members, plants extend their hands and pull these members towards them.
16. Repeat the process until every member has travelled through the Cloud station once.

Debriefing:

- Why did the members coming from clouds hold hands with plants ?
- Why did the plants switch hands when they were transferring rainwater underground?
- Why did plants extend their hands to pull members from the underground station?
- How does water help plants?

Intended Learnings:

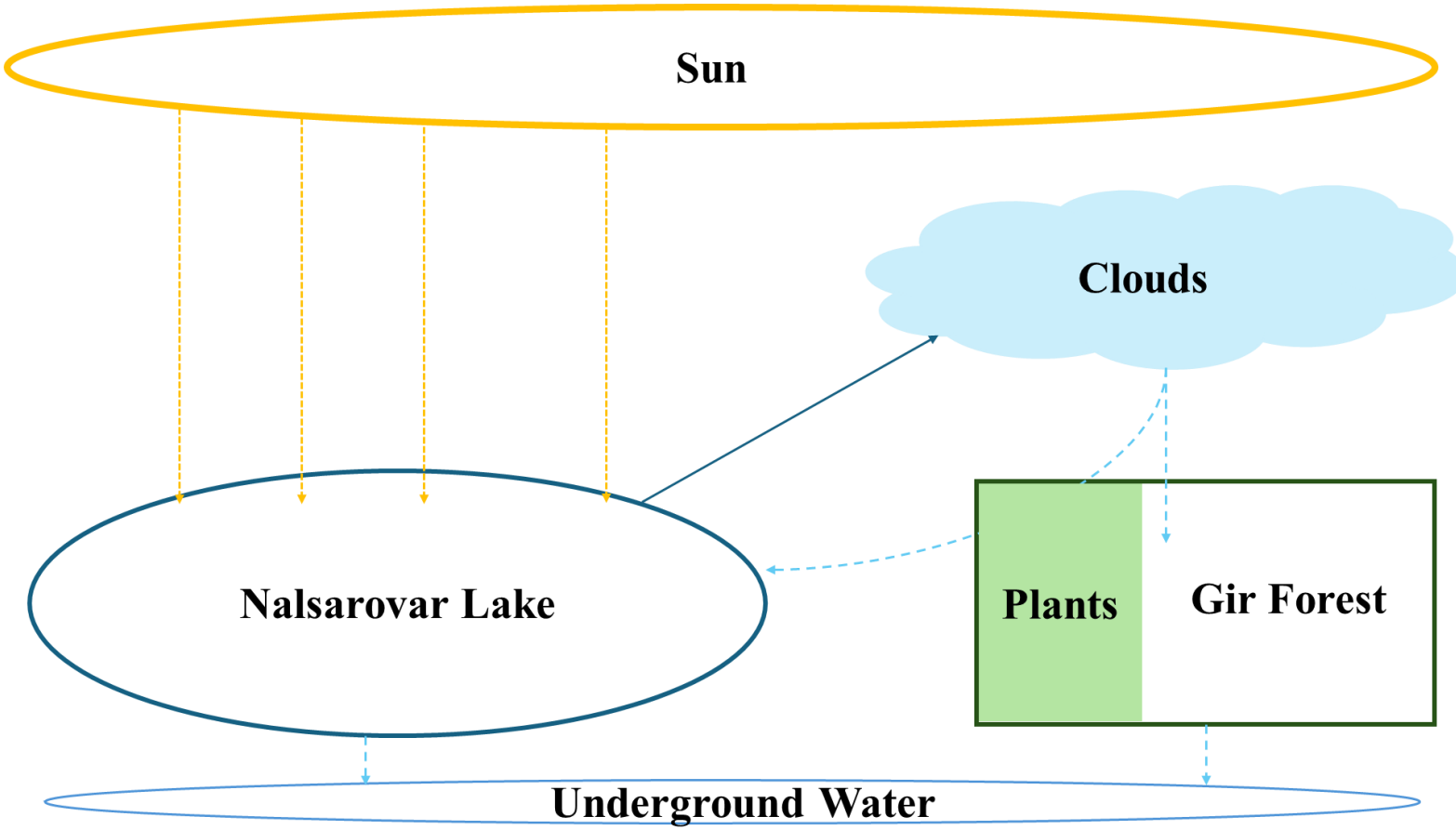
✓ Students will be able to identify the role of water in a plant's growth.

✓ Students will be able to identify the role of plants in the water cycle.

✓ Students will be able to visualize the sources of water for plants.

Figure 5

Ecological Macro-Model for Transpiration



***Ecological* Macro-Model for Water Movement and Human Activity**

Grade: ***8***

Class size: ***40***

Objective:

- To demonstrate how human activity impacts the water cycle and water bodies

Concepts:

Water pollution and acid rain

Equipment:

20 yellow-coloured yellow balls, 10 green-colour balls, 15 black scarves, chalk to draw/rope to outline stations on the ground/grass. Note: draw a distinct mark like a cross on 3 balls of each colour

Sequence and Rules:

1. Draw 5 stations, namely the Sun, Clouds, Lake, Land, and Underground water, on the ground with chalk or ropes as indicated in the diagram. Note: while the other stations can be as big or small, the cloud station should only be able to accommodate 6 members
2. 4 teams as follows
    a. 20% of students as team Sun: 8
    b. 50% of students as team Lake: 20
    c. 15% of students as team Plants: 6
    d. 15% of students as team Human: 6
3. Each member of team Sun stands in a straight line parallel to team Lake and Land
4. Each member of team Sun has all the balls divided equally

5. Lake team members stand in 6 rows of 5.
6. Both Plants and Humans stand inside the Land station. Note: In round 1, only half of the Human team members can stand in the station.
7. Humans must carry black scarves, and no Lake Member can take their spot.
8. The Sun members throw their energy (balls) into the Lake simultaneously.
9. The Lake members catch the ball and move to the Cloud station (representing evaporation). (Note: Instruct students to remember their ball colour)
10. Then they throw the ball inside the Sun station
11. After that, they stand inside the Cloud station holding hands together (representing condensation).
12. Once the Cloud station has 6 members, they move towards the last line of the Lake station and Land station as per the colour. (representing precipitation)
    a. Yellow: Lake
    b. Green: Land
13. Once all the Lake members have completed the journey through the Cloud station and are back to either the Lake or Land station, Humans randomly place black scarves on the Lake member's necks standing in the Land (including Plants) station).
14. The other Human members who did not participate (in round 1) equally divide themselves and then join the Land and Lake Station. (representing human activity "development" or "population increase" and "land reclamation"). They start placing black scarves around the necks of members from Lake station. (representing water pollution)
15. Once an entire row gets hit, the newly joined members in the Lake station who had a mark on their balls move to the Underground water station, including Lake members with black scarves (representing infiltration)

16. The members that move towards land hold hands with plants (the hand that is facing team Sun)
17. Plants holding the hands of members with marks on their balls switch their hands and help them move to the Underground water station.
18. Once the Underground station has 10 members, plants extend their hands and pull these members towards them.
19. Repeat the process until every Lake member with black scarves has travelled through the Cloud, Lake, Land (Plant included) and Underground water station once.

Debriefing:

- What does the black scarf represent?
- What happens to water systems when more humans enter?
- Scientifically, what do the members with black scarves across the station signify (e.g. acid rain)?

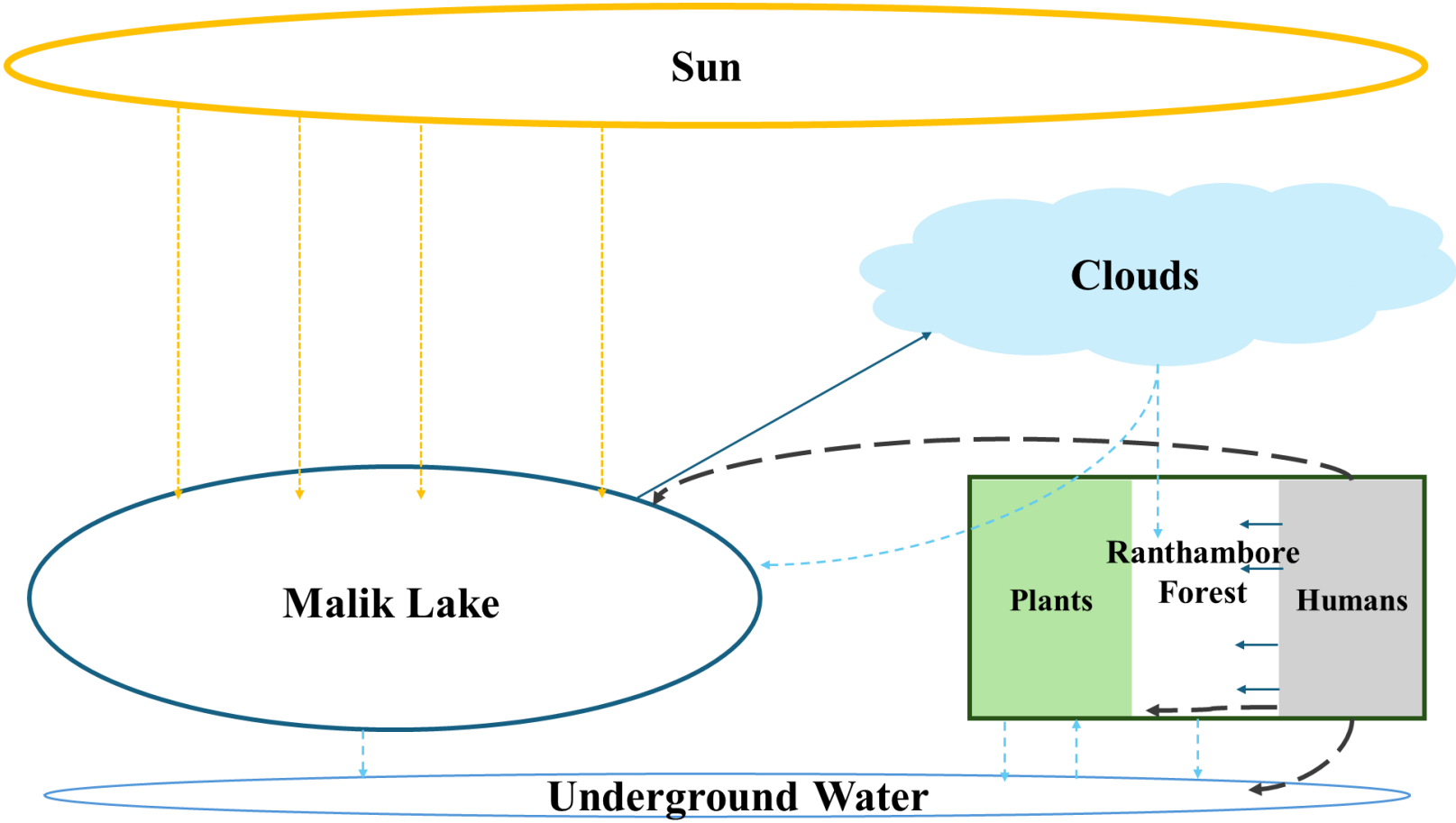
Intended Learnings:

✓ Students will understand various ways humans affect natural surroundings/ water tables.

✓ Students will be able to visualize how pollutants can travel across systems.

Figure 6

Ecological Macro-Model for Water Movement and Human Activity



Ecological Macro-Model: Movement of Light for 4th Grade

Rationale

Light is essential for perceiving our world, enabling sight and communication. It plays a vital role in warming the Earth, influencing weather, and driving photosynthesis, the process that sustains plant life. Understanding light's properties—how it travels, reflects, and refracts—is key to grasping everyday phenomena like shadows, reflections, and why objects look different underwater. By learning about these interactions, students gain a deeper appreciation of how light shapes our environment. This knowledge connects them to the natural world, revealing the significance of light in both supporting life on Earth and providing us with insights into distant stars and galaxies, shaping our understanding of the universe.

Significance to Critical Picture

Understanding the properties of light is essential for developing ecological literacy, as it helps students grasp the fundamental processes that influence life on Earth. However, changes in natural light patterns, driven by human activities and artificial lighting, are increasingly disrupting ecological systems. Light pollution alters the natural day-night cycle, affecting the behaviors of plants and animals, from pollination and migration to feeding and reproductive activities (Hirt et al., 2023). These disruptions impact entire ecosystems, leading to altered predator-prey dynamics and declining biodiversity.

The effects of artificial lighting on natural light cycles are already visible, as many species adapted to specific light conditions struggle to adjust. For example, artificial lights can disorient nocturnal insects, reducing pollination rates and weakening plant reproduction (Hirt et al., 2023). By immersing students in ecological macro-models that demonstrate light's behavior, they gain hands-on experience and insight into these processes. The aim is to

cultivate a sense of connection and responsibility towards the natural environment, fostering a reflective mindset. Through this early engagement, students can become more aware of the consequences of altering natural light cycles, encouraging them to adopt more ecologically mindful behaviors in the future.

Grade: **4**

Class size: **40**

Objective:

- To describe the properties of light, including that light travels in a straight path and that light can be absorbed

Concepts:

Light travels in a straight line, transmission through transparent objects, and absorption

Equipment:

Chalk or rope to mark stations, namely Sun, Land and Tree

Sequence and Rules:

1. Draw 3 stations, namely Sun, Land and Tree as shown in diagram using chalk or ropes on the ground.
2. 3 teams as follows
   a. 20% students as team Light (1): 8
   b. 60% students as team Light (2): 24
   c. 20% students as team Tree: 8
3. The students in team Light (1) stand in a single-file line, holding hands to form a continuous chain. Mimicking a beam of light, traveling straight across the field.
4. The Light (1) and (2) members will stand inside the Sun station and Tree members inside the Tree station.

5. The Light (1) members start walking in a straight line from Sun station to the Land station (representing light travels in a straight line and transmission through transparent object 'air')
6. Team Light (2) stands in a single-file line, holding hands to form a continuous chain.
7. Mimicking a beam of light, traveling straight across the field.
8. The team Light (2) starts walking in a straight line from Sun station to the Tree station
9. As the Team Light (2) reaches the Team Tree, students in the latter team pull Light (2) members inside the Tree station one by one (representing absorption).
10. Once the Light beam has been absorbed, reset the groups and switch roles if time allows, allowing all students to experience both roles (Light and Tree).

Debriefing:

- What did the straight line of students represent?
- Why did the line stop when it reached the trees?
- What does it mean when the tree members pull the light students inside?

Intended Learning:

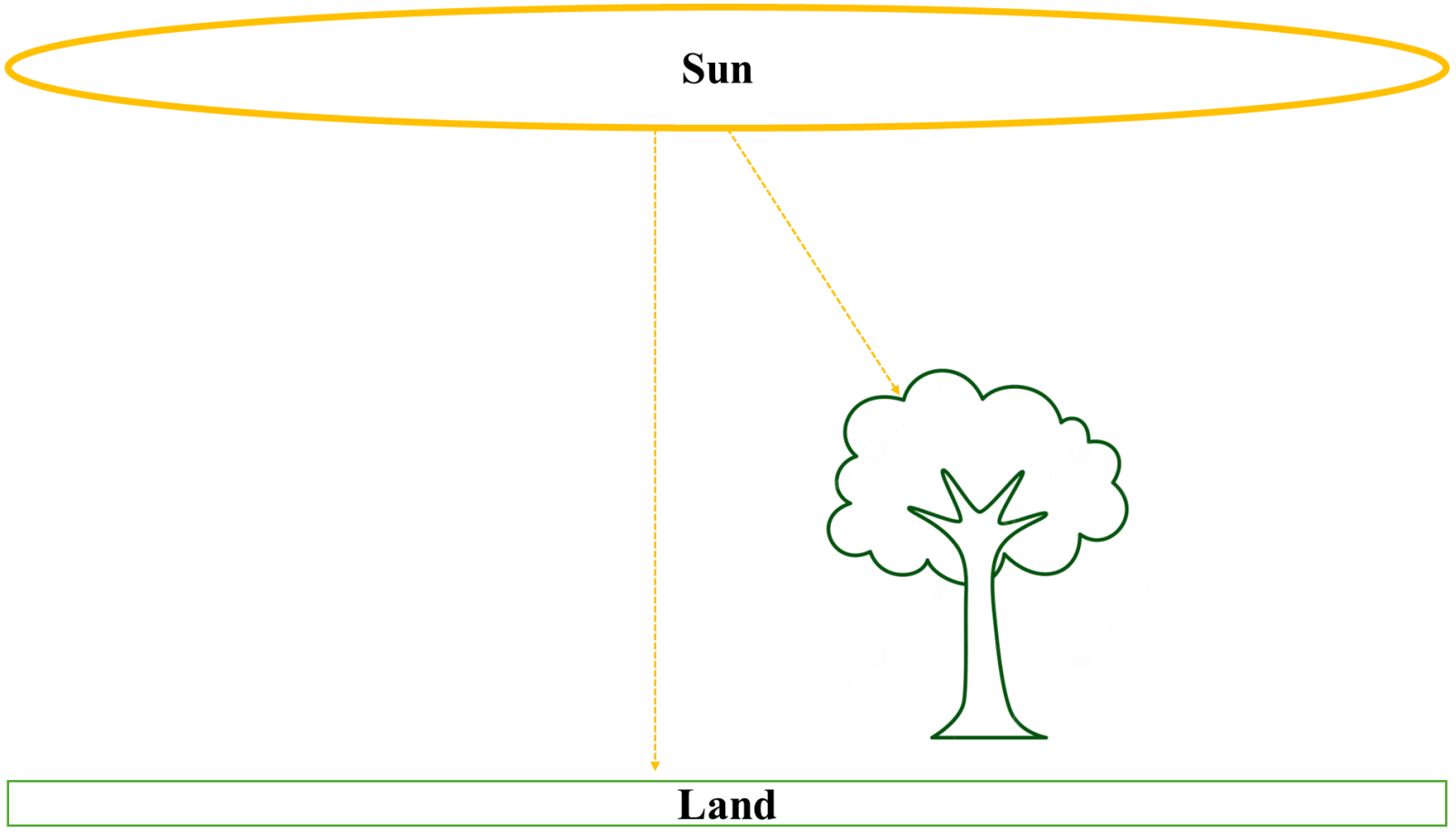
✓ Students will understand that light is a ray and is made out of particles.

✓ Students will understand the movement of light if not obstructed by any object.

✓ Students will understand that absorbed light energy is converted into some other form, such as thermal or heat energy.

Figure 7

Ecological Macro Model for Movement of Light



Ecological Macro-Model: Bouncing and Bending of Light

Grade: **4**

Class size: **40**

Objective:

- To describe the properties of light, including that light can be reflected and refracted

Concepts:

Reflection, refraction and medium

Sequence and Rules:

1. Draw 2 stations, namely the Sun and Lake, on the ground with chalk or ropes as indicated in the diagram.
2. Draw diagonal lines on the ground with chalk or ropes, as indicated in the diagram. This helps students navigate the route they have to follow (representing reflection)
3. Draw a diagonal line on the ground with chalk or ropes, as indicated in the diagram, to demonstrate refraction.
4. 3 teams as follows
   a. 20% students as team Light (1): 8
   b. 20% students as team Light (2): 8
   c. 60% students as team Lake: 24
5. Lake Team members stand parallel to the Sun station (6 rows of 4). All the members hold hands tightly except the 3rd and 4th members in each line.
6. Members in teams Light (1) and (2) stand in a single-file line, holding hands to form a continuous chain. Mimicking a beam of light, traveling straight across the field.
7. Light (1) members stand inside Sun station and walk in a straight line to the Lake station by following the pathway created on the ground.

8. As the first Light (1) member reaches the Lake station, they touch the Lake member, who in turn directs them to follow the second pathway created that goes back to Sun station (representing reflection).
9. Repeat the activity till the last member of Light (1).
10. Similarly, the members of Light (2) follow the path and reach the 3rd member of Team Lake. As only the 3rd and 4th members in each row are not holding hands the Team Light (2) can travel through the Lake only from between them. (Note: Ensure Light (2) members are in a straight line and do not leave each other's hand) (representing refraction).
11. Reset the groups and switch roles if time allows, allowing all students to experience reflection and refraction.

Debriefing:

- What happened when the light hit the surface of the lake?
- Why did the direction of the light change when it entered the lake station?
- What other objects reflect or refract?

Intended Learning:

✓ Students will observe and experience how light changes direction when it hits a reflective surface (e.g., lake), turning back in the opposite direction.

✓ Through role-play, students will visualize how light travels from one medium (air) into another denser medium (water).

✓ Students will be able to distinguish how light interacts with different types of mediums.

Figure 8

Ecological Macro-Model for Bouncing and Bending of Light

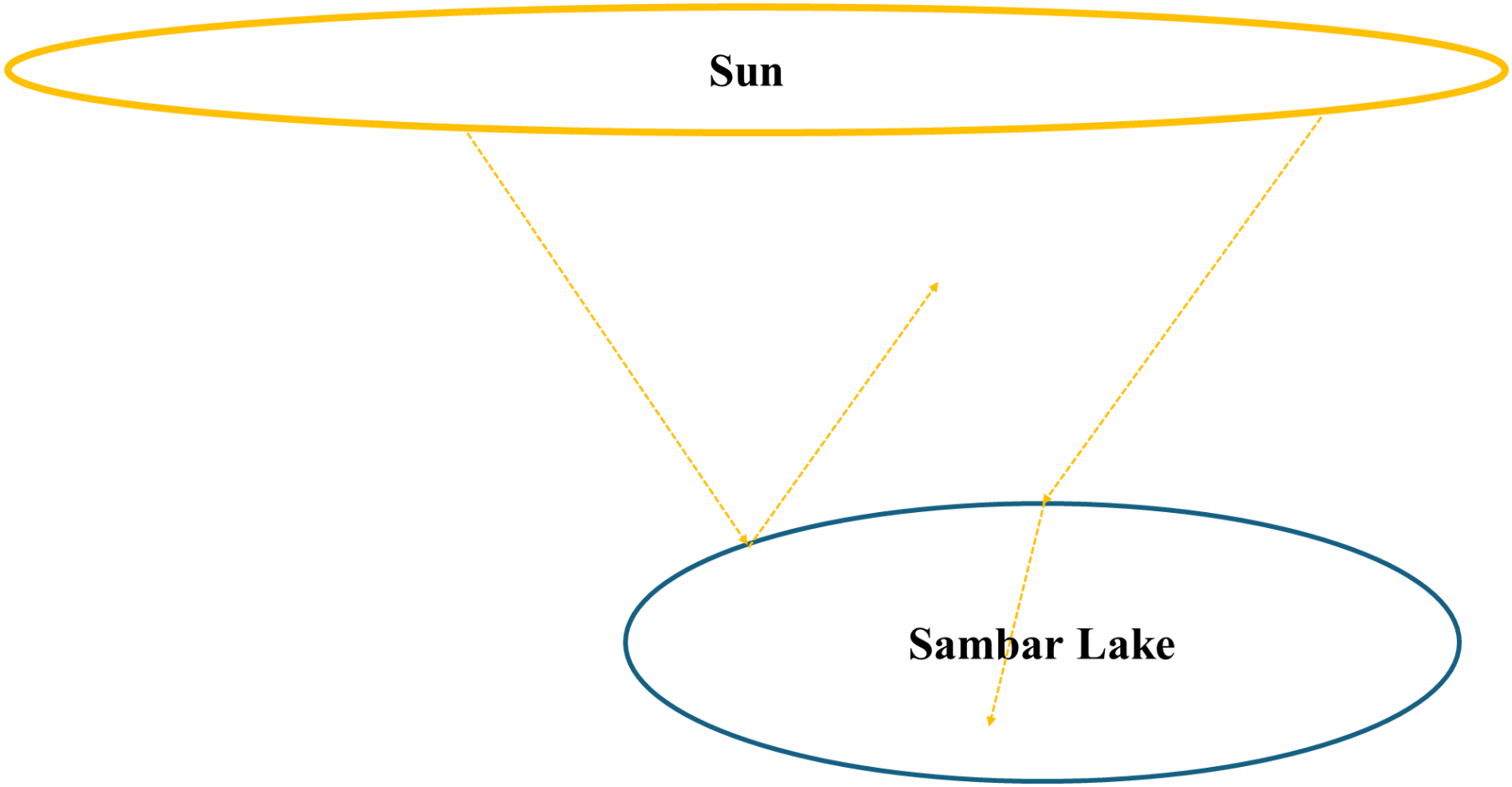
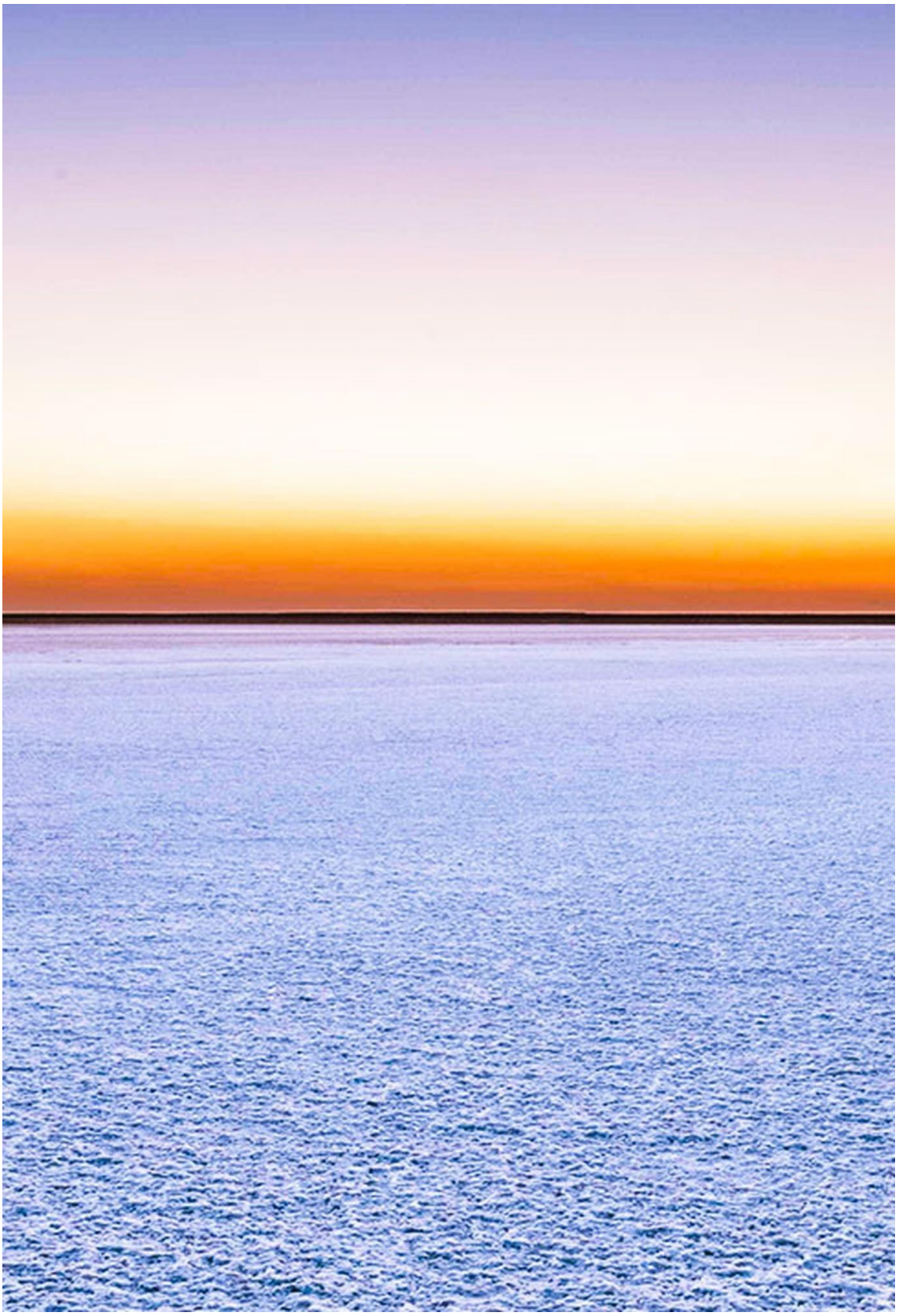


Figure 9

Rann of Kutch, Gujarat, India



Chapter IV: Self Reflection

As I reflect on my portfolio journey, I realize it has been a true roller coaster of experiences, filled with both exhilaration and challenges. Discovering an entirely new branch of education focused on ecological consciousness was eye-opening. Concepts like ecological literacy, ecophily, and embodied learning were initially unfamiliar, but their underlying principles—such as emergent and nature-based immersive learning—were already aligned with my interests. My admiration for Dewey's educational philosophy and Paulo Freire's pedagogy of the oppressed found new dimensions as these concepts added depth and practical application, connecting seamlessly with the philosophies I value. Uncovering these interconnections was blissful and filled me with excitement.

As I engaged more deeply with the literature, I began to see parallels between these modern ideas and Nai Talim, Gandhi's philosophy of education. While not identical, both approaches share a common worldview: a commitment to preserving the resilience of natural systems and fostering their capacity to rejuvenate, as articulated by Puk (Puk, 2009, as cited in Puk & Stibbards, 2010).

When I moved on to conceptualizing the ecological macro-models, I started visualizing key characteristics through mind maps, identifying stages and features. I quickly realized that these models are complex and can be overwhelming to design, especially if you become too idealistic about the concept. Their plurality can be daunting, particularly for someone creating such instructional activities for the first time.

Looking back, I realize that my biggest challenge has been finding balance and embracing the nuances—particularly when it came to integrating Gandhian philosophy into the ecological macro-models. Gandhi's emphasis on productive activities pushed me to think beyond the typical examples like farming or kitchen gardening, which are frequently adapted

in urban school settings. I wanted to push myself to incorporate other forms of productive work, such as weaving, pottery, or community cooking, as part of the ecological macro-model. However, finding emergent activities that also align with the core feature of the ecological macro-model—having students mimic natural systems—proved to be a significant roadblock. As a result, one limitation of these ecological macro-models is that while they embody Gandhi's ideals of engaging the head, hand, and heart, they fall short of including a vital element of productive work.

Another challenge was determining the extent to which nature should be integrated into these models. I struggled with the fear of using nature in a tokenistic way, worrying that I might either overdo or underplay the outdoor engagement. Eventually, I realized that the degree of nature integration should depend on the concept and the grade level. It is acceptable for the level of engagement to vary as long as the activities remain grounded in authentic, nature-based experiences. This realization helped me modulate my approach and strike a balance that felt both intentional and meaningful.

I also struggled with modulating the level of ambiguity within the ecological macro-models, realizing that it needs to be adjusted based on the students' grade level. Initially, I overpacked the models with too many components, attempting to capture every intricate aspect of the natural system. This approach made the models dense and challenging to execute, both for me as the designer and for the students as participants. The complexity risked overshadowing the core concepts, especially for younger grades, where too much detail can overwhelm rather than engage.

This realization led me to simplify the models, embracing a balance between structure and ambiguity while being mindful of the age and developmental stage of the students. This adjustment not only made the ecological macro-models more accessible but also enhanced

the learning experience, making it adaptable and aligned with the cognitive abilities of different grade levels. By embracing this balance, I could create models that foster authentic, experiential learning tailored to the needs of the students.

Further, while designing the ecological macro-models, Dr. Puk's mantra of Function, Fun, and Beauty served as a guiding principle. Function emphasized the need to showcase how natural systems work clearly, ensuring the models effectively conveyed core processes like light reflection or water movement. Fun reminded me to incorporate engaging, playful elements, such as role-playing activities, to make the experience immersive and enjoyable for students. Beauty inspired me to highlight the elegance of natural patterns, fostering a deeper appreciation for the inherent aesthetics of ecological systems. This mantra helped me create balanced models that are educational, engaging, and resonate with the wonder of nature.

Lastly, I am filled with a deep sense of fulfillment as I look back at the journey of creating this handbook. It has been an incredibly enriching experience—transformative in ways I hadn't anticipated. I feel proud of the work I have accomplished, knowing that each ecological macro-model was crafted with care, intention, and a genuine desire to inspire a connection with nature in students. It brings me joy to envision this handbook being used in classrooms, sparking curiosity, fostering critical thinking, and nurturing a love for the natural world. This project has been a labor of love, and I am grateful for every challenge, discovery, and growth moment along the way.

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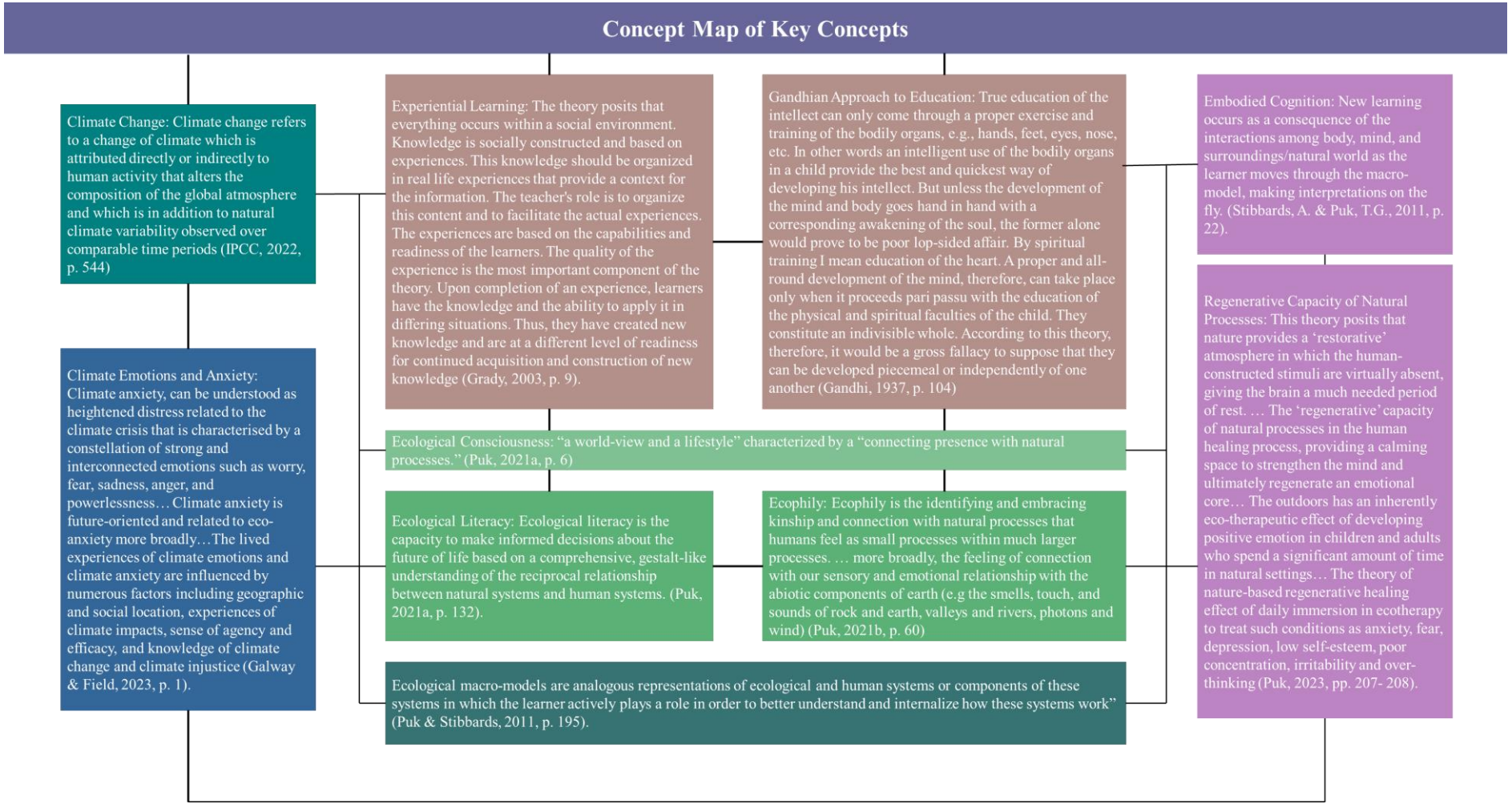
Appendix


Concept Map of Key Concepts
Climate Change: Climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (IPCC, 2022, p. 544)
Climate Emotions and Anxiety: Climate anxiety, can be understood as heightened distress related to the climate crisis that is characterised by a constellation of strong and interconnected emotions such as worry, fear, sadness, anger, and powerlessness… Climate anxiety is future-oriented and related to eco-anxiety more broadly…The lived experiences of climate emotions and climate anxiety are influenced by numerous factors including geographic and social location, experiences of climate impacts, sense of agency and efficacy, and knowledge of climate change and climate injustice (Galway & Field, 2023, p. 1).
Experiential Learning: The theory posits that everything occurs within a social environment. Knowledge is socially constructed and based on experiences. This knowledge should be organized in real life experiences that provide a context for the information. The teacher's role is to organize this content and to facilitate the actual experiences. The experiences are based on the capabilities and readiness of the learners. The quality of the experience is the most important component of the theory. Upon completion of an experience, learners have the knowledge and the ability to apply it in differing situations. Thus, they have created new knowledge and are at a different level of readiness for continued acquisition and construction of new knowledge (Grady, 2003, p. 9).
Gandhian Approach to Education: True education of the intellect can only come through a proper exercise and training of the bodily organs, e.g., hands, feet, eyes, nose, etc. In other words an intelligent use of the bodily organs in a child provide the best and quickest way of developing his intellect. But unless the development of the mind and body goes hand in hand with a corresponding awakening of the soul, the former alone would prove to be poor lop-sided affair. By spiritual training I mean education of the heart. A proper and all-round development of the mind, therefore, can take place only when it proceeds pari passu with the education of the physical and spiritual faculties of the child. They constitute an indivisible whole. According to this theory, therefore, it would be a gross fallacy to suppose that they can be developed piecemeal or independently of one another (Gandhi, 1937, p. 104)
Embodied Cognition: New learning occurs as a consequence of the interactions among body, mind, and surroundings/natural world as the learner moves through the macro-model, making interpretations on the fly. (Stibbards, A. & Puk, T.G., 2011, p. 22).
Ecological Consciousness: "a world-view and a lifestyle" characterized by a "connecting presence with natural processes." (Puk, 2021a, p. 6)
Ecological Literacy: Ecological literacy is the capacity to make informed decisions about the future of life based on a comprehensive, gestalt-like understanding of the reciprocal relationship between natural systems and human systems. (Puk, 2021a, p. 132).
Ecophily: Ecophily is the identifying and embracing kinship and connection with natural processes that humans feel as small processes within much larger processes. … more broadly, the feeling of connection with our sensory and emotional relationship with the abiotic components of earth (e.g the smells, touch, and sounds of rock and earth, valleys and rivers, photons and wind) (Puk, 2021b, p. 60)
Regenerative Capacity of Natural Processes: This theory posits that nature provides a 'restorative' atmosphere in which the human-constructed stimuli are virtually absent, giving the brain a much needed period of rest. … The 'regenerative' capacity of natural processes in the human healing process, providing a calming space to strengthen the mind and ultimately regenerate an emotional core… The outdoors has an inherently eco-therapeutic effect of developing positive emotion in children and adults who spend a significant amount of time in natural settings… The theory of nature-based regenerative healing effect of daily immersion in ecotherapy to treat such conditions as anxiety, fear, depression, low self-esteem, poor concentration, irritability and over-thinking (Puk, 2023, pp. 207- 208).
Ecological macro-models are analogous representations of ecological and human systems or components of these systems in which the learner actively plays a role in order to better understand and internalize how these systems work" (Puk & Stibbards, 2011, p. 195).