

Blue Pedagogy Framework: A Conceptual Study of Coastal-Based Social Studies for Sustainability

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ARTICLE INFO ABSTRACT

Article History

Submitted:

22 January 2026

Revised:

11 April 2026

Accepted:

5 September 2026

Keywords

Blue Pedagogy,
Coastal Based
Social Studies,
Ocean Literacy,
Education for
Sustainable
Development

Background: Despite the growing recognition of Ocean Literacy as an essential foundation for understanding the human–ocean relationship and supporting ocean sustainability, its integration into formal education remains fragmented and is not yet supported by a comprehensive pedagogical framework capable of transforming ocean knowledge into meaningful learning experiences.

Objectives: This study aims to formulate Blue Pedagogy as a conceptual framework for coastal-based education for sustainability.

Method: This qualitative study employed an integrative literature review combined with concept analysis. Academic literature published between 2005 and 2026 was collected from Scopus, Web of Science, Google Scholar, and Publish or Perish and analyzed through four stages: literature mapping, critical review, concept synthesis, and framework construction.

Result: The findings reveal that Ocean Literacy has evolved from a predominantly knowledge-based concept into a multidimensional framework emphasizing the human–ocean relationship. However, its educational implementation remains constrained by epistemic, curricular, pedagogical, and institutional gaps. In response, this study conceptualizes Blue Pedagogy as a transformative pedagogical approach grounded in Ocean Literacy, Place-Based Education, Experiential Learning, Ecological Pedagogy, and Education for Sustainable Development. The resulting framework comprises four interconnected BLUE dimensions: Blue Experience, Learning through Reflection, Understanding through Engagement, and Empowerment for Action.

Conclusion: Blue Pedagogy provides a conceptual foundation for transforming ocean education from learning about the ocean toward learning with, through, and for the ocean, while fostering ocean-literate, engaged, and sustainability-oriented citizens

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INTRODUCTION

The ocean is one of the Earth's primary life-support systems, playing a crucial role in regulating the global climate, providing food resources, and maintaining biodiversity. Despite its vital importance, marine ecosystems are currently facing increasingly severe ecological pressures resulting from human activities. More than 59% of the world's ocean area has been significantly affected by various anthropogenic pressures, including overfishing, marine pollution, and the impacts of global climate change (Halpern et al., 2019). This situation indicates that marine ecosystem degradation is no longer merely an environmental issue but has evolved into a global crisis that threatens the sustainability of social, economic, and ecological systems.

In response to these challenges, the United Nations, through the 2030 Agenda, has emphasized the importance of accelerating the transition toward sustainable development models capable of balancing ecological, social, and economic dimensions (Brenes-Cuevas et al., 2025). In this context, the Ocean Literacy initiative seeks to foster collaboration among researchers, governments, and civil society to deepen understanding of the ocean while developing strategies capable of addressing future marine and coastal challenges (I. O. C. of UNESCO, 2019).

The concept of ocean literacy began to gain global attention in 2005, when the Ocean Literacy Campaign formulated seven fundamental Ocean Literacy Principles as a foundation for fostering an ocean-literate society. Within this framework, an ocean-literate individual is defined as someone who understands the fundamental principles of the ocean, is able to make responsible decisions regarding the use of marine resources, and can communicate meaningfully about ocean-related issues (Cava et al., 2005; Fauville et al., 2019). As the concept has evolved, ocean literacy is no longer viewed merely as the acquisition of factual knowledge about the ocean; rather, it has developed into a more complex framework that emphasizes the dynamic relationship between humans and the ocean (human-ocean relationship) (Brennan et al., 2019; McKinley et al., 2023). This shift underscores that ocean literacy encompasses interconnected cognitive, affective, social, and behavioral dimensions that collectively shape ecological awareness.

Various studies have shown that ocean literacy levels among K–12 students across different countries remain relatively low to moderate (Mogias et al., 2019). This condition suggests that formal education has not yet fully succeeded in fostering an adequate understanding of the ocean's importance within global life-support systems. Tsai, (2019) reported that secondary school students experienced

difficulties in answering questions about ocean-related issues that were not covered in textbooks, particularly those concerning ecosystems and climate change. Recent research by Amiruddin & Usman, (2026) shown that spatial proximity to the ocean does not automatically form a comprehensive understanding of marine issues, so it is necessary to strengthen the integration of ocean literacy in the formal education process of ocean literacy concepts still required substantial improvement.

One of the major factors contributing to this condition is the persistent terrestrial bias in school curricula, whereby ocean-related topics receive only limited integration into teaching and learning processes (Gough, 2017). Consequently, strategic issues such as ocean-related climate change, marine biodiversity, and the sustainability of coastal ecosystems often receive insufficient attention in education. Nevertheless, despite the growing global recognition of the urgency of ocean literacy, its integration into formal education systems across countries remains relatively limited. Previous studies have shown that ocean literacy has not yet been systematically embedded in curricula, educational policies, or school teaching practices (Barracosa et al., 2019; Pazoto et al., 2022). This situation stands in contrast to UNESCO's aspirations under the United Nations Decade of Ocean Science for Sustainable Development, which called for the integration of ocean literacy into formal education curricula by 2025 (I. O. C. UNESCO, 2022). The successful integration of ocean literacy depends substantially on educators' capacity to translate ocean-related issues into meaningful learning experiences for students (Lin et al., 2020; Mogias et al., 2019). However, this process faces various challenges, including limited environmental knowledge, overcrowded curricula, and a lack of resources and instructional materials that support ocean education (Eidietis & Jewkes, 2011; Fauville et al., 2019)).

These conditions reveal a clear gap between the urgent need to enhance ocean literacy and the readiness of formal education systems to accommodate this need. In other words, the primary challenge is no longer merely to introduce the concept of ocean literacy, but rather to transform it into a pedagogical approach capable of providing contextual, reflective, and transformative learning experiences. Against this background, the concept of Blue Pedagogy becomes relevant as a pedagogical framework that seeks to bridge the gap between ocean literacy, coastal-based education, and education for sustainability. Unlike existing approaches, Blue Pedagogy positions the ocean not merely as an object of learning, but also as a space for experience, reflection, and transformation toward sustainable behavior.

Based on this background, this study aims to formulate a conceptual framework of Blue Pedagogy as a pedagogical approach to coastal-based education for sustainability. Through the synthesis of diverse theoretical perspectives, this study is expected to establish a conceptual foundation that clarifies the definition, characteristics, and key dimensions of Blue Pedagogy. The findings are expected to enrich the development of scholarship in pedagogy and education for sustainability while providing a conceptual reference for future research on coastal-based education, ocean literacy, and sustainability-oriented educational innovation.

METHODS

This study employed a qualitative approach using an integrative literature review combined with concept analysis to formulate a conceptual framework of Blue Pedagogy as a pedagogical approach to coastal-based education for sustainability. An integrative literature review is a literature review method that enables researchers to collect, evaluate, and synthesize diverse types of literature, including empirical studies, conceptual articles, and policy documents, thereby generating a comprehensive understanding of a particular concept or phenomenon (Snyder, 2019; Torraco, 2005). This approach was selected because the concept of Blue Pedagogy is still relatively new and has yet to establish a well-developed theoretical foundation in the educational literature.

In addition, this study employed concept analysis to identify the key attributes, antecedents (factors underlying the emergence of the concept), and consequences (implications or outcomes of the concept) of Blue Pedagogy. Concept analysis aims to clarify the conceptual definition of a term so that it can be distinguished from other theoretically related concepts. Through this approach, Blue Pedagogy was analyzed as a synthesis of various pedagogical paradigms related to ocean literacy, place-based education, environmental education, and education for sustainability.

The data sources consisted of academic literature retrieved from scholarly databases, including Scopus, Web of Science, and Google Scholar, supplemented by additional searches using Publish or Perish. The literature search employed keywords such as “blue pedagogy”, “ocean literacy”, “marine education”, “coastal education”, “place-based education”, “ecological pedagogy”, and “sustainability education”. The inclusion criteria comprised peer-reviewed scholarly articles, conceptual papers, academic books, and international policy documents published between 2005 and 2026, in either English or Indonesian, with direct relevance to marine pedagogy and education for sustainability.

Data analysis was conducted in four stages. The first stage involved literature mapping, which aimed to identify the major themes emerging in the literature on ocean literacy and marine education. The second stage involved a critical review, which evaluated the limitations of existing pedagogical approaches to integrating ocean-related issues into formal education. The third stage, concept synthesis, integrated various theoretical foundations to formulate the core attributes of Blue Pedagogy. The final stage, framework construction, involved developing a conceptual framework of Blue Pedagogy comprising its dimensions, principles, and implications for implementation in teaching and learning, particularly in coastal-based Social Studies education. The final outcomes of this study include a conceptual definition of Blue Pedagogy, the identification of its key constituent dimensions, and the development of a conceptual framework that may serve as a theoretical foundation for the future development of coastal-based learning models.

RESULTS AND DISCUSSION

The gap between the conceptual development of Ocean Literacy and the limitations of its implementation in formal education highlights the need for a pedagogical framework capable of translating knowledge about the ocean into meaningful, reflective, and action-oriented learning experiences. Based on the literature synthesis conducted in this study, Blue Pedagogy is conceptualized as a transformative pedagogical approach that places the human–ocean relationship at the center of the educational process through the integration of ocean knowledge, place-based experiences, ecological reflection, and sustainability-oriented action. Thus, Blue Pedagogy aims not only to teach learners about the ocean but also to cultivate ways of understanding, feeling, relating to, and acting toward the ocean as an inseparable part of human life.

This orientation positions Blue Pedagogy as an approach that extends beyond the transmission of scientific facts about marine ecosystems. The ocean is positioned not only as an object of knowledge but also as a learning context, an experiential space, and a transformative space. From this perspective, learning is directed toward building connections among knowledge, experience, values, and action, so that learners do not merely become individuals who know about the ocean but develop into ocean citizens who possess awareness, empathy, decision-making capacity, and responsibility for the sustainability of marine and coastal ecosystems.

Based on a synthesis of various perspectives on ocean education and sustainability, this study defines Blue Pedagogy as a transformative pedagogical approach that places the human–ocean relationship at the center of learning by

integrating Ocean Literacy, local coastal contexts, direct and mediated experiences, ecological reflection, and sustainability-oriented action to develop learners who are able to understand, connect with, and act responsibly toward the ocean and coastal ecosystems.

Blue Pedagogy should also be distinguished from the Blue Curriculum. The Blue Curriculum is primarily concerned with what is integrated into the curriculum structure, including ocean-related content, learning outcomes, technologies, and learning experiences. In contrast, Blue Pedagogy emphasizes how learning is designed and experienced. Therefore, the use of immersive technologies such as Virtual Reality (VR), Augmented Reality (AR), and 360° media does not constitute the essence of Blue Pedagogy; rather, these technologies represent forms of learning mediation that may be employed when direct access to marine and coastal environments is limited.

This definition demonstrates that Blue Pedagogy is not synonymous with Ocean Literacy. Ocean Literacy provides a substantive foundation for understanding the reciprocal relationship between humans and the ocean and emphasizes the capacity to understand, communicate about, and make responsible decisions concerning the ocean (Cava et al., 2005; Fauville et al., 2019; Santoro et al., 2017). Blue Pedagogy, by contrast, focuses on how educational processes are designed to cultivate and strengthen this relationship. Thus, Ocean Literacy serves as both a substantive foundation and an intended educational outcome, whereas Blue Pedagogy functions as the pedagogical framework that organizes the learning process.

Based on the conceptual synthesis of the various perspectives underpinning Blue Pedagogy, this study identifies four core BLUE dimensions: Blue Experience, Learning through Reflection, Understanding through Engagement, and Empowerment for Action. These four dimensions were not directly adopted from any single theory or pedagogical model. Rather, they were formulated through the integration and interpretation of ideas drawn from Ocean Literacy, Place-Based Education, Experiential Learning, Ecological Pedagogy, and Education for Sustainable Development. Together, these dimensions represent a pedagogical process that connects learners' experiences with the ocean and coastal environments, critical meaning-making regarding the human–ocean relationship, engagement with socio-ecological issues, and action oriented toward sustainability. Accordingly, Blue Pedagogy is conceptualized in this study as a process that progresses from experiencing and reflecting to engaging and acting.

The acronym BLUE represents a pedagogical process that moves from experience and connection with the ocean toward critical reflection, engagement with socio-ecological issues, and empowerment for action oriented toward ocean sustainability.

- a. Blue Experience constitutes the initial dimension, positioning experience as the entry point for developing relationships between learners and the ocean. Learning may take place through direct interaction with coastal environments, such as beach observations, mangrove exploration, field activities, and engagement with coastal communities, as well as through mediated experiences such as narratives, visualizations, simulations, and virtual technologies. Experiential and place-based learning can strengthen environmental understanding, foster a sense of connection to place, and encourage ocean stewardship (Dawson, 2015; McPherson et al., 2020; Niedozytko et al., 2019). Within Blue Pedagogy, such experiences are intended not only to develop an understanding of the ocean as an object of knowledge but also to foster cognitive, emotional, and contextual connections with the ocean.
- b. Learning through Reflection refers to the process of transforming experience into meaningful learning through critical and ecological reflection. Learners are encouraged not only to understand what is happening in marine environments but also to question why such problems occur, how human activities contribute to them, who is affected, and what responsibilities humans have toward ocean sustainability. This dimension is consistent with the development of Ocean Literacy, which emphasizes not only knowledge but also awareness, attitudes, emotional connection, and the ways individuals make sense of their relationship with the ocean (Brennan et al., 2019; McKinley et al., 2023). Reflection therefore serves as a process that connects experience with the development of ecological awareness.
- c. Understanding through Engagement emphasizes that deep understanding is developed not merely through the reception of information but through active engagement with real-world issues. Learners participate in inquiry, dialogue, discussion, collaboration, problem-solving, and interaction with communities to understand the complexity of socio-ecological issues affecting marine and coastal environments. The development of Ocean Literacy demonstrates that the human–ocean relationship also encompasses communication, participation, engagement with ocean-related issues, and involvement in decision-making concerning the ocean. Within this

dimension, learners move beyond simply knowing about an issue toward developing understanding through active engagement.

- d. Empowerment for Action is the dimension that directs learning outcomes toward developing learners' capacity and agency to act for ocean sustainability. Such action may take the form of behavioral change, citizen science, environmental monitoring, public campaigns, conservation projects, the development of locally grounded solutions, or other forms of participation. Within the development of Ocean Literacy, behavior encompasses decisions, choices, actions, and habits related to ocean issues, while more recent conceptual developments also emphasize the importance of collective action and systemic change. Therefore, empowerment within Blue Pedagogy is directed not only toward individual behavioral change but also toward developing learners' capacity to participate in socio-ecological transformation.

The relationships among these dimensions are visualized in the conceptual framework of Blue Pedagogy presented in the following figure.

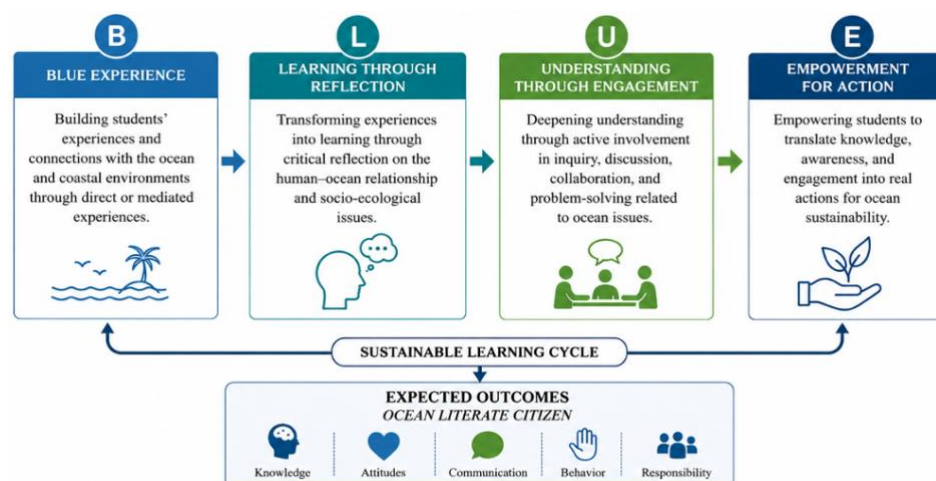


Figure 1. Blue Pedagogy Conceptual Framework

As illustrated in the figure above, Blue Pedagogy represents an interconnected and continuous pedagogical process. 1) Blue Experience serves as the entry point for developing learners' experiences of and connections with the ocean; 2) Learning through Reflection transforms these experiences into a process of critically making sense of the human-ocean relationship; 3) Understanding through Engagement deepens understanding through active involvement in socio-ecological issues;

while 4) Empowerment for Action enables learners to translate knowledge, awareness, and engagement into concrete action for ocean sustainability. Thus, BLUE is not positioned as a rigid sequence of stages but as a learning cycle in which experience, reflection, engagement, and action mutually reinforce one another. Through this process, Blue Pedagogy seeks to develop individuals who not only possess ocean literacy but also demonstrate connectedness, care, the capacity to participate, and responsibility for ocean sustainability.

The conceptual framework of Blue Pedagogy is not derived from a single pedagogical theory. Rather, it is the result of a synthesis of several theoretical perspectives that address different yet complementary aspects of the relationships among education, experience, the environment, and ocean sustainability. This synthesis encompasses Ocean Literacy, Place-Based Education, Experiential Learning, Ecological Pedagogy, and Education for Sustainable Development (ESD). These five perspectives are neither treated as separate components nor merely combined; instead, they are interpreted according to their respective contributions to addressing the pedagogical needs of ocean education: *what* learners need to understand about the ocean, *where* learning derives its context, *how* experience is transformed into learning, *how* an ethical human-ocean relationship is cultivated, and *toward what ends* the educational process is directed.

a. Ocean Literacy: The Substantive Foundation and Orientation of the Human–Ocean Relationship

Ocean Literacy serves as the substantive foundation of Blue Pedagogy because it provides a basic framework for understanding the reciprocal relationship between humans and the ocean. Traditionally, an ocean-literate individual is understood as someone who understands the influence of the ocean on humans and the influence of humans on the ocean, can communicate meaningfully about the ocean, and is able to make informed and responsible decisions concerning the ocean and its resources (Cava et al., 2005; Fauville et al., 2019). The Seven Essential Principles of Ocean Literacy further provide a knowledge base for understanding the ocean as an interconnected system, its role in shaping the Earth and climate, its contribution to life, the diversity of its ecosystems, the human–ocean relationship, and the vast extent of the ocean that remains unexplored (Santoro et al., 2017).

However, the conceptual development of Ocean Literacy reflects a shift from a predominantly knowledge-based orientation toward a more multidimensional understanding of the human–ocean relationship. Ocean

Literacy is no longer viewed solely as the ability to understand ocean-related facts and processes; it also encompasses awareness, attitudes, communication, experience, behavior, and emotional connections between humans and the ocean (McKinley et al., 2023). This shift is consistent with the broader concept of ecological literacy proposed by Orr (1992), who argued that all education is fundamentally environmental education: what is included in or excluded from the curriculum teaches learners whether they are part of, or separate from, the natural world. Orr's argument emphasizes that literacy concerning natural systems including the ocean cannot be reduced to the mastery of facts but involves a quality of thinking that seeks connections across different domains of life. This shift is particularly important because knowledge about the ocean does not automatically lead to care or action that supports sustainability.

Within the construction of Blue Pedagogy, Ocean Literacy therefore functions as both a substantive foundation and an orientation for learning. This perspective addresses the questions of what learners need to understand about the ocean and why such understanding matters. However, Ocean Literacy alone does not fully explain how pedagogical processes should be designed so that knowledge about the ocean develops into connectedness, reflection, engagement, and action. This gap constitutes one of the starting points for the synthesis of Blue Pedagogy.

b. Place-Based Education: Contextualizing Learning within Lived Environments

If Ocean Literacy provides the substantive foundation for understanding the human–ocean relationship, Place-Based Education provides a foundation for understanding where and within what contexts such learning becomes meaningful. The term was first introduced in the early 1990s by Lane-Zucker and Elder through The Orion Society and was subsequently developed systematically by Sobel (2004), who defined the approach as a process of using the local community and environment as a starting point for curriculum across subject areas, with the aim of strengthening community bonds, appreciation of the natural world, and commitment to civic engagement. This approach positions local environments, community experiences, culture, and real-world issues as sources of learning. In the context of coastal education, place is understood not merely as a geographical location but as a space constituted by ecological, social, economic, historical, and cultural relationships.

Beaches, mangrove ecosystems, ports, fishing communities, fish markets, conservation areas, tourism activities, and conflicts over the use of coastal spaces in Indonesia can all serve as authentic contexts for understanding the complexity of the human–ocean relationship. Learning grounded in local environments enables learners to connect abstract concepts with realities encountered in everyday life. Place-based experiences can also strengthen awareness of local environments and foster a sense of connection to place, which may ultimately promote environmental and ocean stewardship (McPherson et al., 2020).

The place-based principle of Blue Pedagogy does not imply that ocean education can only be implemented with learners who live in coastal areas. Human relationships with the ocean extend beyond geographical proximity because climate systems, consumption, production, river flows, plastic use, trade, and economic activities connect inland communities to ocean conditions. This expanded perspective is consistent with the critical pedagogy of place developed by (Gruenewald, 2003), which synthesizes the agenda of decolonization-critiquing how conventional education disconnects learners from place with that of reinhabitation, which involves rebuilding meaningful relationships with surrounding ecological and social systems. This perspective is further reinforced by (Monroe et al., 2019) critique that human beings cannot be understood as isolated individuals but are always nested within cultures that are, in turn, nested within ecological systems. Education about “place,” therefore, must account for these interconnected cultural–ecological relationships rather than merely physical proximity. Accordingly, place in Blue Pedagogy functions as a contextual entry point for understanding local–global relationships within socio-ecological systems. For coastal communities, marine environments may serve as spaces for direct experience; for communities located far from the coast, connections with the ocean can be developed through local issues, technology, visualization, data, narratives, and mediated experiences.

c. **Experiential Learning: Transforming Experience into Understanding**

The local knowledge and wisdom of a community do not, in themselves, automatically produce deep learning. Experiential Learning therefore provides a process-oriented foundation for Blue Pedagogy, particularly in explaining how experience can be transformed into knowledge and meaning. The most influential theoretical foundation within this tradition is the four-stage learning cycle developed by Kolb (1984) which

conceptualizes learning as a continuous process in which knowledge is created through the transformation of experience rather than as an end product passively absorbed by learners (Jongyung, 2025). The cycle consists of concrete experience (direct experience), reflective observation (observation and reflection), abstract conceptualization (the development of conceptual understanding), and active experimentation (testing understanding through new action). Kolb developed this framework by drawing on the work of Dewey, Lewin, and Piaget regarding the role of active engagement in the learning process. Various studies in environmental and ocean education have demonstrated that direct experience, field activities, immersive learning, and interaction with the environment can strengthen learners' understanding of environmental issues (Niedoszytko et al., 2019).

Within Blue Pedagogy, experience is not understood as a stand-alone field activity. Visits to beaches, mangrove observations, citizen science activities, interactions with coastal communities, and the use of virtual technologies become pedagogically meaningful only when accompanied by processes of meaning-making. Learners need opportunities to observe, question, reflect, connect their experiences with concepts, and consider possible responses to the issues they encounter a pattern that closely reflects the movement from concrete experience to reflective observation and abstract conceptualization within Kolb's learning cycle.

On this basis, Experiential Learning provides an important logic for the relationship between the dimensions of Blue Experience and Learning through Reflection. Experience serves as an entry point to learning, but reflection is the process that enables experience to develop into understanding. Thus, Blue Pedagogy does not assume that contact with the ocean automatically produces ocean literacy. Geographical proximity to the ocean does not necessarily guarantee understanding, care, or sustainability-oriented behavior. Experience needs to be pedagogically processed in order to generate changes in how learners understand the human–ocean relationship.

d. Ecological Pedagogy: Cultivating a Relational and Ethical Relationship with the Ocean

Ecological Pedagogy extends the orientation of Blue Pedagogy beyond merely knowing about the environment toward cultivating a more reflective and ethical relationship between humans and ecological systems. This

perspective challenges views that position humans as entities separate from nature. Instead, humans are understood as part of an interdependent web of life—an idea that resonates with the tradition of ecopedagogy, which developed from Freirean thought and was expanded by (Kahn, 2010) into a movement linking ecological literacy with critical awareness of social inequalities. (Bowers, 2001), although critical of what he regarded as the continuing anthropocentric orientation of Freirean critical pedagogy, further reinforced the central argument of ecological pedagogy: individuals cannot be understood independently of the cultural and ecological systems in which they are embedded. Education should therefore cultivate awareness of these interconnections rather than merely transmit information about environmental degradation.

In the context of the ocean, this orientation is particularly important because many marine problems are rooted in ways of viewing the ocean solely as an economic resource, a space for exploitation, or a repository for waste. Education that merely communicates information about ocean degradation does not necessarily transform such perspectives. Blue Pedagogy therefore needs to create space for developing connectedness, empathy, care, responsibility, and awareness that human sustainability depends on the sustainability of ocean systems.

The contribution of Ecological Pedagogy is particularly evident in the Learning through Reflection dimension. Reflection in Blue Pedagogy is not merely cognitive but also relational and ethical. Learners are encouraged to question the position of humans within ecological systems, the consequences of human activities for the ocean, who benefits from and who bears the consequences of environmental degradation, and the individual and collective responsibilities associated with sustainability. Reflection thus becomes a process of transforming perspectives rather than merely recalling learning experiences.

e. Education for Sustainable Development: An Orientation toward Transformation and Action

Education for Sustainable Development (ESD) provides the transformative orientation of Blue Pedagogy. ESD positions education as a means of developing learners' capacities to address complex sustainability challenges through critical thinking, systems thinking, collaboration, future-oriented thinking, problem-solving, and responsible decision-making. The foundations of these competencies can be traced to the five key

sustainability competencies proposed by Wiek, Withycombe, and Redman (2011) systems-thinking, anticipatory, normative, strategic, and interpersonal competencies which were subsequently expanded by (UNESCO, 2017) into eight cross-cutting competencies: systems thinking, anticipatory, normative, strategic, collaboration, critical thinking, self-awareness, and integrated problem-solving competencies. This perspective is particularly relevant because ocean-related challenges are socio-ecological problems that cannot be addressed solely through scientific knowledge. They also require the capacity to understand interconnections among systems, anticipate future scenarios, and act collaboratively under conditions of uncertainty.

Within the concept of Blue Pedagogy, ESD strengthens the transition from understanding to engagement and action. Learners are encouraged not only to recognize marine pollution, mangrove degradation, climate change, or resource exploitation but also to analyze their causes, consider multiple perspectives, collaborate, and explore possible courses of action in line with the systems-thinking and anticipatory competencies emphasized in the UNESCO framework. This orientation provides the foundation for the dimensions of Understanding through Engagement and Empowerment for Action.

Engagement provides learners with opportunities to develop understanding through dialogue, inquiry, collaboration, and the resolution of real-world problems. Meanwhile, empowerment for action positions learners as agents with the capacity to contribute, reflecting strategic competence and integrated problem-solving competence. Such action does not necessarily have to take the form of large-scale activism; it may include changes in everyday practices, citizen science, campaigns, community projects, environmental monitoring, ecosystem restoration, and participation in decision-making. Thus, action becomes an integral part of the learning process rather than merely an outcome that exists outside the educational process.

CONCLUSION

The conceptual framework developed in this study is organized around four interconnected dimensions represented by the acronym BLUE: Blue Experience, Learning through Reflection, Understanding through Engagement, and Empowerment for Action. These dimensions constitute a dynamic and continuous

pedagogical cycle rather than a rigid sequence. Blue Experience establishes experiential and contextual connections with the ocean; Learning through Reflection transforms experience into critical, ecological, and ethical meaning-making; Understanding through Engagement deepens understanding through active participation in socio-ecological issues; and Empowerment for Action develops learners' capacity and agency to contribute to ocean sustainability. Through this process, Blue Pedagogy seeks to move education beyond learning about the ocean toward learning with, through, and for the ocean.

The principal contribution of this study is therefore the formulation of Blue Pedagogy as a conceptual pedagogical framework for coastal-based education for sustainability. Rather than positioning the ocean merely as an object of knowledge, Blue Pedagogy repositions it as a learning context, an experiential space, and a transformative space. The framework provides a theoretical foundation for designing learning processes that connect knowledge, experience, reflection, engagement, and action in order to foster ocean-literate and sustainability-oriented citizens. As a conceptual study, however, the proposed framework requires further empirical validation across diverse educational levels, disciplinary contexts, and geographical settings. Future research should operationalize the BLUE dimensions into learning models, instructional strategies, assessment instruments, and educator professional development programs, as well as examine their effectiveness in strengthening ocean literacy, human–ocean connectedness, ecological awareness, and sustainability-oriented action.

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