

## Article

# Design of a Pedagogical Model to Foster Ocean Citizenship in Basic Education

Caroline Schio \*  and Pedro Reis 

Instituto de Educação, Universidade de Lisboa, 1649-004 Lisbon, Portugal; preis@ie.ulisboa.pt

\* Correspondence: caroline.schio@edu.ulisboa.pt; Tel.: +351-910-950-906

**Abstract:** Following a design-based research methodology, this investigation develops a pedagogical model to foster ocean citizenship through the application of a design cycle consisting of four phases: (1) preliminary research, (2) planning, (3) action and (4) evaluation. This article presents the results of phases 1 and 2, which define the conceptual foundation of the pedagogical model, and the planning of actions for its implementation in the school environment. The conceptual foundation was established by drawing upon the theoretical principles of a systemic/complex approach to education, along with theoretical-methodological elements compiled from the literature in the field of ocean literacy and ocean citizenship. During the planning phase, six educational activities were defined, to be conducted as part of a citizen science project to monitor the coastal zone. This model was developed with the objective of going beyond theoretical concepts, to offer schools a practical and objective guide for fostering ocean citizenship in basic education.

**Keywords:** pedagogical model; ocean citizenship; ocean literacy; basic education; design-based research

## 1. Introduction

### 1.1. Why Should We Train Ocean Citizens?

The development of a pedagogical model that promotes ocean citizenship in basic education is based on the need to promote an understanding of the importance of the ocean in the earliest years of our lives, as well as our responsibility for protecting its health, enabling this immense blue ecosystem to continue fulfilling the primordial functions that guarantee the continuity of life on earth, and which also support numerous socio-economic activities that depend on the environment. Indeed, we are constantly connected to the ocean; we influence it and are influenced by it. Thus, it is essential for an ocean citizen to be aware of this interconnection and understand the importance of the role played by the ocean in today's social, political and economic environments.

The ocean contains 97% of the planet's water, covering more than 70% of the earth's surface, and its volume comprises 99% of the total living space on earth [1,2]. It is responsible for the regulation of the global climate, the production of oxygen, the capture of carbon and the cycle of nutrients, and it is also the source of numerous mineral, energy, medicinal and food resources, which contribute between USD 3 and USD 6 trillion dollars per year to the world's GDP [3]. Today, more than 80% of the goods marketed internationally are transported by sea [4], and more than three million people depend directly on the ocean's live resources, which are the greatest suppliers of protein in the world [5].

The ocean provides diverse eco-systemic services of complex economic value; these preserve and increase the natural capital accumulated in the seas and the ocean through sustainable development practices that permit the regeneration of resources in the long term. This is of utmost importance, because the economy associated with marine resources supports much of the coastal population and represents a significant percentage of the world's GDP [6]. However, there is still a great imbalance between the levels of exploitation



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of the ocean and its preservation. The lack of planning, control and public policy to foster more sustainable maritime activities have an increasingly serious impact on the ocean.

As the socio-economic activities based on the ocean expand, their effects and impacts intensify, including a significant economic loss associated with increasingly frequent and extreme natural catastrophes and climatic events [3]. The increased occurrence of these events, together with alarming data from international reports on the health of the ocean, have triggered numerous intergovernmental initiatives aiming at the discussion of emergency action to mitigate the impact of human action on the different sectors that exploit the marine environment. These actions also emphasize the importance of promoting interdisciplinarity and interconnection between state education, science and policies [7].

Among more recent initiatives is the declaration of the Decade of Ocean Science for Sustainable Development (2021–2030), which seeks to develop scientific knowledge, construct infrastructure and promote partnerships for a sustainable and healthy ocean [8]. One of the main challenges referred to by the International Oceanographic Commission of UNESCO for the decade is the development of transdisciplinary and holistic educational strategies that foster knowledge about the ocean and encourage changes in behavior, leading to the development of an ocean citizenship [9].

### 1.2. What Is Ocean Citizenship?

Ocean or maritime citizenship describes the relationship between our daily life and the health of the marine environment [10]. It involves an awareness and understanding of the impact that our (individual and collective) daily choices may have on this environment to the point of promoting changes in behavior to preserve it, as well as our rights and responsibilities in relation to this common good [11]. It assumes that citizens take more personal responsibility for the ocean, acting as a policy channel to support the delivery of a healthy marine environment and to enhance marine governance [12].

Ocean citizenship is part of the wider approach of environmental citizenship, which is, after all, essentially based on the conventional concept of citizenship, whose central component is the relationship of rights and obligations between members of society and the State to which they belong [12,13]. According to Squarcina and Picorelli [14], ocean citizenship could be considered a revolutionary concept, perhaps even utopian, because it is derived from the relationship between an individual and a space or territory that is independent of a State (such as international waters outside the jurisdiction of a State). It may even apply in those cases of people who have never had contact with the sea, such as those who live far from the coast. These authors mention three different conceptions of citizenship: (1) as a political status relating the individual to the State; (2) as a sense of belonging and individual political capacity within a specific community; and (3) as a personal attitude that encourages people to act for the common good of their community, seeking the improvement of their territory.

According to Fletcher and Spotts [10], the important and numerous functions fulfilled by the ocean for the planet justify a specific “brand” of citizenship, given that: (1) the health of the ocean is a common good and should be an aspiration shared by society; (2) individual behavior has an impact on the health of the ocean, and through their choices and changes in behavior, people can collectively improve the quality of the marine environment; and (3) people can be geographically connected to the ocean, a factor that may influence the level of connection and types of relationship with this environment (subsistence, leisure, aesthetics, values, ethics, etc.).

Buchan et al. [15] defend the need to revisit normative approaches to marine citizenship as a set of individualist, private pro-environmental behaviors that can be encouraged through state education and the raising of awareness, alleging that this is a reductionist approach to marine citizenship, because it does not consider the political aspects of the rights of marine citizens in participating in the transformation of the human–ocean relationship, including social action, civic participation and procedural participation. The authors have refined the current definition of marine citizenship, emphasizing the political context and

individual and collective rights: “Marine citizenship is exercising the right to participate in the transformation of society’s relationship with the ocean, and acceptance of responsibility to make informed decisions and choices about personal and collective actions that will contribute to a sustainable marine environment now and into the future” [15] (p. 18).

The involvement of society in the procedures of marine governance (such as the formulation of public policy, definition of priorities, etc.) is of great importance, in view of the fact that citizens are a channel for the implementation of those policies, and through changes in behavior, they can directly reduce impacts on the marine environment [12]. Furthermore, the active involvement of citizens through organized social and collective movements lends potential not only to society’s power to act in the formulation of marine policy, but also to the reinforcement of power to pressure managers to act to help to implement changes that transform the problems that currently impact the ocean. However, how can ocean citizenship and a greater individual and collective involvement in the preservation and management of the marine environment be fostered if the ocean and the issues it involves are little known by society? This is why it is essential for citizens to be well informed from a very early age and to be ready to take an active role as agents promoting changes towards the future we want.

### 1.3. Objective

The objective of this research is to develop a pedagogical model that would promote ocean citizenship in basic education by applying phases 1 (preliminary research) and 2 (planning) of a design-based research method—DBR. The model proposed should be viable for implementation and replication by teachers in basic education, thus contributing new strategies aimed at fostering ocean literacy and ocean citizenship at a school level.

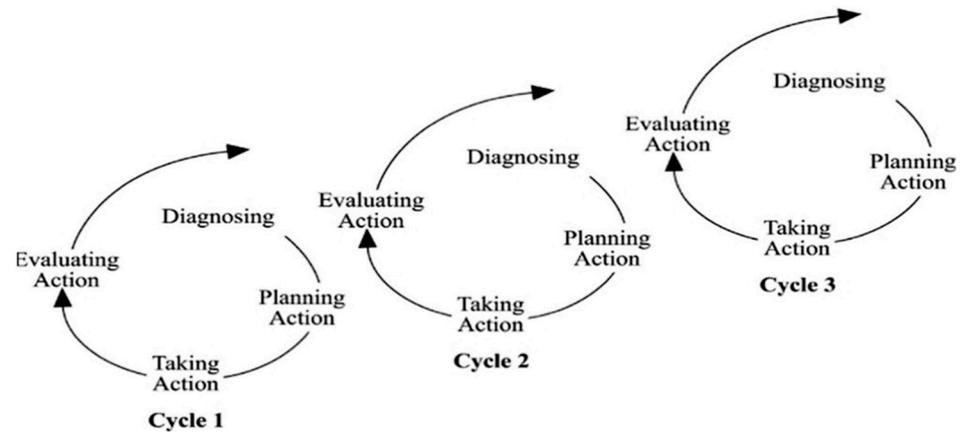
## 2. Methodology

A design-based research—DBR method was chosen for the development of the pedagogical model that promotes ocean citizenship in basic education because of its holistic and interventionist focus. One of the main objectives of DBR is the promotion of systemic change and an understanding of its underlying processes, so as to contribute towards a better “learning ecology” [16]. This method assumes that knowledge does not lie within the individual but is rather a process involving a person who knows the context in question and the activity in which they participate, because learning, cognition, knowledge and context cannot be treated as isolated entities or processes [17].

DBR emerges as a response to the criticism of the lack of relevance and utility of the educational practice offered by a large part of research in didactics [18], with the objective of filling the gap between educational research and praxis [19]. The focus of DBR studies can be the learning experiences of students or the teaching experiences of teachers, the development of improvements to the curriculum or new pedagogical tools and educational materials, the professional development and training of teachers or changes to and reform of the education system [20].

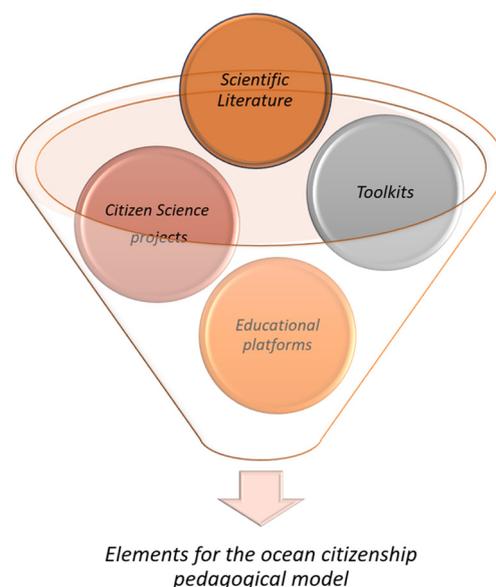
The design process is interactive and recursive, or rather, it is revisited, remodeled, perfected and tested as many times as necessary to achieve learning objectives [18,20,21]. During the design cycle, didactic materials or strategies are developed at the same time as knowledge is advanced. This occurs in a constant interaction between the researchers and the participants in the research, who are considered to be active co-participants in the research process [17]. The cyclical design process and its phases have been illustrated in different ways by various authors [22–27]. We decided to structure the design cycle in 4 phases according to Coghlan and Brannick’s model: diagnosis/preliminary research, planning, action and evaluation [22] (Figure 1). Phases 1 and 2 of the design cycle were applied in the development of the pedagogical model for promoting ocean citizenship in basic education, corresponding to the process of compilation and the definition of the theoretical-methodological components that form the conceptual base of the model, as

well as the definition and planning of the phases of their implementation in the school environment.



**Figure 1.** Example of cyclical design process according to Coghlan and Brannick [22] (p. 24).

In phase 1, a compilation was made of the principles of systemic thinking applied to the educational process, in order to bring a multi-dimensional and complex perspective to the relationship between the subject and the learning environment. Subsequently, a bibliography in the area of ocean literacy was revised, in order to identify theoretical/methodological elements for the promotion of ocean citizenship in the school environment, using the Web of Science Core Collection data platform for gathering the scientific literature associated with the terms “ocean literacy”, “marine education”, “ocean education”, “marine science education”, “ocean citizenship” and “marine citizenship”. In addition to scientific literature, other sources were also used as references in the area of ocean literacy and marine science, such as educational platforms, toolkits and citizen science projects (Figure 2). The results were subsequently compiled in a diagram to systematize the main components with the potential for fostering ocean citizenship in the school environment.



**Figure 2.** Sources used to extract the components of the pedagogical model for promoting ocean citizenship in basic education.

In phase 2, the stages and actions necessary for the implementation of the pedagogical model in schools were planned. These included: (a) the definition of the educational activities of the pedagogical model; and (b) the planning of the training for the teachers. This

article presents the results of these first 2 phases of the design cycle, which correspond to the phases that form the basis of the pedagogical model for promoting ocean citizenship in basic education. Phases 2 and 3 of the design cycle, corresponding to the implementation/testing and evaluation/adaptation of the pedagogical model, will be subsequently described in other articles.

### 3. Results and Discussion

#### 3.1. Results Phase 1—Preliminary Research

##### 3.1.1. Marine Education as Seen by Systemic/Complex Thinking

Due to the complex factors involving the human–ocean relationship, it is essential for teaching and learning about marine sciences to be fostered from a systemic and complex educational approach [28]. An understanding of our influence on the ocean and the ways in which it influences us requires the development of a systemic way of viewing this relationship, which allows us to develop multiple perspectives and to understand the complexity of inter-relationships and dependencies existing in the human–ocean system [29]. Squarcina and Picorelli [14] argue that when we consider the complexity of the issues that currently affect the ocean and the vastness of this eco-system on the Earth’s surface, we have to be idealistic and think in terms of a cultural revolution that can generate a sense of individual and collective responsibility towards this blue vastness.

According to sociologist Edgar Morin [30], for this more complex understanding by the subject about their condition and the subsequent reflection on their practice in daily life, there is an imminent need to reform thinking, because there is an increasingly wide, deep and serious discrepancy between, on the one hand, disconnected, different and compartmentalized knowledge and, on the other hand, realities and problems that are increasingly multidisciplinary, transverse, multidimensional, transactional, global and planetary. According to Morin [30], the education of the future will face this universal problem; the author alleges that this reformulation of thinking is a paradigmatic rather than programmatic reform.

Esteves de Vasconcellos [31] argues that paradigm changes can only occur through experiences or evidence that bring us face to face with the limits of our current paradigm. In this sense, the quality of experiences is one of the main factors to be considered in the learning process, because this may touch individual people at various levels, from the rational to the emotional. However, how is it possible to train ocean citizens if their educational process does not allow students the opportunity to have experiences that connect them to the marine environment, which touch, motivate and mobilize them to act for its conservation? For this to happen, it is essential to promote opportunities for trainees to experience a deep, transformative contact with the ocean, the kind which leaves a “mark”, an emotional record—a life-long bond.

For the neurobiologist Humberto Maturana, teaching provides an experiential environment [32]. It guides knowledge towards actions that are related to daily life, where the subject has the freedom and the responsibility to be a co-creator of the world [33]. Rubem Alves [34] sees the environment as a space for a creative relationship in which the body is the subject of learning. The body wants to learn something connected to its environment; it is constantly stimulated by curiosity, desires, provocations, concerns, relationships and the challenges offered by one’s life context. In this educational approach, the production of knowledge is considered to be a complex and systemic process, resulting from a structural coupling of the organism with the environment [35].

The Autopoietic Theory of Maturana and Varela [36] considers life to be a process of cognition, or rather, living is a constant act of knowing, in which all we do is a knowing and all knowing is a doing. This process of knowing depends on the structure of the person who knows and, thus, involves all of the person who knows, is rooted in the totality of living beings and, therefore, involves all of their body, emotions, sentiments and interpretations of their experiences. The Theory of Complexity of Edgar Morin [30] is linked to this approach and emphasizes the fact that knowledge is not a mirror that reflects things or the outside

world. All perceptions are, at the same time, cerebral translations and reconstructions based on stimuli or signs captured and codified by the senses. Thus, the integration of the knower within their knowledge should be a permanent principle of and necessity for education [30].

In brief, the educational process is a learning process that happens constantly throughout the life of human beings. It is rich and complex and involves the totality of being in its most varied aspects and dimensions. It is a relational process, inherent to the constant interactions that the individual experiences in their daily life, both in exchanges with other people and with the environment that permeates these exchanges. The educational process is intrinsic not only to the education of individuals, but also to societies, cultures and nations [35–40]. Thus, it is a generational, living, constant, mutable and systemic process. Understanding education from this wider, more holistic and complex perspective is fundamental if we wish to promote educational processes that are increasingly significant and transformative, and which educate citizens who are committed to acting not only for the sustainability of the marine environment, but for the planet as a whole.

The educator Paulo Freire [41] (p. 46) argues that “reality cannot be modified until men discover that it is modifiable and that they can do it. It is thus necessary for raising this awareness to be the first objective of education: to first provoke a critical, reflective attitude which commits people to action”. In this sense, Santos and Costa Pinto [42] develop the concept of power of action, which is related to our ability to act in the world and to transform the reality in which we live in the direction that we desire, one that gives us pleasure and that makes sense to us. According to the authors, to effectively know something is to “know by the cause”; thus, it is fundamental for us to be aware of the primary cause of our desires, because it is our desires that boost and increase our strength or power to exist and act.

If we want to connect and engage students in marine issues and motivate them to come together and act to transform the problems inherent in these issues, it is essential for children and young people to find meaning in what they are doing. They have to find a motive and reason for getting involved with this cause in order to actually become ocean citizens. Mckinley and Fletcher [12] affirm that “Personal attitude to life, behaviour and responsibility will shape how the knowledge is used within the constraints of personal capacity to act”. They add that: “raising awareness and understanding of marine issues must be supported by encouraging a value shift, towards taking personal responsibility for the marine environment”. However, how can we promote this change in the human–ocean relationship, to stimulate the citizens’ power of action to transform the problems that currently impact the marine eco-system? It is essential to search for new horizons to inspire us, new bases to support us and new tools to try different ways of stimulating holistic and innovative educational processes, which actually lead to the development of a transformative practice in society.

Considering the complexity of the man–ocean relationship, Mckinley et al. [43] proposed four new dimensions, to be added to the six previously proposed by Brennan et al. [29], to be included in marine education projects: (1) knowledge, (2) communication, (3) behavior, (4) awareness, (5) attitudes, (6) activism, (7) emotional connection, (8) access and experience, (9) adaptive capacity and (10) trust and transparency. The success of literacy/citizenship projects will depend much on the integration of these multiple dimensions and strategies used to raise awareness, to train and engage citizens to act in support of the marine cause.

### 3.1.2. Ocean Literacy as a Path to Fostering Ocean Citizenship

Ocean literacy is the international term adopted by a group of American scientists in the marine area and education profession who, in 2002, began to develop strategies to foster ocean education in the formal education system. Although it was at the Stockholm Conference in 1972 that the United Nations declared the necessity to promote environmental education as a transverse theme in teaching programs, more than fifty years later, the marine

issue is still struggling to find a place in the school curricula of most countries [44,45]. This is what some scholars call “ocean blindness” [9], and it is often referred to in the literature as one of the main weaknesses that make it difficult to promote both ocean literacy and ocean citizenship in the educational environment [10–14,46–48].

Although the term “literacy” originally only referred to the ability to read and write, as defined at the beginning of Industrial Revolution, when efforts to teach the population to read and write were intensified, more than 50 years later, the development of science in the cognitive field has broadened the understanding of this concept as a tool for the continuous construction of knowledge [49,50]. Today, skills and individual potential allow people to play an active role in society, make informed decisions, resolve problems and achieve their objectives in the society [50].

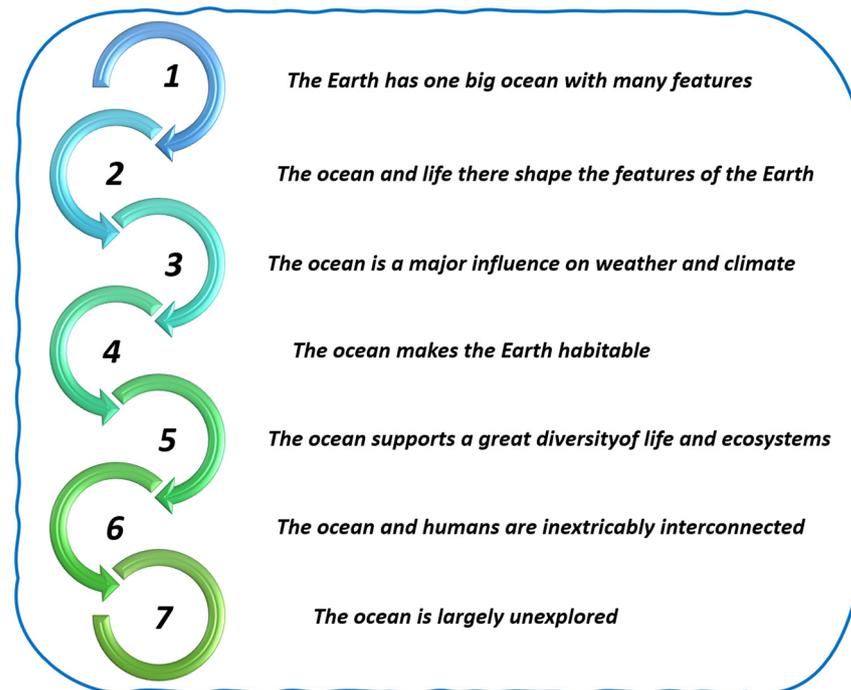
The evolution of ocean literacy during the last decade was stimulated by the promotion of international conferences, the formation of research alliances and the commitment launched by UNESCO in 2017, called Ocean Literacy for All: A Global Strategy for Promoting the Raising of Consciousness for the Conservation, Restoration and Sustainable Use of Our Ocean [9]. The same year marked the launch of a document called Our Ocean, Our Future: Call for Action, a product of the 1st Ocean Conference, held in New York, which called for “the need to further improve the knowledge of the ocean, including its importance for sustainable development and how it is impacted by anthropogenic activities” as well as to “support plans to foster ocean-related education, for example as part of education curricula, to promote ocean literacy and a culture of conservation, restoration and sustainable use of our ocean [51] (paragraph 13, sub-paragraph “d” and “e”, p. 4).

The Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), recognized ocean literacy as a priority area for achieving the objectives of the Ocean Decade, playing a fundamental role in promoting dialogue between different sectors of society, fostering public policy, encouraging more responsible (individual and corporative) practices and also promoting “blue careers” that are more sustainable and attractive to young people [8]. In 2021, it launched a global strategy for the promotion of ocean literacy [52], which culminated in the launching of the program entitled Ocean Literacy With All (OLWA), whose aim was stimulate international research, actions, partnerships and networks in the area of ocean literacy.

In 2022, during the One Ocean Summit held in France, the Director-General of UNESCO established the objective of including ocean literacy in the curricular programs of all 193 Member States of UNESCO by 2025 [53]. In order to achieve this objective established by UNESCO, and if we want to train a blue generation prepared for and dedicated to act for the sustainability of the ocean, it is crucial for the seven essential principles of ocean literacy (Figure 3) and its 45 basic concepts [54] to be understood and fostered in curricular teaching plans.

In a document entitled A roadmap for using the UN decade of ocean science for sustainable development in support of science, policy, and action [3], ocean literacy is considered to be one of the three pillars, together with science and the financial sector, that should be addressed in an integrated way through public policy to achieve the desired sustainability of the marine sector.

The Decade of Ocean Science for Sustainable Development represents an opportunity for the international community of marine sciences to organize and create synergies, partnerships and actions necessary for developing regional and global marine policies guided by science and knowledge [55]. However, the successful implementation of these policies will depend a great deal on the integration of the pillars referred to above, together with the effective participation and contribution of society.



**Figure 3.** The 7 principles of ocean literacy (adapted from Santoro et al. [9]).

### 3.1.3. What Strategies to Use to Foster Ocean Citizenship in the School Environment?

During the last few decades, ocean literacy has been incorporated into formal and informal education in different ways and at different levels. A series of virtual documents, manuals and platforms (Table 1) have been developed to structure new educational strategies and activities to foster the raising of awareness and knowledge in different sectors of society. The manual entitled *Ocean Literacy For All—A Toolkit* [9] systematized 14 suggestions for educational activities on the most varied themes associated with the ocean. The manual entitled *A Handbook for Increasing Ocean Literacy: Tools for Educators and Ocean Literacy Advocates*, structured by the NMEA—National Marine Educators Association [56], includes 28 conceptual flow charts and guides educators in sequential planning for teaching the principles of ocean literacy to students in basic to middle school classes.

As a strategy for the promotion of new public policy for the inclusion of ocean literacy in the school curriculum, in 2022, UNESCO published a manual entitled *A New Blue Curriculum—A toolkit for policy-makers* [57]. This manual offers guidelines and tools to provide the people who formulate policies with the information and strategies necessary for effectively integrating the principles of ocean literacy in teaching plans. The three aforementioned manuals complement each other, addressing different strategies for different target publics; they include information that is accessible to the general public, a practical orientation for educators and an overview of the influence of education policy for the systematic integration of ocean literacy in education systems.

Biometric studies in ocean literacy have shown that although this is a recent area of research (with its first recorded publication being in 2004), it is also an area of research that is in constant expansion [55,58,59]. According to Salazar-Sepúlveda et al. [59], publications in this area began to show significant growth from 2013, although it was from 2020 that they increased exponentially ( $R^2 = 86\%$ ), with 192 publications in the Web of Science between 2004 and 2022. This recent exponential growth coincides with the beginning of the Decade of the Ocean and with efforts to promote ocean literacy in every sector of society. A new search of the WoS database using the term of ocean literacy and its associated terms—“marine education”, “ocean education”, “marine science education”,

“ocean citizenship” and “marine citizenship”—found a total of 231 articles published by September 2023, showing that this area of research is in significant expansion.

**Table 1.** Examples of platforms that offer educational activities and resources for the promotion of ocean literacy.

	Platform	Website
1	All-Atlantic Blue Schools	<a href="https://allatlanticblueschools.com/ocean-literacy-material/">https://allatlanticblueschools.com/ocean-literacy-material/</a> (accessed on 4 October 2023)
2	AXA Ocean Education	<a href="https://encounteredu.com/education-programmes/axa-ocean-education">https://encounteredu.com/education-programmes/axa-ocean-education</a> (accessed on 4 October 2023)
3	Encounter Edu	<a href="https://encounteredu.com/">https://encounteredu.com/</a> (accessed on 4 October 2023)
4	European Maritime Day	<a href="https://maritime-day.ec.europa.eu/my-country_en">https://maritime-day.ec.europa.eu/my-country_en</a> (accessed on 4 October 2023)
5	Explorers Marine Project	<a href="https://www.marine.ie/site-area/areas-activity/education-outreach/explorers-education-programme?language=en">https://www.marine.ie/site-area/areas-activity/education-outreach/explorers-education-programme?language=en</a> (accessed on 4 October 2023)
6	National Geographic Ocean Education	<a href="https://www.nationalgeographic.org/education/programs/oceans-education/">https://www.nationalgeographic.org/education/programs/oceans-education/</a> (accessed on 4 October 2023)
7	NOAA Ocean Exploration and Research	<a href="https://oceanexplorer.noaa.gov/edu/welcome.html">https://oceanexplorer.noaa.gov/edu/welcome.html</a> (accessed on 4 October 2023)
8	Ocean Literacy Portal of UNESCO	<a href="https://oceanliteracy.unesco.org/?post-types=all&amp;sort=popular">https://oceanliteracy.unesco.org/?post-types=all&amp;sort=popular</a> (accessed on 4 October 2023)
9	Sea Grant Ocean Education	<a href="https://seagrant.noaa.gov/education/">https://seagrant.noaa.gov/education/</a> (accessed on 4 October 2023)
10	World Ocean Day for Schools	<a href="https://worldoceanday.school/">https://worldoceanday.school/</a> (accessed on 4 October 2023)
11	World Ocean Observatory	<a href="https://www.worldoceanobservatory.org/education">https://www.worldoceanobservatory.org/education</a> (accessed on 4 October 2023)

However, when only the terms “ocean citizenship” and “marine citizenship” are searched in the WoS database, just 23 publications related to the theme appear, five more than Buchan et al. [15] found in their bibliographic research up to March 2021. The small number of publications shows the incipient nature of this area of research, with no more than three publications per year up to September 2023 (Figure 4). Beyond the small number of publications, marine/ocean citizenship is included as one of the central subjects of research in only 7 of these, while the 16 other publications only refer to this type of citizenship as an important component to be fostered in education for marine conservation.

Conceptual models of ocean citizenship only include McKinley’s model [11]. The author based his work on the model of environmental citizenship of Hawthorne e Alabaster [60], including new components with a potential for fostering ocean citizenship, such as perception, participation, dependence on means of subsistence and proximity with the resource (Figure 5). McKinley [11] subsequently refined his previous model of ocean citizenship with elements with a great potential for a positive impact on the management of the marine environment, according to the opinion of marine practitioners in the United Kingdom (Figure 6). According to the author, ocean citizenship would not be created through a linear relationship between the model’s components, and it would be necessary to consider the multiple cumulative connections and impacts of each one of these individual factors.

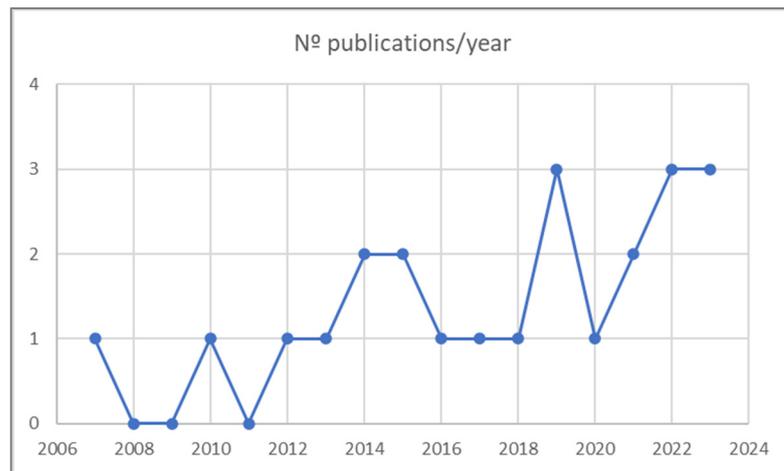


Figure 4. Number of publications per year in the area of ocean/marine citizenship in the Web of Science database.

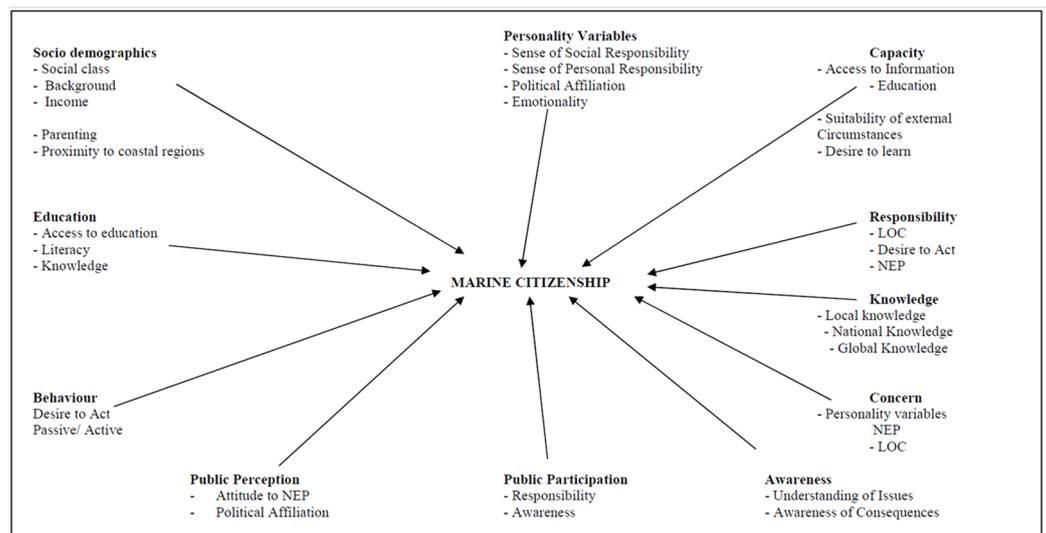


Figure 5. Model of ocean citizenship developed by McKinley [11] (p. 66), based on a review of the literature on models of environmental citizenship.

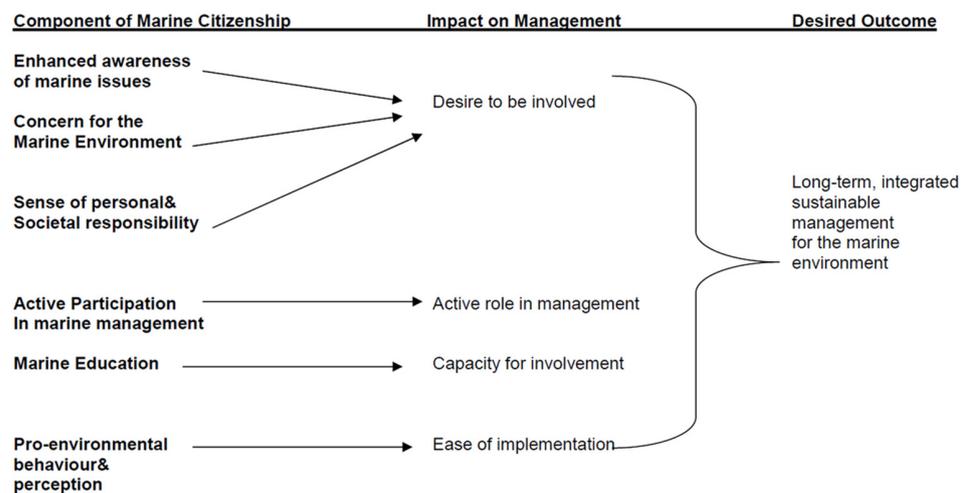


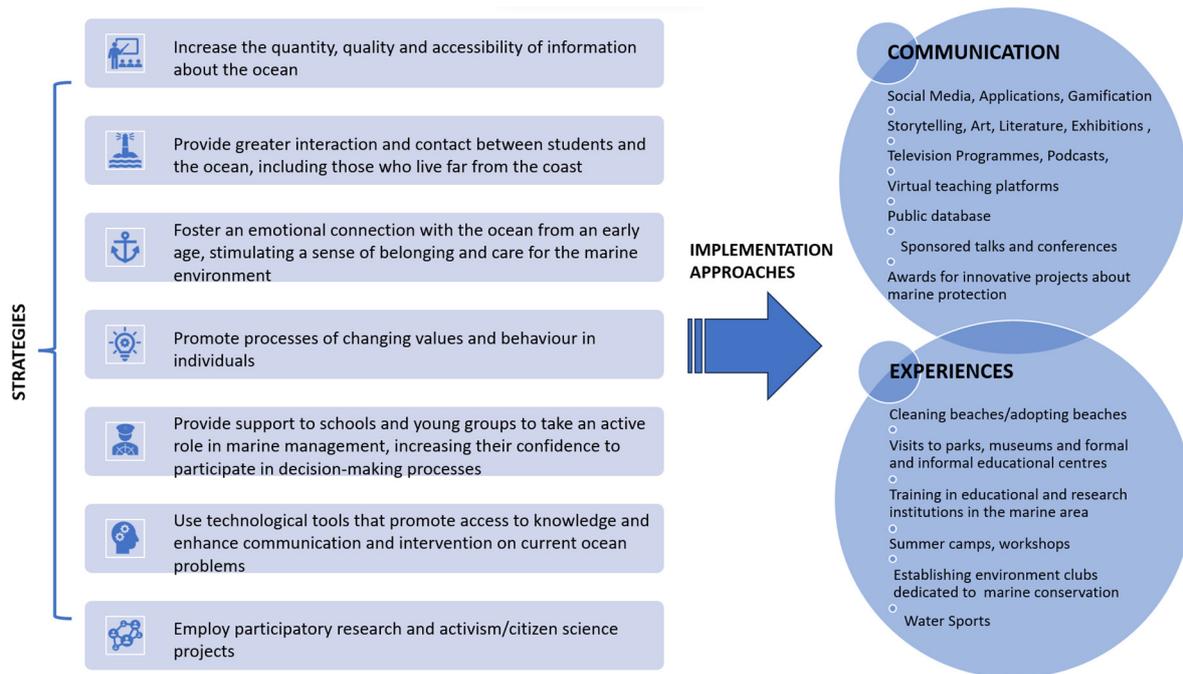
Figure 6. Refined model of ocean citizenship (source: McKinley [11], p. 162).

McKinley [11] adds that for ocean citizenship to be established successfully in society, marine management strategies should facilitate the involvement of the public and the raising of consciousness at a national level. For this to happen, however, it is fundamental for public policy to foster ocean citizenship, which should be developed and implemented from basic education onwards, in order to train a generation that is capable of taking action and fighting for the marine cause. Thus, it is essential to develop pedagogical models of ocean citizenship adapted to the school environment, bringing together various strategies and approaches that help to promote an active citizenship among students. Marine citizenship science projects [61–63] have proved to have great potential for fostering ocean literacy and citizenship, because they promote (a) the connection and direct contact of the public with the marine-coastal environment; (b) the collection of environmental data; (c) the production of new knowledge that, when shared, may influence and gain the trust of other groups of marine users, contributing to a positive effect on marine management; (d) the raising of consciousness; and (e) a social license, with a sense of responsibility and belonging to this environment.

Combined with youth activism, citizen science is considered to be a pedagogical approach from the bottom up, designed to promote the interest of students in the community, the environment, democracy and social justice, encouraging them to be active citizen scientists who contribute to the well-being of their communities [64,65]. The ideology behind this combination of citizen science and activism puts an emphasis on learning about the health of the local community, developing socially responsible curricula, blurring the boundaries between subjects and breaking down the walls of the school—facilitating a connection between the school learning and the space outside the school where students and their families live [65].

Youth activism is considered to be a key element in education for environmental citizenship, because “it refers to a process of collective, democratic, research-informed and negotiated problem-solving action on socio-environmental problems” [65] (p. 141). However, promoting activism in education encompasses several challenges that can make this process quite complex. These complexities arise from diverse perspectives, institutional structures, curricular considerations, teacher preparedness, cultural context and the promotion of meaningful student engagement [65]. The creation of tangible projects for local change that are simultaneously feasible and empowering facilitates the development of the conviction that change is possible [65], which can be a factor for attracting the engagement of citizens and stimulating their power to act to achieve the desired changes.

A study conducted in Scotland with young people between the ages of 11 and 26 showed that the vast majority were interested in participating in decision-making processes in plans for the management of the marine environment in their country [48]. The results of the research showed that young people value and recognize the coastal environment as an important space for leisure, recreation and social interaction, with these factors awakening their interest in the sea. Based on their own experiences, they suggest that visiting the coast is an important factor and is a precursor to promoting the interest and involvement of young people with regard to the sea. They also suggested other varied strategies for achieving this objective, such as practical actions, field trips, technical visits, the adoption of a beach, youth conferences, training with professionals working in the marine area, television programs and a better use of digital platforms, particularly social networks [48]. These and numerous other strategies with a potential for fostering ocean citizenship have been illustrated in Figure 7, compiled from the literature [3,13,43,46,48,57,61–63,66–75].



**Figure 7.** Diagram of the different strategies for fostering ocean literacy and citizenship, compiled from the literature.

### 3.1.4. Structuring the Conceptual Base of the Pedagogical Model

If used in an integrated and continuous way in the school curriculum, the multiple strategies referred to in the previous section facilitate the fostering of ocean citizenship in the school environment. Thus, the integration of these different strategies into four essential dimensions is proposed, each one with a specific action: (1) training, (2) experiences, (3) involvement and (4) activism (Figure 8).



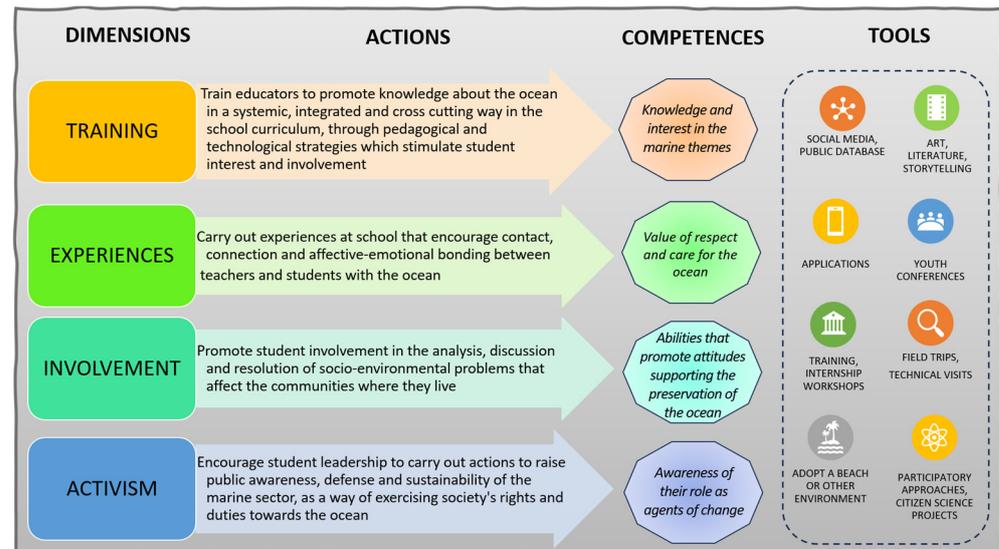
**Figure 8.** Four main dimensions and their respective actions for fostering ocean citizenship in the school environment.

It is hoped that the ocean citizenship projects, which include these four dimensions and their respective actions, can contribute to the development of basic competences in students, such as:

1. Knowledge and interest in marine themes;

2. Values of respect and care for the ocean;
3. Abilities that promote attitudes favoring the preservation of the ocean;
4. Awareness of their role as agents of change.

These competences, associated with each of the dimensions and actions of the model, as well as a series of tools that can help to foster initiatives for ocean citizenship have been systematized in the diagram of Figure 9, in this way structuring the conceptual base of the model for promoting ocean citizenship in the school environment. The definition of the conceptual base of the model was followed by the planning and structuring of the stages of its implementation in the school environment, corresponding to phase 2 of the design cycle.



**Figure 9.** Dimensions, actions, tools and competences that structure the conceptual base of the pedagogical model for promoting ocean citizenship in basic education.

### 3.2. Results Phase 2—Planning of Stages for the Implementation of the Pedagogical Model

Considering the series of elements that make up the conceptual base of the pedagogical model, a series of educational activities were planned for basic education (more specifically, the 4th, 5th and 6th years), to integrate these elements in the area of a citizen science project that would involve schools in the research and monitoring of and caring for their coastline. Six activities were chosen for the teachers to complete with their students during the school year: (1) contextualization of the problematic related to the ocean; (2) holding three field trips to monitor the beach; (3) evaluation of the data obtained in the field; (4) recording of the results; (5) sharing of results; and (6) actions for intervention in the school/community. This series of activities was structured with a view to the application of the four dimensions, actions and tools in the conceptual base of the pedagogical model. This correlation between the different elements of the conceptual base of the pedagogical model and the educational activities to be applied in the school environment has been structured in Figure 10.

In the contextualization stage, teachers should teach their students introductory content on the ocean to prepare them for the topics they will subsequently research at the beach they monitor. This content involves themes and scientific experiments that embrace the origins of the ocean and salt in sea water, the formation of waves, currents, tides, sand and beaches, the socio-environmental importance of the ocean to the planet and the impacts threatening the ocean at the present time. In order to be able to address this content, the teachers will first have to be trained in these themes. The training course has been structured to include three online workshops, one workshop for field work practice and three online evaluation workshops, as shown in Figure 11.

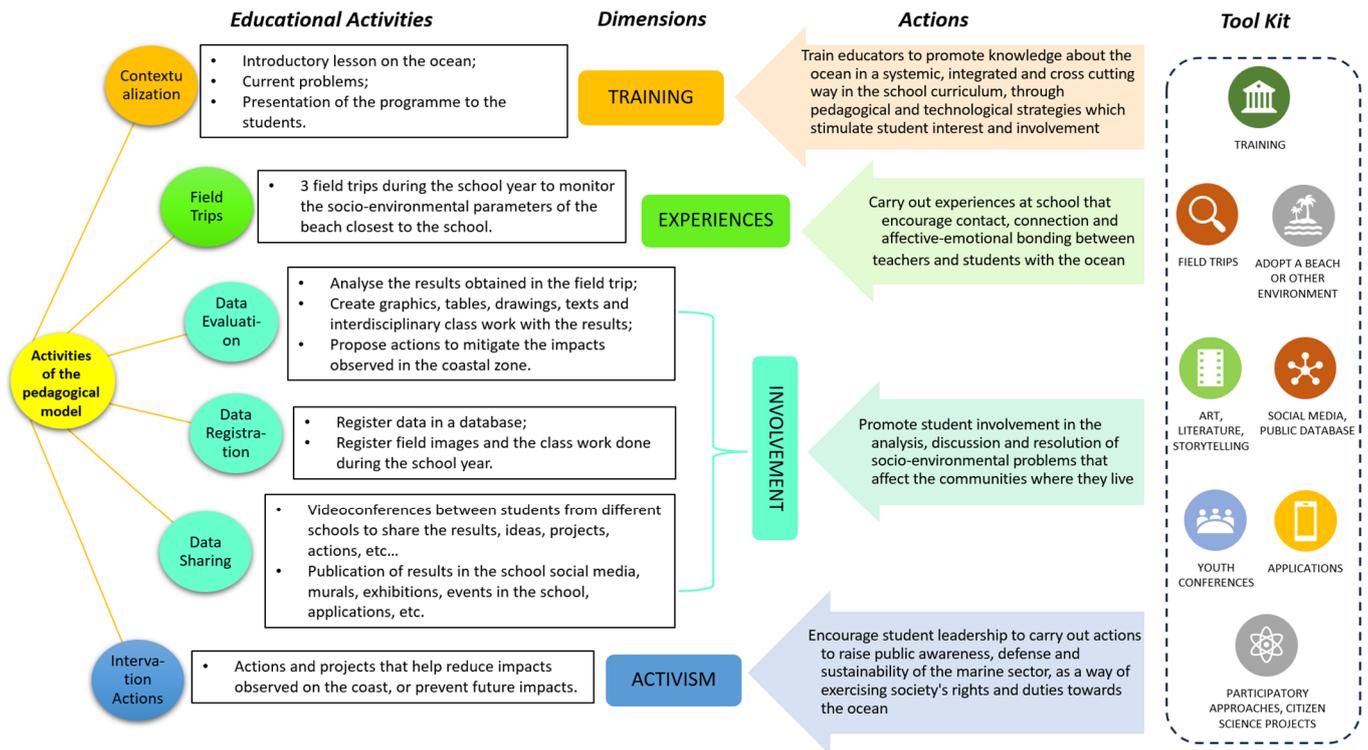


Figure 10. Correlation between the conceptual base and the educational activities of the pedagogical model.

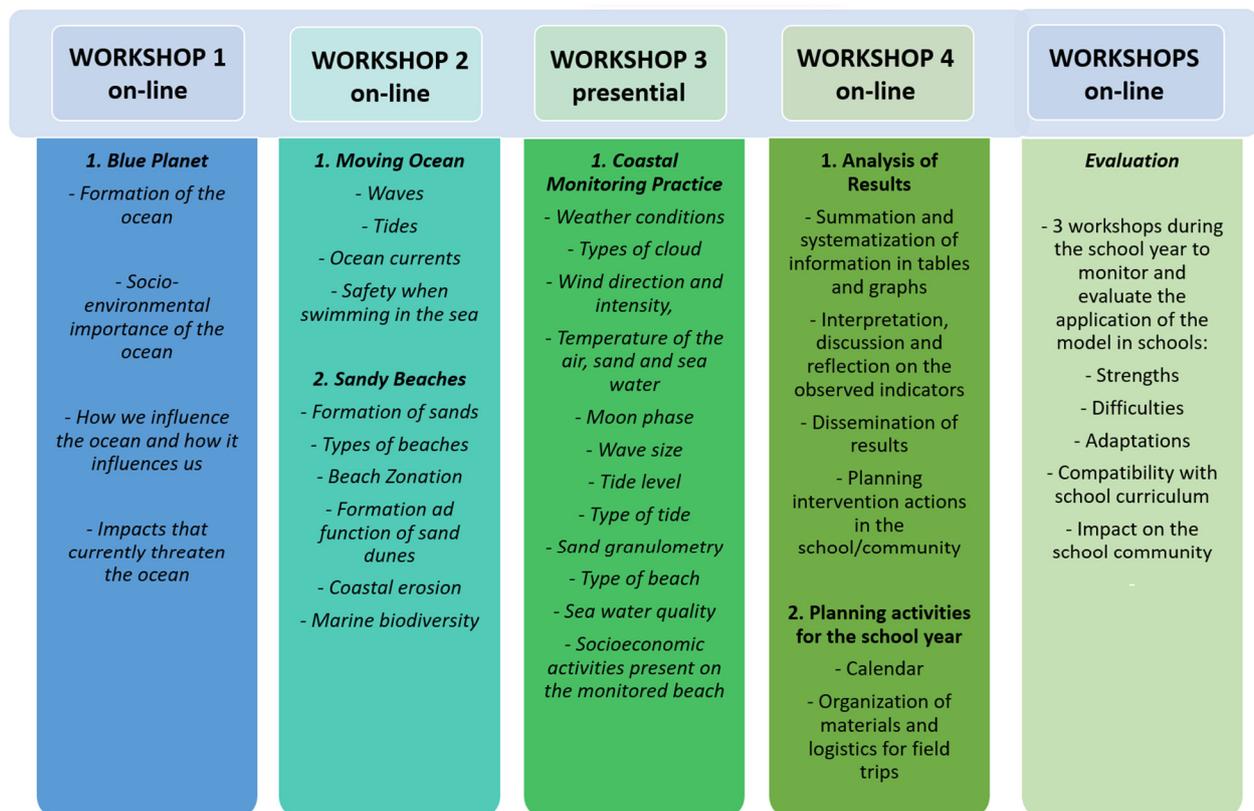
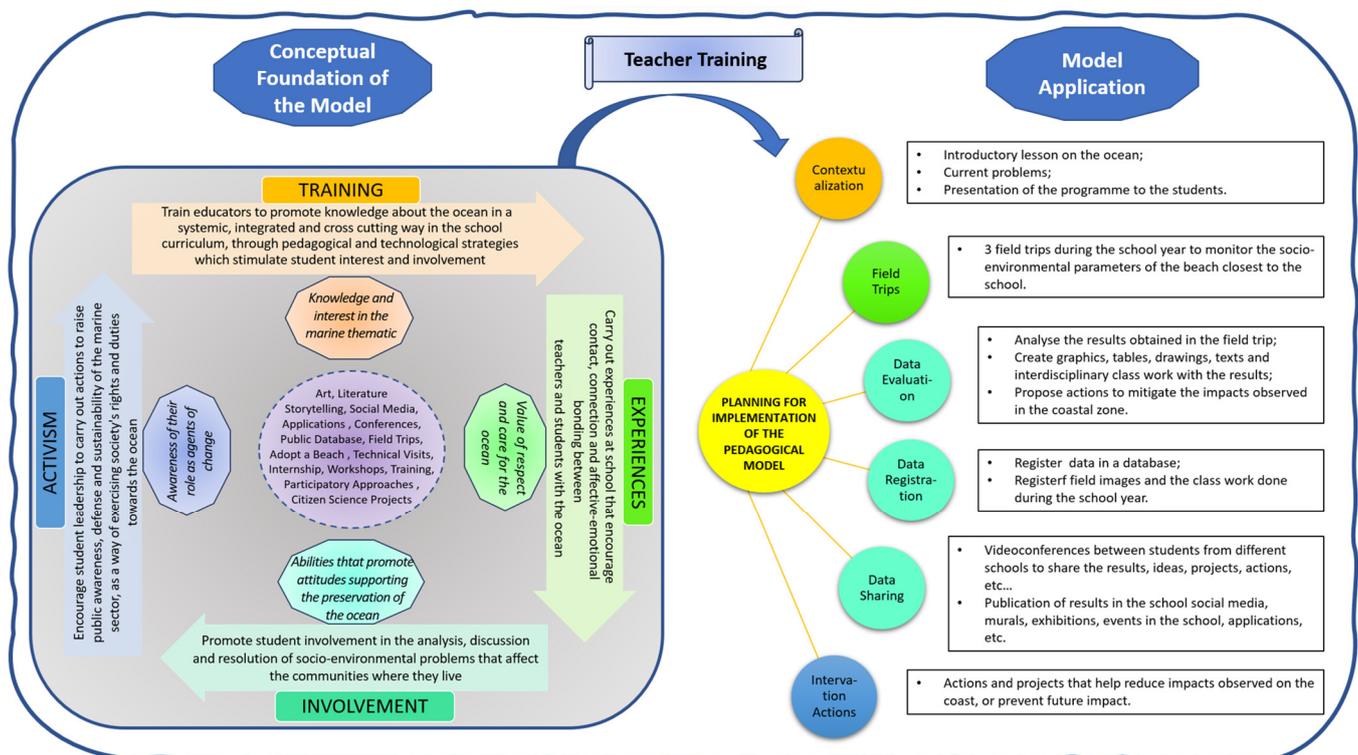


Figure 11. Diagram of the programmatic content of phase 1 of the training course for teachers.

For field trip activities, four types of analyses were chosen for the students in the monitoring of their coast, using the same parameters as the Monitoramento Mirim Costeiro Program (note: information about the Brazilian coastal monitoring program can be accessed at: “<https://www.monitoramentomirimcosteiro.com.br/> (accessed on 15 November 2023)”), which has monitored beaches with students from basic education since 2012. The analyses to be made include: (1) observation of the weather conditions of the day; (2) analysis of the quality of the sea water; (3) research of a sector of sand on the beach using a transect consisting of five squares of  $2 \times 2$  m, covering a total of  $20 \text{ m}^2$ ; and (4) observation of the socio-economic activities, services and structures of the beach.

In the evaluation, registration and data-sharing stage, teachers should work on the results obtained in the field in an interconnected way in the school curriculum, developing interdisciplinary projects with the students that involve the systematization of data (production of graphs, tables, diagrams, etc.), with their registration in an Excel bank and dissemination in the school community, social networks and other means of communication (news in the newspaper, letter to the state authorities, applications, videoconference between students, etc.). Lastly, teachers should have a discussion with the students with critical reflection on the results obtained, in order to consider possible actions to reduce the problems observed on their coast.

After structuring the educational activities of the pedagogical model, a final drawing was structured around two fundamental components. The first is the conceptual base of the model, and the second is the stages of its implementation in schools, with the training of teachers as the link between each component, making it feasible to implement the pedagogical model promoting ocean citizenship in basic education (Figure 12).



**Figure 12.** Final design of the pedagogical model promoting ocean citizenship in basic education.

It is expected that the application of this pedagogical model can contribute to an education committed to forming citizens who are more connected to nature, well informed, and more prepared to deal with the current problems that threaten not only the ocean but the environment as a whole. Although this is a pedagogical model developed with a focus on the marine environment, it is believed that it could be easily implemented in other

aquatic and terrestrial environments, adapting the theoretical content and field-analyzed parameters to the type of environment being monitored. Its adaptability and viability need to be tested; this will determine its potential to foster not only ocean citizenship but also environmental citizenship.

The proposed pedagogical model is aligned with the concept of Education for Environmental Citizenship, which is defined as “the type of education that cultivates a coherent and adequate body of knowledge as well as the necessary skills, values, attitudes and competences that an Environmental Citizen should be equipped with in order to be able to act and participate in society as an agent of change in the private and public sphere on a local, national and global scale, through individual and collective actions in the direction of solving contemporary environmental problems, preventing the creation of new environmental problems, achieving sustainability as well as developing a healthy relationship with nature” [76] (p. 8).

By fostering education, responsible behavior and community engagement, the pedagogical model also aligns with Education for Sustainable Development (ESD), which is recognized as a key enabler of all Sustainable Development Goals (SDGs) of the UN’s Agenda 2030, in particular SDG 4—Quality Education [77]. According to UNESCO [78], education can accelerate progress towards the achievement of the SDGs, as it holds significant power in transforming environmentally harmful behaviors by improving knowledge, instilling values and shifting attitudes. Education boosts environmental awareness and concern and fosters citizen engagement, with more educated individuals actively advocating for political decisions that protect the environment. With the aim of promoting ocean citizenship, the implementation of this pedagogical model in basic education has the potential to contribute to UNESCO’s indicator 4.7.1: assess the extent to which global citizenship education and education for sustainable development are mainstreamed in national education policies, curricula, teacher education and student assessment [79]. However, to accomplish this, it is imperative to employ multiple methodological approaches, considering the perspectives of both educators and students, and to assess the contributions of the pedagogical model not only for formal education but also for the implementation of a blue curriculum in schools, which is one of the goals stated by UNESCO for the Ocean Decade [53].

The proposed pedagogical model encompasses the main tools highlighted in the New Blue Curriculum—A toolkit for policy-makers [57] as essential to supporting teachers in implementing a blue curriculum, specifically: (1) lesson plans containing up-to-date resources about the ocean for teachers to present content in the classroom; (2) field trips, excursions and immersive experiences; (3) experiments designed to introduce science-based ocean processes to students; (4) documentaries, media and audiovisual materials; (5) digital tools; and (6) art [57] (p. 40). The toolkit emphasizes ocean citizenship as a key element to be fostered throughout the curriculum framework, encouraging student agency to act, interact and participate as active citizens. Thus, employing this pedagogical model to foster ocean citizenship in basic education will provide multiple educational tools for educators and students, which can underpin the implementation of a blue curriculum in schools.

Since ocean citizenship is part of the wider approach of environmental citizenship [13], it is suggested for future research to assess the potential for integration of this model with other educational approaches, such as science education, environmental education, education for sustainability and citizenship education, as each type of education has something important to contribute to environmental citizenship through its specific approaches, dimensions and practices [76].

#### 4. Conclusions

The proposed pedagogical model has a conceptual component based on the principles of systemic thought and elements compiled from the literature in the area of ocean literacy and citizenship, as well as a practical component based on marine citizen science and youth activism. This model has been designed to go beyond theoretical concepts, offering schools

a practical and objective way to foster ocean citizenship in basic education, with this being an innovative aspect of the research on ocean literacy. It is hoped that the implementation of this pedagogical model of ocean citizenship will contribute to rich and significant learning experiences for students and teachers, enabling them to develop a more systemic and integrated vision of their relationship with the ocean and motivating them to become real agents of change in their community.

The application of this pedagogical model in schools will be essential for testing its viability, measuring its educational impact and also for making the necessary adjustments and improvements, perfecting it through continuous design cycles. It is hoped that this pedagogical model can become an example to be replicated in basic education, contributing to new strategies for fostering ocean citizenship in elementary education as part of an international blue curriculum.

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