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The semantics of Ocean Literacy: several definitions in only one ocean

A semântica da cultura oceânica: várias definições num só oceano

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ABSTRACT: Despite its potential, formal education still hardly addresses topics referring to the marine and ocean environment in teaching-learning practices. Work in this area is being done in the context of Coastal and Marine Environmental Education (CMEE) and, more recently through the inclusion of the Ocean Culture (OC), resulting from Ocean Literacy (OL) guidelines. This article provides a bibliographic review of the different translations of the term "Literacy", as the terms "literacy" and "culture" have different meanings and semantic applications in Brazil, even in the science education context. The paper also contributes a bibliographical review of how CMEE and OC have been developed in the formal areas of basic education in Brazil. The results show that using the term "Ocean Culture" to translate Ocean Literacy has the greatest semantic relevance for the inclusion of topics related to the ocean in the formal teaching scope. As for the survey of papers carried out in these approaches, CMEE and CO during the period stipulated, it was verified that despite the diversity of topic contemplated in the studies, few are associated with the formal curriculum and the school context.

Keywords: ocean literacy; formal education; scientific education.

RESUMO: A educação formal, apesar do seu potencial, ainda pouco traz a abordagem a temas referentes ao ambiente marinho e oceânico nas práticas de ensino – aprendizagem. Os trabalhos na área ocorrem por meio da Educação Ambiental Marinha e Costeira (EAMC) e, recentemente, pela inclusão da Cultura Oceânica (CO), oriunda das diretrizes da *Ocean Literacy (OL)*. Este artigo traz uma revisão bibliográfica das diferentes traduções ao termo *Literacy*, visto que no Brasil os termos alfabetização, letramento e cultura apresentam sentidos e aplicações

semânticas distintas, inclusive no âmbito da educação científica. O trabalho também traz um levantamento bibliográfico de como vem sendo desenvolvida a EAMC e a CO nos espaços formais da educação básica no Brasil. Os resultados apontam que o uso do termo "Cultura Oceânica", para a tradução de *Ocean Literacy,* é o mais relevante semanticamente para a inserção de temas referentes ao oceano no âmbito formal de ensino. Já para o levantamento de trabalhos realizados nessas abordagens, EAMC e CO no período estipulado, verificou-se que, apesar da diversidade de temas contemplados nos estudos, poucos estão associados ao currículo formal e ao contexto escolar.

Palavras-chave: cultura oceânica; educação formal; educação científica.

1. Introduction

Knowing the relationships between the health of the ocean ecosystem and human health is fundamental for maintaining ecosystem services and human life (Ballantyne, 2004; Guest *et al*., 2015). The Anthropocene is the period marked by changes to the planet's balance resulting from the impacts caused by the way of life of the modern consumer society, ranging from the chemical composition of the atmosphere to the sixth mass extinction (Moore, 2015; Freitas *et al*., 2020). There is an urgent need for behavioral changes in the way modern society operates to maintain integrity of the oceans and the planet and, consequently, of humanity.

According to UNESCO (2019), our relationship with the ocean must be recognized as a culture – an Ocean Culture (OC), which involves knowledge, respect, art and customs and is embedded in our lives. In this context, formal education can act as a space for the inclusion of an OC associated with scientific and environmental education, and this requires a clear definition of concepts for their application in curricular guidelines (Ghilardi-Lopes *et al*., 2019; Pazoto *et al*., 2022a).

Ocean sciences and Marine and Coastal Environmental Education (MCEE), a typology proposed by Pedrini (2009; 2010) to synthesize what has been carried out on the Brazilian coast in the Environmental Education (EE) field, have been neglected in scientific education and most school curricula in different countries for a long time, resulting in a decline in public attention to ocean issues (Schoedinger *et al*., 2005; Pedrini *et al*., 2010). These authors suggest that, in some cases, oceans have been completely ignored in formal primary and secondary education, as well as in undergraduate courses that are not related to the topic. MCEE oftentimes takes a backseat to environmental education for terrestrial or freshwater ecosystems (Fauville, 2017).

Based on the perception of scientists, teachers and environmental educators in the United States about lack of content in school curricula that specifically contemplates the marine environment, the expression *Ocean Literacy* (OL) was coined between 2001 and 2004, being defined as "an understanding of the ocean's influence on you – and your influence on the ocean; that is, an ocean literate citizen uses knowledge and engagement to communicate about the ocean in a meaningful way and makes responsible decisions about this environment" (Cava *et al*., 2005, p. 5).

In Brazil, the expression was translated as *Cultura Oceânica (CO)* and has been applied based on the content available in the material called "*Cultura Oceânica para todos: kit pedagógico*", translated into Portuguese by Luís Filipe Alvarez Penereiro

in Santoro *et al*.(2020) from the original "*Ocean Literacy for All: a toolkit"*[1] (Santoro *et al.*, 2017). However, the literal translation of the document from English to Portuguese would be "*Alfabetização/Letramento Oceânico para todos: um kit de ferramentas*". Due to the semantic analogy of the Portuguese language in relation to the terms *alfabetização* (literacy), *letramento* (literacy) and *cultura* (culture) and their uses in scientific education, it is important to bring to light an analysis and discussion about the most appropriate way to refer to this topic, seeking an alignment in the terms based on the Brazilian reality, considering what has been used in other global contexts, such as "*Ocean Literacy*" or "*Literacia Oceânica*".

Therefore, this study aimed to:

(i) carry out a semantic analysis of the terms *alfabetização* (literacy), *letramento* (literacy), and *cultura* (culture) and their analogies in scientific education and the Portuguese language; and

(ii) understand the use and application of these terms by experts in MCEE and OC in the scientific literature within the scope of formal basic education in Brazil based on papers published in the field.

2. Methodology

This paper was developed based on a qualitative bibliographic research study (Severino, 2007; Gil, 2002; 2008). According to the aforementioned authors, bibliographic reviews, carried out based on past studies, allow the understanding of a certain topic or problem, contributing different analysis perspectives towards the object of interest of the research. To meet objective (i), a review of the available scientific literature was carried out, both via a virtual search (on the *CAPES* and *SciELO* portals) and in person (in collections at the *Univille* and *UFSC* libraries). We looked for the use of the terms "*alfabetização*", "*letramento*" and "*cultura*" and their respective semantic structures, analogies and uses in scientific education. To this end, authors such as Kleiman (1995), Freire (1996), Lacerda (1997), Soares (1998), Cuche (2002), Veiga-Neto (2003), Araújo (2004), Eagleton (2005), Mamede & Zimmermann (2005), Sasseron (2008) and Cunha (2017), among others, were extremely important. The analysis of this review was presented in a table format in order to guide the reader about the consulted authors and the term they address in their studies (documents).

To meet objective (ii), a bibliographical survey was carried out focusing on papers that address MCEE and/or OC and that were made within the scope of formal education in Brazilian schools. This survey was carried out using the keywords "*cultura oceânica*", "*alfabetização oceânica*", "*letramento oceânico*" and "*educação ambienal marinha e costeira*", associated with the terms "*escolas*" and "*Brasil*" in Portuguese. In English, the search was carried out using the "*ocean culture*", "*ocean literacy*" and "*marine and coastal environmental education*" keywords, associated with the terms "*schools*" and "*Brazil*" in *Google Scholar*, *Scopus* and *Web of Science*, encompassing studies published over a nine-year period, from 01/2013 to 04/2022. This period refers to the introduction of the concept of *Ocean Literacy* in South American countries, especially in Chile, by the National Ocean Policy (2017),

[1] *Ocean Literacy for All: a toolkit,* (https://ioc.unesco.org/publications/ocean-literacy-all-toolkit).

and in Brazil by the Interministerial Commission for Sea Resources (*Comissão Interministerial de Recursos do Mar*, CIRM) (2013). The results of this stage were incorporated into a table and discussed based on the data therein presented. The "Results and discussion" section – item 3 – has subtitles that, throughout the text, aid the reader in understanding how the proposed objectives were achieved.

3. Results and discussion

3.1. Semantic analysis of the terms "alfabetização", "letramento" and "cultura" and their analogies in scientific education and the Portuguese language

The texts by nineteen (19) authors who discuss and address the terms "*alfabetização*", "*letramento*" and "*cultura*" were analyzed within their structures and semantic analogies, totaling twenty (20) documents (Table 1). "*Alfabetização*" and "*letramento*" constitute an object of study by linguists and educators who focus on language. Among the documents, we highlight the contributions of three papers by author Magda Soares, a pioneer in the semantic discussions and application of the term *literacy* in Brazil, her developments in the use of the terms "*alfabetização*", "*letramento*", "*alfabetização científica*" and "*letramento científico*" in Brazilian education, especially in the work called *Alfabetização e Letramento* (Soares, 1998); Ângela Kleiman's work, who brought the concept of reading and literacy, addresses this discussion in the work entitled *Os significados do letramento: uma nova perspectiva sobre a prática social da escrita* (Kleiman, 1995); an article by Mamede & Zimmermann (2005), which discusses *Scientific literacy and STS in teacher training for the teaching of science*; and an article by Santos & Mortimer (2001), which discusses the importance of scientific and technological literacy so that students can act as citizens, making decisions and acting with social responsibility. We also consulted five articles that address scientific literacy in the teaching of natural sciences and other approaches, such as school culture and scientific culture: Sasseron (2008), Sasseron (2015), Sasseron & de Carvalho (2011), Lacerda (1997) and Cunha (2017). The latter provides a broad approach to the uses of the definitions of *scientific literacy* in the work called *Alfabetização científica ou letramento científico?: interesses envolvidos nas interpretações da noção de scientific literacy*; Freire (1996) addresses literacy practices. Another six papers were reviewed to bring the concept of culture and its different epistemological and philosophical aspects: Cuche (2002), Araújo (2004), Eagleton (2005), Nussbaumer (2007), Teixeira (2013) and Veiga-Neto (2003), the latter in particular with the work called *Cultura, culturas e educação*. Finally, two articles that address the concepts of scientific culture, including *Dossiê: História da cultura escrita* (Galvão & Frade, 2016). The authors' contributions are cited throughout the discussion.

3.1.1. The semantics of the term Literacy

The term *literacy* has its origins in the Latin *littera*, which means letter; in turn, suffix *cy* denotes quality, condition. Thus, *literacy* is the "state or condition assumed by those who learn to read and write" (Soares, 1998, p. 17). In the English language, the term *literacy* can be used both in reference to

TABLE 1 – Documents analyzed for understanding the uses of the terms *Alfabetização* (A), *Alfabetização Científica* (AC), Letramento (L), *Letramento Científico* (LC), *Cultura* (C) and *Cultura Científica* (CC) in education, based on the authors referenced.

References	Occurrences					
	A	AC	L	LC	C	CC
Araújo, 2004					•	
Cuche, 2002					•	
Cunha, 2017		•		•		
Eagleton, 2005					•	
Freire, 1996			•			
Galvão & Frade, 2016						•
Kleiman, 1995			•			
Lacerda, 1997		•				
Mamede & Zimmermann, 2005				•		
Nussbaumer, 2007					•	
Santos & Mortimer, 2001				•		
Sasseron, 2008		•				
Sasseron, 2015		•				•
Sasseron & De Carvalho, 2011		•				•
Soares, 1998	•	•	•	•		
Soares, 2009			•			
Soares, 2018	•	•	•			
Teixeira, 2013	•		•		•	
Veiga-Neto, 2003					•	
Vogt, 2006.						•
Total documents by terms	**3**	**7**	**6**	**4**	**6**	**4**

SOURCE: the authors, 2022.

learning written code and referring to the effective possibility of the social use of reading and writing skills (Soares, 1998).

When translated into Portuguese, in Brazil, the term *literacy* can become "*alfabetização*" or "*letramento*". However, one must be vigilant when choosing one of the terms over the other, because "*alfabetização*" and "*letramento*" have different meanings, according to Brazilian linguists (Teixeira, 2013). "*Alfabetização*" refers to the act of teaching/learning to read and write. On the other hand, "*Letramento*" is the state or condition of someone who not only knows how to read and write, but also carries out reading and writing activities – to satisfy social demands (Soares, 2009).

In other languages, such as English, studies related to scientific education use the term *literacy* to designate "*alfabetização*" and "*letramento*" as simultaneous teaching-learning processes. Thus, the use of the term *Ocean literacy* to strategically define the incorporation of scientific concepts about oceans in school curricula is popularly disseminated and translated as "*alfabetização dos oceanos*" or "*letramento dos oceanos*"

This concept of *Ocean Literacy* (or marine literacy) was conceived based on the definition of *science literacy* (Strang, Decharon & Schroedinger, 2007), translated into Portuguese by some authors as "*alfabetização científica*" or "*letramento científico*", justified by Sasseron (2008) as the incorporation of scientific knowledge into culture and its appropriation through reading and writing, in order to use it to change oneself and the world.

However, in Brazil and other South American countries, the term chosen for this approach was "*cultura*" (culture). According to the authors referenced in Table 1, this is due to the semantic

analogies that the terms "*cultura*", "*alfabetização*" and "*letramento*" present in the area of Linguistics and in the dissemination of scientific education in Brazil, the latter being shaped by a polysemy of terms such as: "*cultura científica*" (scientific culture), "*enculturação científica*" (scientific enculturation), "*alfabetização científica*" (scientific literacy), and "*letramento científico*" (scientific literacy) (Cunha, 2017; Soares, 2018). For some of the authors referenced in Table 1, such as Sasseron & Carvalho (2011) and Teixeira (2013), the difference between these terms, despite being semantic, does not represent significantly differences in the objectives for scientific education which, according to Freire (1996), should enable citizens to participate in decision-making in a critical and emancipatory way.

3.1.2. Why use the term "Cultura" instead of "Alfabetização" or "Letramento" to translate "Literacy"? An analysis based on the semantic relationships and analogies of terms and their uses in scientific education (Table 1)

For Magda Soares (2018, p. 16), etymologically, the term "*alfabetização*" does not go beyond the meaning of "leading to acquisition of the alphabet", that is, teaching the code of the written language, teaching the skills of reading and writing; "[…] '*alfabetização*' would be a process of representing phonemes in graphemes (writing) and graphemes in phonemes (reading)".

"*Alfabetização*" develops basically around two points of view: the "mechanical" part of the written language versus understanding/expression of meanings, considered individual processes of "*alfabetização*", and from a third point of view that is associated with the social aspect or, on other words, "*alfabetização*" is not the same in all societies (Soares, 2018). For example, for an artisanal fisherman, the process of "*alfabetização*" has different functions and purposes than the process of "*alfabetização*" for a merchant marine employee. Therefore, "*alfabetização*" depends on social determinants such as culture, economy and technology to develop (Soares, 2018).

In this sense, education brings the analogy to the term and its application in scientific education. Thus, the expression "*alfabetização científica*" (scientific literacy), according to Lacerda (1997, p. 98), is considered:

> [...] the understanding of basic scientific principles, essential for the individual to understand, interpret and interfere appropriately in discussions, processes and situations of a technical-scientific nature or related to the use of science and technology. It is instrumentation of the individual with valid and significant scientific knowledge from both a social and personal point of view.

The need to change the understanding that it is not enough for individuals to know how to read and write in the process of "*alfabetização*", but rather to engage in reading and writing practices in various contexts, including scientific education, gave rise to discussions on the concept of "*letramento*" to Brazil around 1980. In the meantime, the discussion of "*letramento*" in the country, as a result of the action of reading and writing, understanding language as a social practice, is always rooted in the concept of "*alfabetização*", that is, the initiation in the use of

the orthographic system, leading to an inadequate fusion of both concepts (Soares, 2018).

"*Letramento*" is the result of the action of teaching and learning the social practices of reading and writing, the state or condition that a social group or an individual acquires as a consequence of having appropriated writing and its social practices (Soares, 1998).

Before constituting a set of intellectual skills, "*letramento*" is a cultural, social and historically established practice, which allows the individual to leverage their advantages and, thus, exercise their citizenship, deciding the destinies of the community to which they belong, the traditions, habits and customs with which they identify (Santos *et al*., 1998).

The plurality of the term "*letramento*" is also discussed in scientific education, and authors such as Santos & Mortimer (2001) and Mamede & Zimmermann (2005) use the expression "*letramento científico*" (scientific literacy) based on the meaning of the term defended by two great linguistics-researchers, presented in Kleiman (1995, p. 19) and Soares (1998, p. 18). These authors define "*letramento científico*" as "the result of the state or condition that a social group or an individual acquires as a consequence of having appropriated writing". Thus, we can say that "*letramento científico*" involves not only the action of teaching or learning to read and write scientific and technological knowledge, but especially its interrelationship with society (Cunha, 2017).

These interrelationships inherent to different social contexts are embedded in the cultural plurality of each individual. To this end, it is necessary to define the concepts attributed to the term "*cultura*" (culture).

For Araújo (2004), "*cultura*" is common to everyone, it is ordinary, and is part of living in society. It is constructed from the interrelations of social practices and is a fundamental element for understanding who we are and where we are going.

Due to the variety of meanings of this term, derived from Latin, which gave rise to both expressions of care and cultivation and expressions that designate sets of knowledge and habits of certain societies, it is difficult to achieve its conceptual exhaustion (Veiga-Neto, 2003). Given the vast production of meanings on the topic - in Anthropology, Sociology and Philosophy - in general terms, we adopted the concept of "culture" synthesized by Eagleton (2005), which defines it by the composition of norms and practices: norms that govern what is done and practices the way these actions are performed, that is, "culture" cannot be understood except through relationships.

Leaving the technical and semantic concept of "culture" and moving on to its use/concept in scientific education, there is the incorporation of the term "*cultura científica*" (scientific culture), which, according to (Vogt, 2006, p. 25), can be understood as:

> [...] the advantage of encompassing social paradigms and also containing, in its field of meanings, the idea that the process which involves scientific development is a cultural process, whether it is considered from the point of view of its production, of its dissemination among peers or in the social dynamics of teaching and education, or even, from the point of view of its dissemination in society as a whole, for establishing the necessary critical relationships between the citizen and the cultural values of their time and history.

For this author, the expression "*cultura científica*" (scientific culture) or "*enculturação científica*" (scientific enculturation) has shown that science is a cultural manifestation, understood as the manifestations of a people presented in the most diverse knowledge areas.

Given this plural and semantic context of the term "literacy" translated as "*alfabetização*" or "*letramento*" (with different meanings and applicability in Brazilian Portuguese) and the analogy to the term "*cultura*" (culture), the use of the term "*cultura*" is reinforced to compose the concept of "*Cultura oceânica*" (Ocean Culture) for the translation of "Ocean Literacy" in Brazil, as it has been used in different nationalities and contexts, mainly in South America (Santoro *et al*., 2020; MacNeil *et al*., 2021; Worm *et al*., 2021).

In other countries, the term *literacy* presents translations and linguistic connotations characteristic of the root of its words, that is, diachronic nuclear morpheme and lexical meaning, specific to their cultures and, when they make up the term "ocean", it gives meaning to the needs of each nation to recognize the importance of this ecosystem. For example: in Portugal, the translation of *Ocean Literacy* is "*Literacia Oceânica*"; in France the terms *Connaissance de l'océan/Alphabétisation océanique* are used, which can be translated into English as "Knowledge of the ocean"/"Ocean Literacy"; in Italy, *Educazione all'oceano*, translated as "Oceanic Education"; and in Poland. *Świadomość morska*. translated as "Consciousness of the sea". In South America, some countries like Brazil and Colombia use *Cultura Oceânica*, and Chile uses both forms: *Alfabetización Oceânica* and *Cultura Oceânica*. We also find other translations in Portuguese, such as: *Conhecimentos do mar*, *Consciência do mar*, *Educação marinha/habilidades marinhas*, and a term that is widely recognized in Brazil – *Mentalidade Marítima* (Maritime Mentality) – which gave rise to the Maritime Mentality Program (*Programa Mentalidade Marinha*, PROMAR), created in 1997 to disseminate diverse information about the ocean and marine environments and their conservation, becoming an important communication means between civil society and the academia on this topic during the 1990s (CEMBRA, 2019; Pazoto *et al.,* 2023). Ultimately, each nationality adapts the term to its linguistic properties and the intrinsic sociocultural demands of each location depending on the environmental requirements and standards of the current period (Worm *et al*., 2021).

In a recent paper, Worm *et al*. (2021) report that a person that can read and write and is literate in the ocean is understood as someone who has specialized knowledge on the subject matter, such as a scientist or another professional related to marine sciences. However, for the IOC (Intergovernmental Oceanographic Commission), the term "culture" implies that the relationship with the ocean must involve different forms of knowledge, values and customs that are part of the everyday life of any citizen, not merely those with a scientific aspect.

Dealing with the application of terms, MacNeil *et al*. (2021) consider that the concept of "*alfabetização*" itself reflects the Western scientific understanding, that is, it is a term that is particularly problematic in the context of indigenous and *quilombola* peoples, as well as in isolated communities, as it risks perpetuating a colonial appropriation of the knowledge, practices, pedagogies and relationships of these peoples with nature. Finally, we delve into translation and language issues of the term *Ocean Literacy*, which was conceived in Anglophone ins-

titutions and is now being applied and translated in different linguistic and cultural contexts.

3.1.3. The Ocean Culture in the school context

In Brazil, especially in the school and scientific education contexts, as already mentioned, the concept of "*alfabetização*" is confused and incorporated into the concept of "*letramento*", and both can be understood as inseparable, as the "*alfabetização*" process is inserted in the "*letramento*" process and, consequently, both are part of the Brazilian educational culture (Figure 1).

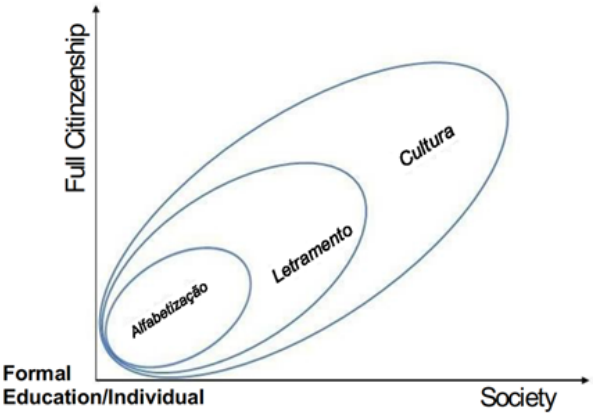

FIGURE 1 – Integration of concepts to understand the relationship between "Cultura", "Alfabetização" and "Letramento" in the educational and social spheres.

SOURCE: the authors, 2020.

Thus, it can be stated that, in the sphere of formal basic education, the use of the terms "*alfabetização*" or "*letramento*" is part of the broad universe of different cultural expressions (school, religious, family, material, immaterial and organizational, among others). However, as we understand that the history of "*alfabetização*" focuses on understanding the phenomenon of acquisition/appropriation of a new technology and its materials (Soares, 1998), and that the history of "*letramento*" focuses on the social uses of reading and writing (Soares, 1998), the use of the term "*cultura*" is reinforced to compose the translation of *Ocean Literacy*, as it is understood in different spheres and social contexts as part of the individual.

In culture lies what regulates our coexistence and our communication in society (Galvão & Frade, 2016); thus, it is conceivable that culture, in the composition of the term "ocean", refers to a breadth of the concept that today brings about an approach supported by recognition of attitudes and behaviors that go beyond the acquisition of scientific knowledge and emphasizes that behavioral change requires certain understanding of how the audience connects with a given place and with the dominant relationships established, or not, in that place (McKinley, Burdon & Shellock, 2023).

When properly interpreted and applied, the proposal of Transversal Contemporary Topics, listed in the National Common Curricular Base (*Base Nacional Comum Curricular*, BNCC) (Brazil, 2017) is relevant because it enhances reflection and criticism on the issues that emerge from contradictions derived from multiple cultural backgrounds (multiculturalism). For Sasseron (2015, p. 53), the relationships established at school, and being in this institution, already mean participating in a culture. The actions that take place at school and participation in its activities, the relationships that are established through coexistence, life experiences, and shared knowledge constitute school culture (Cunha, 2017). In this sense, when associated with

relations with the ocean in the school space, the term "culture" implies the involvement of different forms of knowledge, values and customs that are part of everyday school life. To this end, this space has the important role of collaborating so that issues related to the environment, health, economy, multiculturalism, science, technology and citizenship are developed.

Likewise, dealing with MCEE and/or OC in the school space initially requires certain understanding of the multiculturalism present in that space. For example, students from the same school and born in the same city have different biotypes and cultures, associated with cultural heredity, such as indigenous, African, European, Arab and Asian, among others (Ciliato & Sartori, 2015). This cultural plurality, imbued in each individual with different forms and perceptions, becomes complex, requiring the school to address cultural relationships and differences in the curriculum, favoring interactions and engagement in society. Thus, OC incorporates the idea that respect for the ocean is directly related to the knowledge, traditions and historical context of communities. For example, the artisanal fishing culture is intricate in a process of art of knowledge focused on social relations and political, economic and moral reflections (D'Angelis, 2020). The cultural universe of fishing is a representation of the art of fishing, the naval construction of boats, the fisherman's specific language, legends and beliefs, religiousness and the daily history of the old fishing masters, who perpetuate this culture across generations (Da Silva, 2009).

We can also highlight the cultural traditions that link the sea to the consecration of *Iemanjá*, a religious manifestation that modifies the usual landscape of beaches, coves, bays and oceans, incorporating elements, people, objects, feelings, sounds and colors (Damasceno, 2015). Body, religious and symbolic languages are exposed and celebrated, values and beliefs are exalted, identification with the place is also reasserted, and tradition remains in society. The Queen of the Sea is represented in many cultural expressions that promote ocean values (Worm *et al*., 2021).

However, the diverse cultures related to the ocean are not always associated with the most sustainable practices, both individually and collectively, as can be seen by industrial fishing and whaling (D'Angelis, 2020). Despite the religious and spiritual connection with the ocean, the use of non-biodegradable material is common, as is neglecting fishing nets that are lost in the oceans, pointing to lack of knowledge that could be addressed by an integrated effort by MCEE and OC articulated with scientific knowledge (Worm *et al*., 2021).

The school can become a suitable space to strengthen the development of MCEE and, consequently, of OC, if regulatory agents recognize the importance of this task. According to Pazoto *et al*. (2021), the school can help disseminate OC by incorporating this topic into the curriculum content, through practical, dynamic and interactive activities. Although there are projects involved in expanding knowledge about ocean issues in Brazil, (Fonseca *et al.*, 2010; Berchez *et al.*, 2016; Pedrini *et al.*, 2019; Pazoto *et al.*, 2022a), especially the edition of the book organized by Pedrini (2010), which addresses topics relevant to marine and coastal environmental education, proposing preservation policies and educational proposals for the area, even so, actions that are isolated and disconnected from national, state or municipal education policies still configure the published documents.

3.2. Bibliographical review of the scientific literature on MCEE and OC within the scope of formal basic education in Brazil based on papers published in the area, from 2013 to 2022

3.2.1. Analysis of the papers on MCEE and OC with focus and development in formal education in basic education schools in Brazil

The survey of articles in the area indicated that, in Brazil, studies that address MCEE and OC related to the school context and formal teaching activities have had a significant increase in the last three years (Table 2).

Of the forty-seven (47) papers identified by the search system, twenty-four (24) were published in journals as scientific articles, three (3) are PhD theses, seven (7) are MSc theses, five (5) are chapters from books or notebooks, and eight (8) are course conclusion papers. Of the forty-seven (47) documents, 32 (68.1%) addressed activities or themes related to formal education, 27 (57.5%) described non-formal activities, and ten (10) (21.3%) papers included both approaches. Among the descriptors, the most representative were *Educação Ambiental Marinha e Costeira* (Marine and Coastal Environmental Education), with twenty-four (24) documents and *Cultura Oceânica* (Ocean Culture) (both in Portuguese), with the latter appearing in seventeen (17) papers published since 2020, one year after institution of the term OC in Brazil. When using the term *Ocean Literacy*, nine (9) papers were found, the first one published in 2018; and only one using the term *Letramento Oceânico* (reference, in 2022).

The papers are related to topics such as marine litter and solid waste (Carreiro & Fernandes, 2014; De Araújo *et al*., 2014; Menck, 2020); curricular interventions associated with Oceanography courses (Zappes *et al*., 2021; Turra *et al*., 2021; Da Silva; Kitzmann, 2020); production and application of teaching material about the marine environment, such as games, booklets, collections and playful activities (Towata, 2013; Fernandes *et al*., 2017; Dos Santos Gomes & Aguiar, 2021; Stefanelli-Silva *et al*., 2019; Pazoto *et al*., 2021; Costa *et al*., 2022; Cunha Junior *et al*., 2022); climate change (Berchez *et al*., 2016; Cunha Junior *et al*., 2022); activities on mangroves (Campos & Gonçalvez, 2020; Brito, 2020) and work related to the BNCC, curriculum and OC in formal education (Ghilardi-Lopes *et al*., 2019; Pazoto *et al*., 2022a; Pazoto *et al*., 2022b ; Motokane *et al*., 2021). Few papers have addressed terms related to scientific education, such as scientific knowledge, scientific education and dissemination, scientific literacy ("*alfabetização*"), scientific education (Amorim Junior, 2014; Santos *et al*., 2018; Stefanelli-Silva *et al*., 2019; Motokane *et al*., 2021; Barradas, 2020; Barata, 2021).

In the documents that are restricted to non-formal activities, the papers that stand out the most are those related to projects or data collection on coastal management (Pedrini, 2019; Friedrichsen, 2020; Gonçalves, 2021; Pfuetzenreuter, 2021); emblematic topics, such as traditional populations, trails, charismatic species, fishing communities and tourism (Ghilardi-Lopes *et al*., 2015; Rodrigues, 2018; Silva *et al*., 2019; Pedrini *et al*., 2019; Arruda, 2020); associated with perception and knowledge about the marine environment through drawings and questionnaires to the general population (Pedrini *et al*., 2013; Rua *et al*., 2015; Lima, 2021); trips and vi-

TABLE 2 – Documents analyzed between 2013 and 2022 on Marine and Coastal Environmental Education (MCEE) and Ocean Culture (OC) related to the school context and formal teaching activities in Brazil.*

Period		Descriptors							Databases			Documents					Modalities		
Year	**(n)**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**G**	**S**	**W**	**1**	**2**	**3**	**4**	**5**	**FE**	**NF**	**FN**
2013	2							2	2			1	1				1	1	
2014	3							3	3			1		1		1	3		
2015	3						1	2	3			2				1	1	2	
2016	2						1	2	2	1	1	1		1			2	1	1
2017	1							1	1			1					1		
2018	2		1	1				2	2		1	1				1	1	1	
2019	6			4			3	3	5		1	2			3	1	4	5	3
2020	9	4		1			2	4	8		1	3	1	3		2	5	7	3
2021	14	10	1					4	14			9	1	1	2	1	10	8	4
2022	5	3	1	3	1	1	1	1	6	3	1	4		1		1	4	3	1
Total	**47**	**17**	**2**	**9**	**1**	**1**	**8**	**24**	**45**	**4**	**5**	**24**	**3**	**7**	**5**	**8**	**32**	**27**	**10**

KEYS:

Descriptors:

a) “cultura oceânica” AND “escolas” AND “Brasil”

b) “ocean culture” AND “in schools” AND “in Brazil”

c) “ocean literacy” AND “in schools” AND “in Brazil”

d) “alfabetização oceânica” AND “escolas” AND “Brasil”

e) “letramento oceânico” AND “escolas” AND “Brasil”

f) “marine and coastal environmental education” AND “in schools” AND “in Brazil”

g) “educação ambiental marinha e costeira” AND “escolas” AND “Brasil”

Documents

1 - Articles; 2 - Theses; 3 - Dissertations; 4 - Book Chapters;

5 - Course Conclusion Papers/Monographs

Research databases:

G – Google Scholar

S – Scopus

W – Web of Science

Modalities:

FE - Formal Education

NF - Non-Formal Education

FN - Formal + Non-Formal

*Full TABLE 2 in Supplementary Material.

SOURCE: the authors, 2022.

sits to museums (Biondo & De Oliveira, 2021; Dos Santos Gomes & Aguiar, 2021), activities related to raising awareness about marine litter (Rosa, 2020; Menck, 2020) and activities proposed for work related to cultural musical aspects (Cordeiro, 2022).

Despite the diversity of topics covered in the studies, few addressed the relationship between these themes and the formal teaching curriculum and its guiding documents. Most of the papers were carried out in non-formal or informal education, such as short-term university extension projects

on awareness and conservation, resulting in the creation of teaching materials and exhibitions. This trend was also observed by Lima (2021), who verified that the knowledge about the ocean of the study target audience was greater in the participants who had contact with non-formal or informal activities, with marine conservation projects, such as the *Tartarugas Marinhas* (TAMAR) (Sea Turtles), *Golfinho Rotador* (Dolphins) and *Albatroz* (Albatross) projects, among others. Therefore, although OC and its principles were designed for formal education, there are few publications from this educational space.

Most of the papers in the analysis mention the works as MCEE practices without linking them to or describing the OC Principles. This premise comes from the recent period, the 1980s, in which MCEE work became prominent, although restricted to academic activities (Fauville, 2017). Specifically, when related to formal education, in primary schools, the field of research in marine education is scarce and a large part of the publications are descriptions of teaching activities without studying the learning processes or results (Uyarra & Borja, 2016).

In its structure, this pattern of publications and papers presents a naturalistic view concerning the environment, as well as the constant elaboration of curricula and textbooks prepared with a strong terrestrial bias, omitting in parts the diversity of information that could be explored about the marine environment (Brito, 2020). In fact, these omissions are specific and result in an incomplete or inaccurate addressing of fundamental concepts, ending in little availability of information with accessible language about coastal and ocean marine ecosystems in the Brazilian literature (Brito, 2020).

The scarcity of terms and concepts related to the marine environment and scientific education, as observed in the data presented (Supplementary material) is a factor to be considered, as only five documents address these concepts. Scientific vocabulary and practices with an emphasis on scientific education require a knowledge from teachers and researchers that goes beyond the semantic structure of terms. Educating scientifically means reading its language to understand the syntactic and discursive structure, as well as the meaning of its vocabulary, interpreting formulas, graphs, tables and different text genres. This approach shapes a critical citizen who builds their arguments based on scientific assumptions, which distinguishes it from common sense argumentation (Santos, 2007).

Non-exposition to MCEE and OC in the school space can be related to the documents that guide formal education in different instances, both national (BNCC) and regional. For example, Pazoto *et al*. (2022a) observed nineteen (19) words and seven hundred and ninety-seven (797) citations related to the marine environment, with greater variation in words and citations in the regional curricula, when compared to the BNCC (national). These authors concluded that marine content appears in the reformulated documents from 2018 onwards, and that the curricula are heterogeneous across the Brazilian Federation Units, which is expected when understanding the concept of OC.

In relation to the content for the final years of Elementary School at the national level (BNCC), the word "*oceano*" only appears in the subjects of Geography, in the topic of Ocean Pollution and History, in topics concerning the navigation routes of the Atlantic, Pacific and Indian oceans (Ghilardi-Lopes *et al*., 2019). In the guidelines for High

School, topics such as climate change, pollution by chemical and solid waste, interference in the dynamics of beaches and in the management of Conservation Units, anthropogenic impact on biodiversity and extraction activities of living and non-living resources from the ocean are included in competencies two and three of Natural Sciences and Human Sciences (Geography), respectively (Motokane *et al*., 2021). Fortner (2009) reinforces that the Ocean Science has been addressed in schools in a transversal way, as part of Biology and Earth sciences, which mainly meets principles five and six of the OC, indicating certain underutilization of the potential that is working with OC in this space.

Due to its nature of connecting knowledge from different areas, Environmental Education in schools has a transversal, interdisciplinary or transdisciplinary character (Fonseca *et al*., 2010; Correia, 2019). Due to this characteristic, OC can be included in different modalities of formal education curricula, as well as in non-formal practices, given the need for this knowledge to reach all segments of society. The integration of scientific education, MCEE and OC presents itself as an alternative, oftentimes experimental, way of knowing and learning about the environment in which the school community is located, and it is effective in contemplating knowledge from a holistic and inclusive approach (Worm *et al*., 2021).

3.2.2. What is still missing to truly develop MCEE and the Ocean Culture in the school space?

The challenge of making citizens aware of the dynamics and functionality of the oceans involves incorporating concepts about the ocean into curricular proposals, political pedagogical projects and didactic planning on a regular, disciplinary and interdisciplinary basis or as a transversal topic, with the premise of changing perceptions and behaviors in relation to oceans and coastal ecosystems. Therefore, there is a need for a change in the school space to add practices that go beyond:

i. the current curriculum, in which topics concerning the terrestrial environment predominate;

ii. the technical and fragmented view of knowledge;

iii. the lack of medium- and long-term integrative projects associated with the high turnover of non-permanent teachers who are disconnected from the school community; and

iv. the absence of training to work on the topic, whether in coastal or inland municipalities.

As we still have a school built with greater focus on the "*alfabetização*" perspective, that is, a priority to teach the code of the written language and the skills of reading and writing, the cultural, social and emancipatory processes that permeate the objectives are left out of the scientific and critical education (Soares, 2018).

Considering that:

i. the construction of the cultural model of consumer society took us to the Anthropocene (Moore, 2015; Freitas *et al*., 2020);

ii. the ocean is a little-known biosphere compartment of planetary importance for regulating processes on global scales, such as climate (IPCC, 2022); it is urgent to develop critical education fo-

cused on the cultural context, based on natural and ocean sciences, to move towards a healthy society.

Some current problems, such as loss of biodiversity, plastic pollution, ocean acidification and rising sea levels due to climate change, have transcended society and resulted in behavioral changes and, consequently, in cultural changes (Uyarra & Borja, 2016; McKinley, Burdon & Shellock, 2023).

OC has always been present in humanity due to its subsistence and resource needs; however, it was little considered in the elaboration of school curricula in Brazil, a fact evidenced by the analysis of objective (ii). Thus, the need to implement strategies and documents that guide OC in the school context is reinforced. Many coastal school communities are located in traditional territories or have students' families that have lived there for generations. Traditional ecological knowledge of people's connection with the land and sea presents itself as a powerful and alternative experience of knowing and learning about our environment (Worm *et al*., 2021). The memory and cultural recovery of the human-nature connection can be the first step towards thinking about a sustainable future, committed to the Ocean and Ecosystem Restoration Decades.

OC alone or through MCEE can integrate knowledge into a transdisciplinary and planetary vision. To this end, it is fundamental to integrate the school into the communities through learning communities (Pacheco, 2018) and, from there, with local problems with a view to overcoming them (Fonseca & Horta, 2022). There is also promotion of public policies, integration between institutions (schools and universities), training, capacity building, and career improvement of educators, in addition to strengthening the integration of the existing OC by bringing together social actors, such as fishermen or artists, promoting citizen science (Barata, 2021).

4. Final considerations

Planetary environmental degradation puts the survival of our civilization at risk (IPCC, 2022). In Brazil, the school space serves 99% of the population aged between six (6) and fourteen (14) years old and 93% of the young people between fifteen (15) and seventeen (17) years old (Brazil, 2021). Our future society is showing its importance as a space to foster citizenship, critical analysis of the current system and a new thinking/paradigm in favor of environmental, social and economic justice and sustainability.

We need to reinforce the idea that there is no universal model for developing MCEE and/or OC and, consequently, we can have different approaches, different pedagogies, methods and semantic currents to translate this view at the local level (our community, our school). But it is fundamental that this discourse remains in constant scientific dissemination, mediated and fostered by the competent bodies, whether through reformulated curricula, academic/artistic productions, teaching materials and social media, among others. However, it is important that there is alignment among researchers in the use of terms/expressions, even though it is a new approach. The search for papers with the "*Cultura Oceânica*" (Ocean Culture) composition was linked to searches using the term *Ocean Literacy*, which is noticeable by the number of references throughout the manuscript that make use of this word structure. In this sense, a common understanding of this

approach is necessary to ease future research studies from a single semantic perspective, one that can be understood by the audience lacking the scientific technical knowledge associated with the topic.

It is already consensual that classical paradigms do not have enough scope to explain this expressed reality (Silva, 2016), as they have been treating science, knowledge and common sense in separate compartments for a long time, responding little to the challenges posed by the Anthropocene. In other words, it is necessary to educate about sustainability of the different ecosystems, using new approaches and tools that can understand the relationships between human beings and the ocean in a holistic, critical and conscious way.

The research herein presented contributed part of the papers developed in basic education schools in Brazil based on the keywords targeted for this purpose. However, it is consistent that research in this space is underrepresented, with limited dissemination and insufficient engagement both from researchers in the field and from educators working in these areas, considering the data presented. In addition to including the Ocean Culture in school curricula and planning, it is indispensable to train the teachers to disseminate their work and practices. These social actors have the school space as a living laboratory, where experiences can result in changes in perceptions, behaviors and attitudes in the face of the adversities presented by the current era.

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