Australian Journal of Environmental Education (2026), **42**, 817–839
doi:10.1017/aee.2025.10092

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

Evaluating Teachers' Experiences Piloting an Ocean Citizenship Pedagogical Model

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(Received 17 June 2025; revised 04 September 2025; accepted 01 October 2025; first published online 10 December 2025)

Abstract

This article examines teachers' experiences in implementing a pedagogical model designed to promote ocean citizenship in primary education. Conducted during the 2021/2022 school year, the study involved 23 teachers from 10 Portuguese public schools who applied the model through citizen science and coastal monitoring activities. The results highlight the model's effectiveness in fostering ocean citizenship by enhancing teachers' pedagogical practices, strengthening interdisciplinary approaches, and raising environmental awareness among students. Teachers reported improved motivation, engagement, and critical thinking skills while addressing real-world marine conservation issues. However, the study also highlighted challenges such as transportation and resource constraints, difficulties in curriculum integration for 6th-grade students, and limited community activism initiatives. To address these challenges and enhance the model's effectiveness, recommendations include reducing field trips, forming local partnerships, and adapting the model for different educational levels. Additionally, incorporating quantitative assessments in future research is recommended to evaluate broader impacts on teacher practices and student outcomes. The study underscores the model's potential to embed ocean citizenship in school curricula, aligning with global initiatives like the Decade of Ocean Science and the 2030 Agenda, offering a scalable framework to advance ocean literacy worldwide.

Keywords: Ocean citizenship; ocean literacy; pedagogical model; primary education; teacher training

Introduction

Ocean sustainability is vital to planetary and societal well-being, yet marine ecosystems face growing threats from climate change, pollution, and overexploitation. Addressing these issues requires not only scientific innovation but also an informed and engaged citizenry capable of making responsible decisions about the ocean's future, ultimately contributing to a more ocean-literate society (Santoro *et al.,* 2017). Increasing ocean literacy — understood as the reciprocal influence between humans and the ocean (NOAA, 2024) — has become a strategic global priority. Initiatives such as the United Nations Decade of Ocean Science for Sustainable Development (2021–2030) stress the importance of transforming humanity's relationship with the ocean through education and public engagement (UNESCO, 2021).

A major challenge highlighted by UNESCO's Intergovernmental Oceanographic Commission is the need for transdisciplinary and holistic educational strategies that not only build understanding of ocean issues but also foster behavioural change and ocean citizenship (Santoro *et al.,* 2017). Ocean citizenship extends beyond awareness, encompassing the values, attitudes, and actions that empower individuals and communities to take responsibility for the ocean and engage in its stewardship

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(Fletcher & Potts, 2007; McKinley & Fletcher, 2012; Buchan *et al.,* 2023). Research shows that cultivating ocean literacy from an early age can lead to lasting behavioural shifts, equipping future generations to adopt sustainable practices and advocate for marine conservation (Boaventura *et al.,* 2021; Garcia-Vazquez *et al.,* 2022; Mioni, 2022; Guest *et al.,* 2015).

Various strategies have been employed to advance ocean literacy, from formal frameworks like the USA's Next Generation Science Standards (NGSS) to informal approaches such as field trips, public engagement, simulations, and storytelling — all shown to enhance awareness and promote behavioural change (Freitas *et al.,* 2023; Guest *et al.,* 2015; Winn *et al.,* 2006). Key resources — including UNESCO's *Ocean Literacy for All Toolkit* (Santoro *et al.,* 2017), the NMEA *Handbook for Increasing Ocean Literacy* (Halversen *et al.,* 2021), and *A New Blue Curriculum* (IOC-UNESCO, 2022) — offer structured guidance for integrating ocean concepts into teaching and strengthening students' connection to marine environments.

Despite their promise, these initiatives face significant obstacles to consistent implementation in formal education. Key barriers include the lack of suitable teaching materials, inadequate teacher training, and limited curricular integration of ocean literacy, particularly in primary education (Freitas *et al.,* 2024). Furthermore, the absence of robust assessment frameworks hampers efforts to evaluate long-term impacts on student behaviour and environmental engagement, reducing the scalability and adaptability of current models (Asikin *et al.,* 2025).

The lack of evaluation frameworks and challenges in assessing behavioural change have also been noted by Fauville *et al.* (2019), Kelly *et al.* (2020), and Kelemen-Finan et al. (2018). Without effective monitoring tools, the long-term impact of ocean literacy initiatives on citizenship and environmental action remains unclear. However, educational models incorporating citizen science and experiential learning offer a promising alternative by engaging students in hands-on activities that link theory to real-world marine issues (Bonney *et al.,* 2016; Yang *et al.,* 2024). These approaches not only enhance scientific understanding but also foster agency and responsibility — core elements of ocean citizenship.

Building on this foundation, the pedagogical model developed by Schio and Reis (2024a) (Figure 1) offers a structured, locally adaptable framework that promotes ocean citizenship in primary education through citizen science. Detailed in their earlier work, the model integrates conceptual elements — grounded in systems thinking, ocean literacy, and citizenship theory — with practical components focused on hands-on science and youth activism. By engaging teachers and students in coastal monitoring activities, the model bridges theoretical understanding with real-world application.

The model's conceptual component encompasses four core dimensions — training, experiences, involvement, and activism — each associated with specific actions and competencies. To support implementation, the model offers practical tools that guide educators through its processes. Its practical component is structured around six activities within a coastal monitoring project: (1) contextualising ocean issues, (2) conducting three field outings, (3) analysing field data, (4) documenting results, (5) sharing findings, and (6) initiating school or community interventions. Teacher training serves as the bridge between both components, ensuring educators are prepared to apply the model and embed ocean citizenship into the school curriculum (Figure 1).

This study examines teachers' experiences implementing a pedagogical model grounded in citizen science and coastal monitoring, focusing on its role in fostering ocean citizenship, environmental awareness, and interdisciplinary practices in primary education. Conducted as a pilot project in 10 Portuguese public schools during the 2021/2022 academic year, the research addresses the question: *What are teachers' assessments of the educational potential and limitations of this model for promoting ocean citizenship after its implementation in their primary education classrooms?* A complementary study by Schio and Reis (2024b) underscores the model's impact on students, highlighting gains in environmental awareness, active engagement, and responsible behaviours, while also noting the need to strengthen components related to activism and community involvement.

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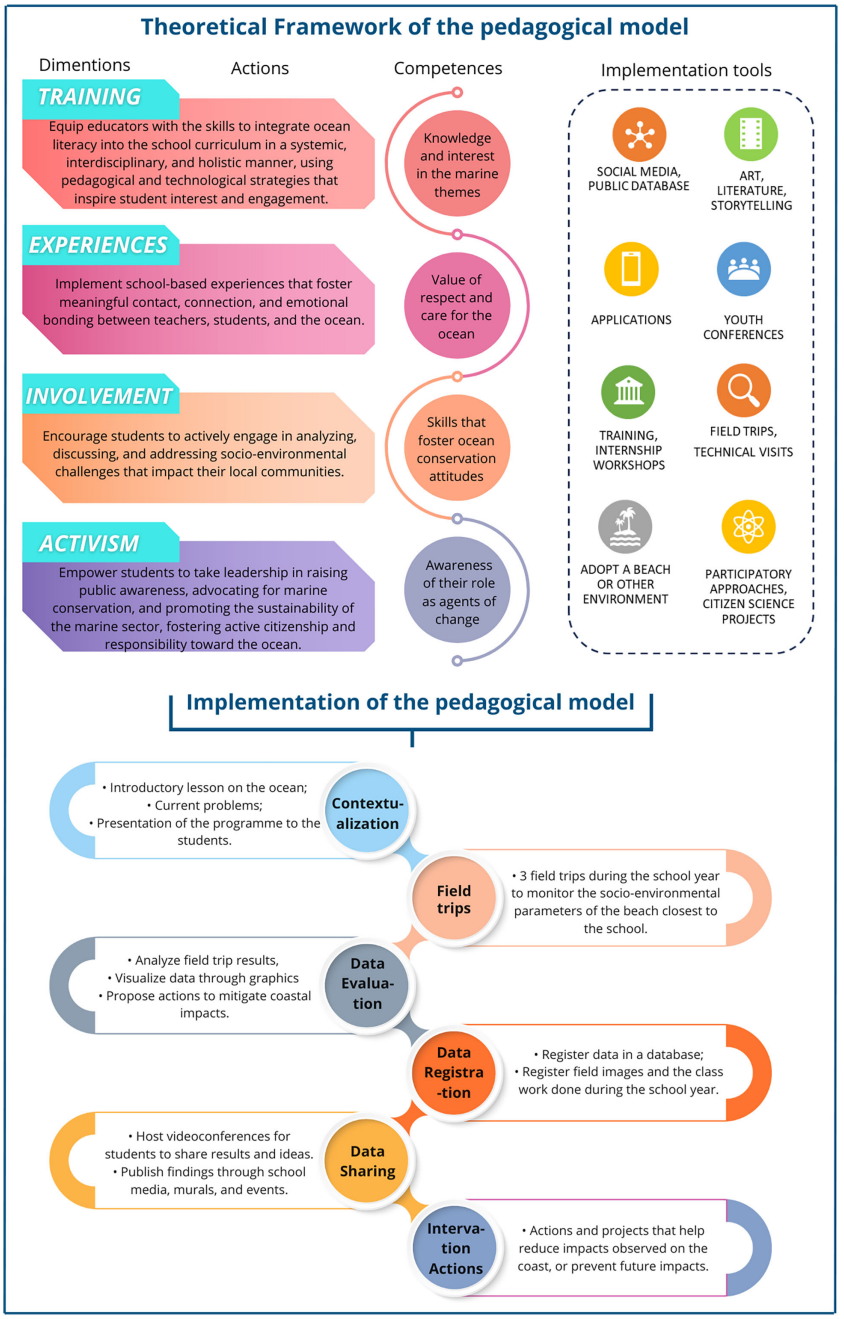


Figure 1. Pedagogical model for promoting ocean citizenship in primary education.

Materials and Methods

The development of the pedagogical model was guided by phases 1 and 2 of the Design-Based Research (DBR) method, as detailed by Schio and Reis (2024a). DBR follows a four-phase cycle — diagnosis, planning, implementation, and evaluation — where knowledge and educational strategies are developed iteratively (Barab & Squire, 2004). In the first two phases, previously described by Schio and Reis (2024a), the authors defined the theoretical and methodological

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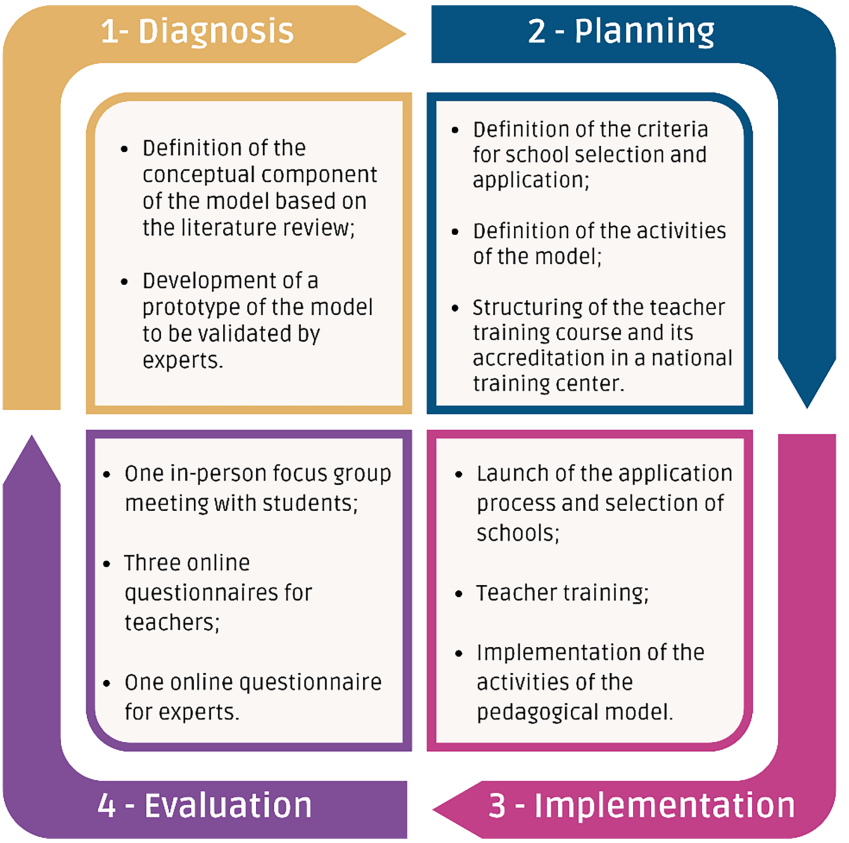


Figure 2. Actions carried out in each phase of the design cycle for the development and implementation of the pedagogical model.

foundations of the model (phase 1) and planned its implementation within school contexts (phase 2) (Figure 2).

This article reports on phases 3 and 4 of the design cycle, focusing on the implementation and evaluation of the pedagogical model through teachers' experiences. Implementation followed three key stages: (1) selection of schools and teachers, (2) teacher training, and (3) application of the model's educational activities. In phase 4, teachers' experiences were assessed using qualitative methods, including focus groups and semi-structured questionnaires (Figure 2), detailed in Section 2.4.

The diagram shown in figure 2 presents a structured overview of the actions involved in each phase of the design cycle during the development and implementation of the pedagogical model, showcasing the whole process applying during the design cycle.

Selection of schools and teachers

Since this was a pilot project, the decision was made to test the pedagogical model with Science and Maths teachers from Blue Schools — a programme run by the Portuguese Ministry of the Economy and the Sea that certifies schools committed to fostering ocean literacy within the curriculum (https://escolaazul.pt/). Pre-registration took place from June 14 to 30, 2021, through an online form published on the Blue School program's website, social media, and mailing list. A total of 40 teachers initially registered to participate, but only 23 teachers from 10 public schools

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Figure 3. Diagram of the programme content for teacher training.

along the Portuguese coast (2 in the north, 5 in the central region, and 3 in the south) confirmed their participation in the training.

Teacher training

Teacher training, as a core dimension of the pedagogical model (Figure 1), equips educators with the knowledge needed to integrate ocean literacy systemically and across subjects within the curriculum. This stage is essential, as teachers are the primary agents implementing the model's educational activities in classrooms. The training workshops, outlined by Schio and Reis (2024a) during the model's planning phase, were structured to align with the knowledge required to implement its six core activities (Figures 3 and 4). The programme also defined the specific competencies to be developed, establishing clear links between the model's activities, training content, and teacher skill development (Figure 4).

Conducted in October 2021, the teacher training comprised 50 hours — 25 synchronous and 25 asynchronous — combining face-to-face and online sessions in a blended learning format. Zoom was used for live instruction, while Google Classroom supported the distribution of materials, session recordings, and submission of teacher assignments.

Application of the pedagogical model

Between November 2021 and June 2022, 23 teachers implemented the model with 26 primary classes — 20 from 5th grade and 6 from 6th grade — reaching 543 students aged 09 – 11. Fieldwork was conducted across diverse aquatic environments, including 12 coastal beaches, one river beach, and two estuary beaches. Teachers adapted the activities to their local contexts,

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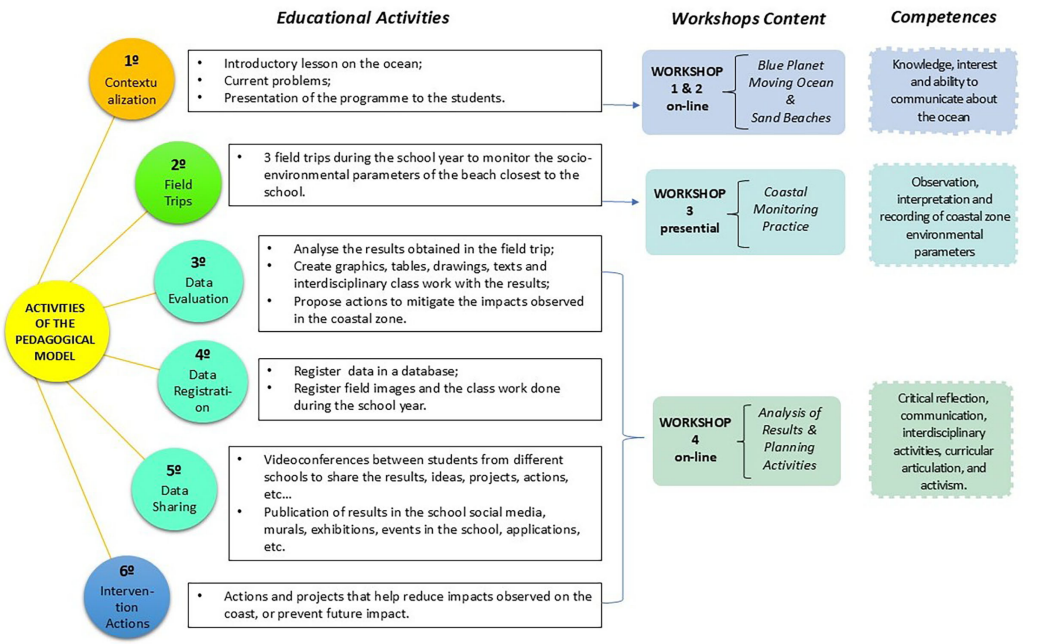


Figure 4. Correlation between the educational activities of the pedagogical model, the training workshops and the competencies to be developed by teachers after the training.

promoting hands-on learning and strengthening ocean literacy. They were also encouraged to develop interdisciplinary projects in collaboration with colleagues, integrating subjects such as Science, Mathematics, Geography, Portuguese, the Arts, and others to connect theoretical content with real-world issues and foster critical thinking and collaboration.

Evaluation

The evaluation of teachers' experiences in implementing the pedagogical model was conducted using qualitative methods, including three semi-structured questionnaires administered at different stages of the process (the questions for each questionnaire are detailed in the corresponding appendices):

1. **After teacher training (October 2021):** Focused on teachers' preparedness, confidence in applying the model, and anticipated challenges (Appendix A).
2. **Following the first field trip (March 2022):** Collected feedback on the initial application of the model, logistical aspects, and student engagement (Appendix B).
3. **At the end of the school year (June 2022):** Gathered overall reflections on the implementation process, lessons learned, and suggestions for improving the model (Appendix C).

In addition to the questionnaires, an online session was held in the middle of school year (March 2022), during which teachers were invited to share their experiences. All participating teachers presented their reflections in three key areas:

- Field trips and student engagement,
- Analysis of results conducted at school,
- Activities or actions developed with students based on project data, including interdisciplinary workclasses, activism initiatives, and project dissemination within the school and community.

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Teachers were encouraged to highlight successful aspects, challenges faced, and adjustments made during the implementation process.

Given the small sample size ($n = 23$), a process evaluation lens was adopted to ensure meaningful interpretation of the data. Such an approach is particularly relevant in pilot studies, where the aim is less about measuring large-scale impacts and more about generating insights to refine the model and prepare it for future iterations. This approach prioritises understanding the quality of implementation, contextual influences, and the practical lessons that can inform the future adaptation and scalability of the model.

A thematic content analysis was used to examine the qualitative data, combining deductive and inductive approaches. The initial coding framework was partially theory-driven, informed by the model's conceptual pillars — training, experiences, involvement, and activism — and supported by key constructs in environmental education, such as ocean citizenship (Fletcher & Potts, 2007), transformative learning (Mezirow, 1997), and systems thinking (Sterling, 2001). This framework guided the creation of preliminary codes like "critical awareness," "interdisciplinary integration," and "student agency."

Simultaneously, the analysis remained open to emergent codes from the data, allowing for refinement based on recurring themes in teachers' narratives — for example, "logistical constraints" and "community engagement." The coding proceeded in three stages: open coding of a subset to test theoretical fit, axial coding to group related concepts, and selective coding to establish the six core thematic categories presented in Figure 5.

The following section presents the results for each category in detail, supported by selected teacher quotes that illustrate key findings, reflect diverse perspectives, and offer deeper insight into the strengths and challenges encountered during the model's implementation.

Results and discussion

Acquired competences

Teachers identified the practical and experimental aspects of the model as the most impactful moments for students. Field trips ($n = 19$), interdisciplinary activities ($n = 6$), and water analysis ($n = 5$) were highlighted as particularly significant (Figure 6). This finding aligns with Schio and Reis (2024b), where students reported that hands-on experiences and outdoor activities significantly enhanced their understanding of marine environments and contributed to skill development in coastal monitoring.

Teachers considered the opportunity to conduct activities outside of school with their students as an added value, as it enriches the educational experience by connecting learning to its local context, bringing more meaning and involvement to the educational process. One teacher noted:

> *'For me as a teacher, this experience has reinforced the importance of carrying out activities outside of the classroom and confirmed that these activities are an asset for motivating students and for creating interdisciplinary projects in which students see an interconnection and contextualisation of the content.'*

Interactive educational experiences in coastal environments have demonstrated how investigative and citizen science activities can broaden students' interest in and understanding of the marine ecosystem (Boaventura *et al.,* 2021; Gillooly, 2022; Severin *et al.,* 2023; Winks *et al.,* 2020). These activities strengthen the personal connection with the ocean, increasing learners' admiration, curiosity, and sense of responsibility and belonging (Murray *et al.,* 2023).

When asked if the educational experience had fostered new competencies that showed the development of ocean citizenship in the students, 100% of the teachers ($n = 23$) confirmed that it

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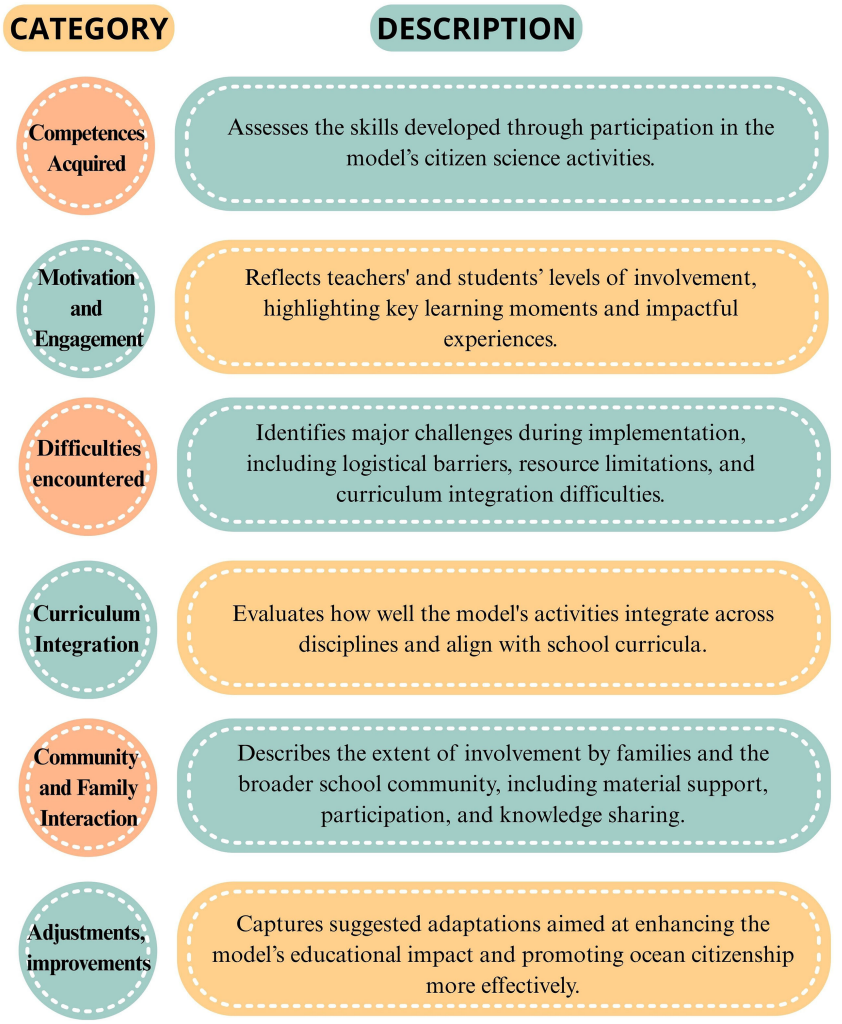


Figure 5. Categories of analysis used to assess teachers' experiences in implementing the pedagogical model and their perceptions of its educational impact on students.

had. The competencies identified were grouped into four main categories systematised in Table 1: 1) New knowledge; 2) Critical perspective; 3) Socio-environmental responsibility; and 4) Activism.

Alongside student learning, teachers also demonstrated notable professional growth through the implementation of the pedagogical model. As outlined in Figure 3, they not only conveyed new ocean-related content but also developed competencies in conducting all stages of the coastal monitoring project — collecting, analysing, and discussing data with students. Additionally, they engaged in interdisciplinary collaboration and successfully integrated content into the school curriculum. These findings align with Capps & Crawford (2013), who highlight that teachers who undergo inquiry-based science education (IBSE) training develop a deeper understanding of investigative teaching methods and become more confident in applying them in the classroom.

Activism-related competencies were less developed compared to other areas. Although intervention actions were planned to address issues observed during coastal monitoring, 63% of teachers were unable to implement them — primarily due to time constraints. Among the 37%

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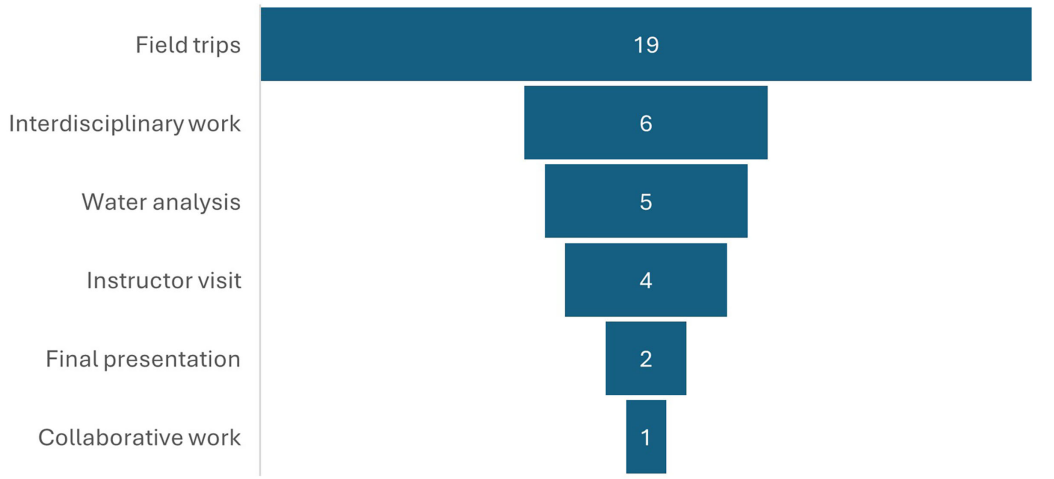


Figure 6. Teachers' opinion of students' most significant learning.

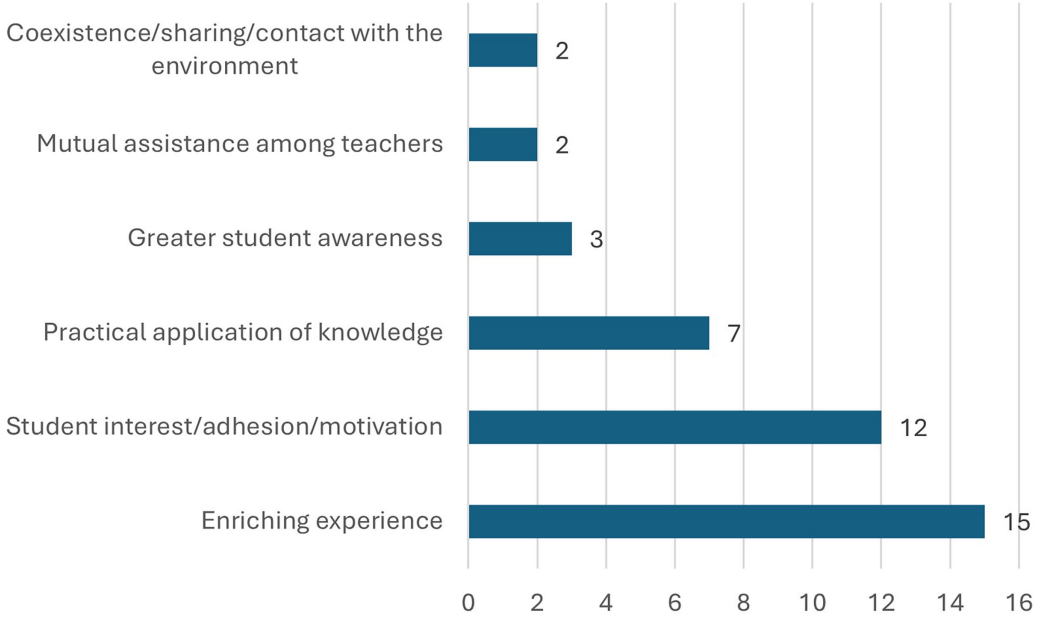


Figure 7. Positive aspects highlighted by teachers in their experience of implementing the educational activities of the pedagogical model.

who did carry out such actions, most limited their efforts to internal dissemination through school-based initiatives and social media, rather than direct community engagement. As this was the model's first year of implementation, the demands of coordinating multiple activities alongside existing responsibilities, as well as the logistical complexity of organising external actions, likely contributed to these limitations. Nonetheless, these challenges are expected to diminish as the model becomes more integrated into schools' pedagogical planning and gains institutional support.

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Motivation and engagement

All participating teachers ($n = 23$) reported feeling motivated and confident in implementing the proposed educational activities. Nonetheless, a few expressed specific needs: two teachers indicated they might require assistance during fieldwork, and five felt they needed additional support to address ocean-related content. The main positive aspects identified were: overall satisfaction with the experience ($n = 15$), high student engagement and motivation ($n = 12$), and the practical application of knowledge ($n = 7$) (Figure 7). Teachers also highlighted the value of fostering students' environmental awareness and encouraging behavioural change ($n = 3$), as well as the social and emotional benefits of peer interaction and direct contact with natural environments ($n = 2$).

Several teachers' reports reinforced the importance of practical activities in contact with the environment, identifying them as factors that enhance both their own and their students' motivation and engagement, as well as promoting greater environmental awareness. These findings are consistent with the results reported by Schio and Reis (2024b), where students highlighted hands-on activities, such as coastal monitoring, as the most engaging and impactful components of the project. Students expressed that direct interaction with the environment fostered a stronger emotional connection with marine issues and motivated them to adopt more responsible behaviours.

This perspective was echoed by one teacher, who remarked:

> *'It was very good. The kids took part with enthusiasm and interest. As positive aspects, I'd like to mention the students' involvement in the tasks, their contact with the sea and the beach in a different way to what they're used to. I think they started to notice details they hadn't realised, such as the importance of water quality.'*

Teachers' experiences implementing the model not only enhanced their pedagogical skills but also enabled them to actively involve students in environmental investigations within their communities. Research supports the effectiveness of practical, inquiry-based approaches — such as citizen science — in improving teacher motivation, educational quality, and student engagement (Aristeidou *et al.,* 2022; Capps & Crawford, 2013; Johnson *et al.,* 2019; Lakeman Fraser *et al.,* 2023). Peasland *et al.* (2021) further emphasise that students with prior fieldwork exposure tend to show greater motivation, highlighting the importance of early, hands-on engagement in fostering interest in marine environments.

These dynamics were evident in students' active involvement and motivation during the coastal monitoring activities. As they explored the environment using research tools, students became aware of the volume of litter on the beaches. This first-hand observation deepened their understanding of marine pollution and the complexities involved in addressing it. It also underscored the importance of individual responsibility, reinforcing their potential as local agents of change — an insight echoed by teachers' reflections presented in Table 1.

These findings align with the experiential learning framework proposed by Yang *et al.* (2024), which highlights the role of fieldwork-based marine science education in promoting environmental awareness, scientific literacy, and pro-environmental behaviours. Their study shows that direct engagement with coastal ecosystems helps students perceive ecological issues more holistically, deepens their sense of responsibility, and fosters active participation in citizen science. By integrating field-based learning into formal education, both models demonstrate that immersive experiences in natural environments are essential to cultivating ocean stewardship and fostering long-term behavioural change.

While a previous study (Schio & Reis, 2024b) mapped these student-centred outcomes to the eight dimensions of ocean citizenship proposed by McKinley et al., (2023) (knowledge and understanding, identity and values, responsibility, participation, emotional connection, agency, systems thinking, and justice), the present research expands this analysis by highlighting how teachers perceive and mediate these dimensions in classroom practice. Their experiences reveal

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Table 1. Competences identified by teachers in their students that contribute to the development of ocean citizenship

Competencies observed in students	Examples of teacher quotes
New Knowledge	*'The students have become more informed; they have learnt new things in a real context that makes more sense.'* *'All the students benefited from the knowledge they gained about Ocean Literacy, along with the connections they were able to make with other subjects. Applying the Mirim Coastal Monitoring method, learning about our oceans and their importance, and recognising the local fauna and flora, among other things, were skills acquired by the students and put into practice.'* *'They became much more aware of the importance of preservation. They learnt more about the ocean, its pollution issues, and the associated risks.'*
Critical Perspective	*'The simple fact that the students realised how much rubbish is on the beach, and that every time it is picked up, the same thing happens again, has raised awareness of this issue, developing ocean citizenship in the students and promoting an environmental attitude.'* *'The project raised awareness of the amount of plastic found on beaches and the need to act individually and collectively to prevent this scourge.'* *'They became much more attentive to certain human behaviours that pollute the beaches and consequently the sea.'* *'The project sensitised them to the importance of preserving our beaches and seas. Their three opportunities to observe the fauna and flora of the beaches they visited, check for the presence of non-organic and polluting material, and analyse water quality were very important. They realised that our waters are good and that we must protect them to prevent pollution.'*
Social and Environmental Responsibility	*'It aroused curiosity to learn more about the oceans and motivated responsibility for preserving nature, in this case, the ocean.'* *'It brought a lot of knowledge and discoveries on-site at the beach they frequent. All the documentation provided, and activities are very comprehensive and allow for continuity. Raising awareness of this issue is fundamental and topical. The students' commitment to being guardians of the ocean is a principle of conscious citizenship that doesn't end with the school year. Some students have said with conviction that they will look at the beach with 'fuller eyes'.'*
Activism	*'They created a mini project/club to clean up the school grounds/beaches with friends and colleagues from other classes who weren't part of the project.'* *'I believe so, such as saving water and using certain utensils in favour of others because of ocean pollution (they were able to see this problem when they searched for unnatural objects on the beaches).'*

that ocean citizenship is not only an outcome of student engagement, but also a pedagogical construct actively shaped by teacher decisions, values, and strategies.

For example, teachers observed a marked increase in students' *knowledge and understanding* of ocean systems through field-based inquiry and data analysis, along with a stronger *emotional connection* to the ocean fostered by experiential learning at the beach — findings consistent with Schio and Reis (2024b). However, new insights emerged regarding *systems thinking* and *agency*. Teachers noted that facilitating discussions on the causes and consequences of pollution helped students connect local environmental problems — and their own behaviours — to broader global patterns. Furthermore, they reported that allowing students to take ownership of specific actions, even small-scale initiatives, strengthened their sense of empowerment and responsibility, as illustrated in the teachers' statements presented in Table 2.

These findings underscore the central role of teachers in fostering ocean citizenship by creating learning environments that cultivate not only knowledge, but also responsibility, agency, and action. When examined through theoretical lenses such as transformative learning (Mezirow, 1997), civic ecology education (Krasny & Tidball, 2015), and experiential learning (Kolb, 1984), the themes emerging from teacher reflections offer valuable insight into how pedagogical practice

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Table 2. Mapping theoretical constructs to emergent themes from teacher data

Emergent Theme from Teacher Data	Representative Teacher Insight	Aligned Theoretical Construct	Theoretical Source
Increased student agency and self-initiated action	"Some students formed clean-up groups and invited classmates from other classes to join their initiatives."	Civic and environmental agency	*Civic Ecology Education* (Krasny & Tidball, 2015)
Growth in critical environmental awareness	"They were surprised by the amount of trash and questioned why it kept returning."	Perspective transformation / Critical reflection	*Transformative Learning* (Mezirow, 1997)
Integration of learning across subjects	"We connected beach data with maths graphs and wrote opinion pieces in Portuguese on ocean protection."	Systems thinking / Interdisciplinary literacy	*Sterling, 2003*; *Capra, 1996*
Increased student sense of responsibility for the ocean	"They now talk about protecting the sea like it's their own responsibility."	Environmental citizenship — Responsibility	*Dobson, 2007*; *Fletcher & Potts, 2007*
Teachers' enhanced confidence in outdoor learning pedagogy	"After doing the first field trip, I felt more confident facilitating learning outside the classroom."	Experiential learning and professional growth	*Kolb, 1984*; *Crawford, 2012*
Challenges in implementing activism beyond the classroom	"We shared results online, but we didn't manage a public event due to time constraints."	Partial realisation of civic engagement dimension	*Ocean Citizenship* (Buchan et al., 2023)

facilitates meaningful change. Table 2 synthesises these connections by linking representative teacher insights to key theoretical constructs, reinforcing the model's grounding in interdisciplinary and participatory approaches to education.

Difficulties encountered

Although this was the teachers' first time implementing the project, most reported no difficulties in teaching ocean content or applying the coastal monitoring method. The main challenges identified were logistical and external to classroom practice. Across three evaluation stages — before, during, and after implementation — six recurring difficulties were reported: securing transport for field trips, lack of monitoring materials, limited time in the school schedule, adverse weather conditions, limited availability of support staff, and water quality analysis. Additionally, three other difficulties were cited, but they only appeared in two of the three evaluations. Notably, five teachers indicated they encountered no difficulties during the activities (Table 3).

Despite the challenges, none of the reported difficulties prevented the successful implementation of the model's educational activities. Teachers showed strong commitment and resourcefulness, often developing creative solutions to logistical barriers. Many schools already had some required materials in their science or maths labs, while others supported the purchase of additional items. In cases with limited institutional support, teachers sourced materials from students or collaborated with colleagues from other subjects. Some even purchased equipment themselves — such as shovels, sieves, magnifying glasses, and compasses — to ensure the activities could proceed.

While over a third of teachers ($n = 9$) reported that students faced no major difficulties, the most frequently mentioned challenge was managing student behaviour during field trips ($n = 4$). The excitement and distraction were attributed to the novelty of the beach setting and students' limited prior experience with outdoor group activities, especially due to COVID-19 restrictions. Additional difficulties included working with field data ($n = 3$), integrating content across subjects ($n = 2$), and maintaining focus ($n = 2$). Less frequent issues ($n = 1$) involved completing field forms, time constraints, and identifying natural elements such as waves or clouds (Figure 8).

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Table 3. Main difficulties experienced by teachers

Aspects that hindered the implementation of the educational activities proposed throughout the school year	Number of mentions			
	Before (Forecast)	During (Sense)	After (Sense)	Total mentions
1° Student transport	9	4	12	**25**
2° Availability of field materials	3	4	3	**10**
3° Time to carry out activities	4	2	3	**9**
4° Adverse weather	4	1	3	**8**
5° Having support teachers at school	1	3	3	**7**
6° Conducting water analysis	1	1	1	**3**
7° Number of students and classes	2	1	0	**3**
8° Combining project content with 6th grade	2	1	0	**3**
9° Sharing the water analysis kit	0	1	1	**2**
Didn't experience any difficulties	–	4	1	5

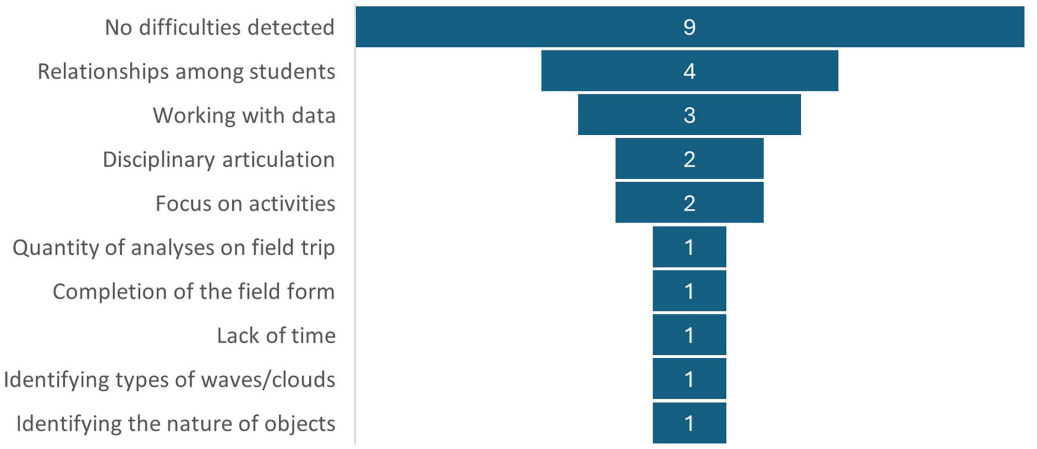


Figure 8. Aspects that students found most challenging according to teachers' observations.

Despite the challenges, teachers' motivation and commitment were key to the successful implementation of the educational activities. Their adaptability, creative problem-solving, and collaboration fostered active student and family engagement — skills that are essential for advancing innovative and high-quality marine education in contemporary school contexts.

Interdisciplinarity and curricular compatibility

The integration of the project's content into the 5th and 6th-grade curriculum (ages 9 to 11) was another positive outcome, demonstrating the model's alignment with curricular goals and its potential to embed ocean literacy and citizenship across disciplines. As one teacher observed:

> *'The coastal monitoring project can serve as a catalyst for developing interdisciplinary projects, as it addresses a significant topic that allows work to be conducted within various curriculum*

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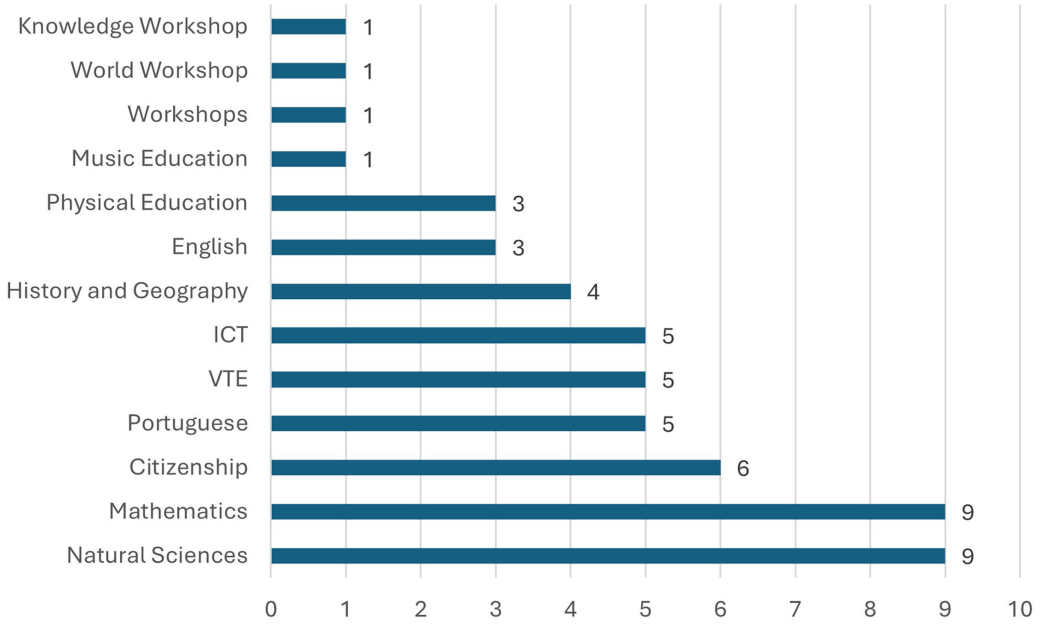


Figure 9. Integration of the content of the coastal monitoring programme with the 5th and 6th grade school curriculum.

subjects. For example, Portuguese in text production; Natural Sciences, due to the topic's relevance; Citizenship and Development, focusing on the importance of preserving the oceans; Maths, in the statistical analysis of collected data and the implementation of methods on the beach; Visual and Technological Education in poster production and illustration work.'

Due to the scientific nature of the educational activities and the qualifications of the teachers, Maths and Sciences were the subjects most utilised throughout the coastal monitoring project, followed by Citizenship, Portuguese, Visual and Technological Education (VTE), Information and Communication Technology (ICT), History and Geography of Portugal (HGP), English, Physical Education, and Music Education, along with some specific workshops developed in the schools (Figure 9).

Some 6th-grade teachers (students aged 10 to 11) reported difficulty integrating the content into the school curriculum but managed to do so in collaboration with other teachers. One teacher explained, 'We worked in pedagogical teams to see how it was possible for the 6th grade to tackle this issue. We linked the content we were teaching — such as food, microplastics in food, the impacts of pollution on food, wellbeing and health, and food conservation — with the curriculum. In history, we taught about tsunamis and the transport of slaves, creating a learning scenario from it all.'

Examples of interdisciplinary work shared by teachers during a year-end videoconference illustrated diverse ways the programme was integrated into other subjects, workshops, and school projects. This collaborative exchange also generated interest among other educators, fostering greater engagement for future editions. Such involvement is essential to ensuring the long-term sustainability of the model within school communities.

A notable finding was the teachers' adaptation of coastal monitoring activities to nearby aquatic environments such as lagoons, rivers and estuaries. This highlights the model's flexibility and its applicability beyond coastal areas, supporting broader curricular integration. Such adaptability is critical for expanding ocean education in diverse geographic contexts, advancing the goals of the *blue school curriculum* (IOC-UNESCO, 2022), and promoting meaningful learning experiences that lead to behavioural change and action for ocean sustainability (McKinley & Burdon, 2020).

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Community and family interaction

When asked whether students had shared their learning experiences with their families, 82% of teachers responded positively. They cited examples of family involvement, including helping gather field materials, assisting with tasks, participating in a field trip, and supporting transportation costs. The following two teacher testimonials illustrate the feedback received from students' families:

> *'The parents have shown their satisfaction with the experience and learning more than once. On the day of the open school, they thanked me, and some offered to help with any action to be taken.'*
> *'The feedback from parents was very good. Parents sent me emails thanking me and saying that the students were motivated. Parents were invited to take part in the last field trip.'*

Additional forms of engagement by parents, students, and school staff included exhibitions, project presentations, sharing content via Padlet, school newspaper articles, blogs, social media posts, and parent meetings. This triangulation of communication between school, students, and families illustrates the potential of a bottom-up approach to fostering ocean citizenship, positioning students as knowledge multipliers and agents of change within their communities.

Research underscores the important role children play as agents of change in advancing sustainability. Their capacity to learn, advocate, and engage in initiatives can influence family behaviours and generate broader social impact (Hugo, 2022). Zampas' (2013) *children's influence and confidence model* explains how children's self-confidence shapes parental perceptions and decision-making. This intergenerational dynamic supports the formation of lasting sustainable habits and values within families (Carrigan *et al.,* 2023; Ritch & Brownlie, 2016). In this context, Von Braun (2017) highlights the need for transformative education with an emphasis on exploration, engagement, and action, to empower children to actively participate and lead changes towards sustainability.

Adjustments and improvements

As a teacher-led pilot project, the implementation of the pedagogical model had a notably positive impact on participating schools. Despite some challenges, all teachers completed the training, and 87% ($n = 20$) expressed their intention to continue the project in future school years. Regarding proposed improvements, 29% ($n = 7$) aimed to enhance interdisciplinarity, 17% ($n = 4$) wished to expand the project to more classes, another 17% ($n = 4$) planned to maintain its current format, and 9% ($n = 2$) suggested reducing the number of field trips due to logistical constraints. A few teachers emphasised the need for broader student and school community engagement to increase the project's reach and impact (Figure 10).

At the end of the school year, all participating teachers (100%) expressed confidence in the potential to build a community of practice and establish a *Network of Ocean Guardians* within the school system over the medium to long term. To support this goal, they proposed several strategies: expanding the project nationally, including inland schools; aligning with existing programmes such as Blue School and Eco-Schools; creating a digital platform for data sharing; increasing interschool collaboration; integrating the project into annual curriculum plans; allocating school time and resources; acquiring additional water testing kits and transport funding; involving local authorities; and strengthening family engagement.

These suggestions offer valuable input for refining the pedagogical model and enhancing its long-term impact on ocean citizenship within school communities. This process aligns with the iterative nature of Design-Based Research (DBR), which involves ongoing cycles of testing, evaluation, and revision to improve both the educational prototype and the learning system it

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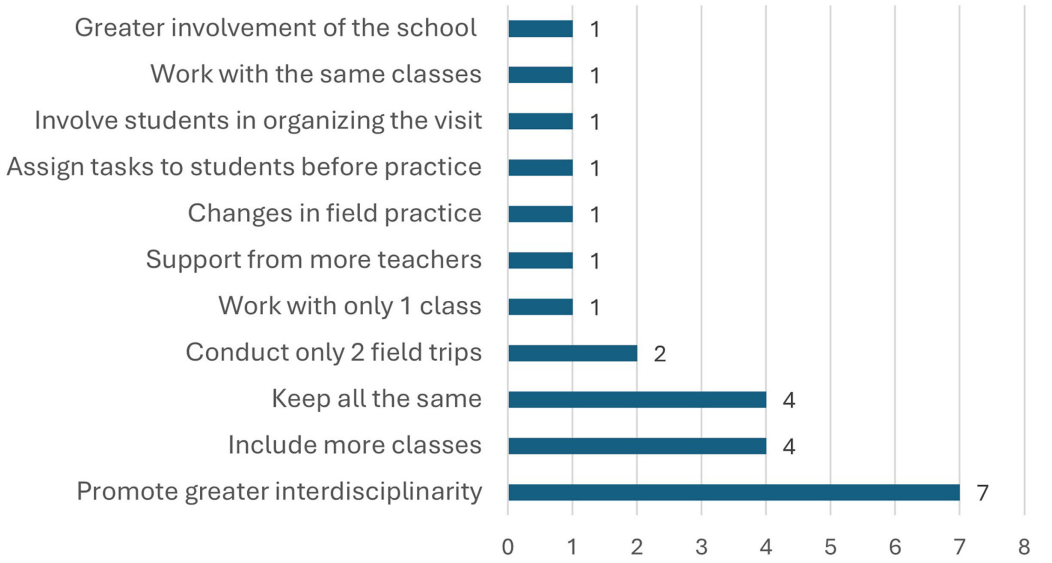


Figure 10. What teachers would do differently in future school years.

supports (Ponte *et al.,* 2016; Gravemeijer & Cobb, 2013). As such, the model's evolution is envisioned as a dynamic, inclusive, and co-constructed journey that will be continuously shaped through practice.

To ensure the model's long-term viability and integration into school routines, proposed improvements must respond directly to the challenges identified by teachers. One frequently cited concern was the difficulty of organising three field trips, due to transport and time constraints. In response, several teachers recommended reducing this to two visits, complemented by in-school alternatives such as simulations or digital tools — an adjustment that balances pedagogical goals with practical realities. Similarly, while the model encourages community engagement, only a minority (37%) carried out activism beyond the classroom, citing barriers like lack of time, support, or confidence. To address this, the inclusion of simplified and accessible activism formats — such as class-based campaigns or online awareness actions — could increase teacher adherence. Grounding these recommendations in the teachers' experiences enhances the credibility and applicability of the model's ongoing refinement.

Overall assessment

To consolidate the analysis of teachers' experiences, Figure 11 synthesises the main strengths, limitations, and improvement suggestions identified. It provides a strategic overview to guide future adaptations and support the model's continued effectiveness in promoting ocean citizenship and interdisciplinary practices in school.

Conclusions

The pedagogical model for promoting ocean citizenship in primary education proved effective in enhancing teaching practices and engaging students through citizen science and hands-on activities. It fostered interdisciplinary approaches, critical thinking, and increased awareness of marine conservation. Despite logistical challenges, the strong commitment of educators and support from families contributed to a collaborative learning environment.

https://doi.org/10.1017/aee.2025.10092 Published online by Cambridge University Press

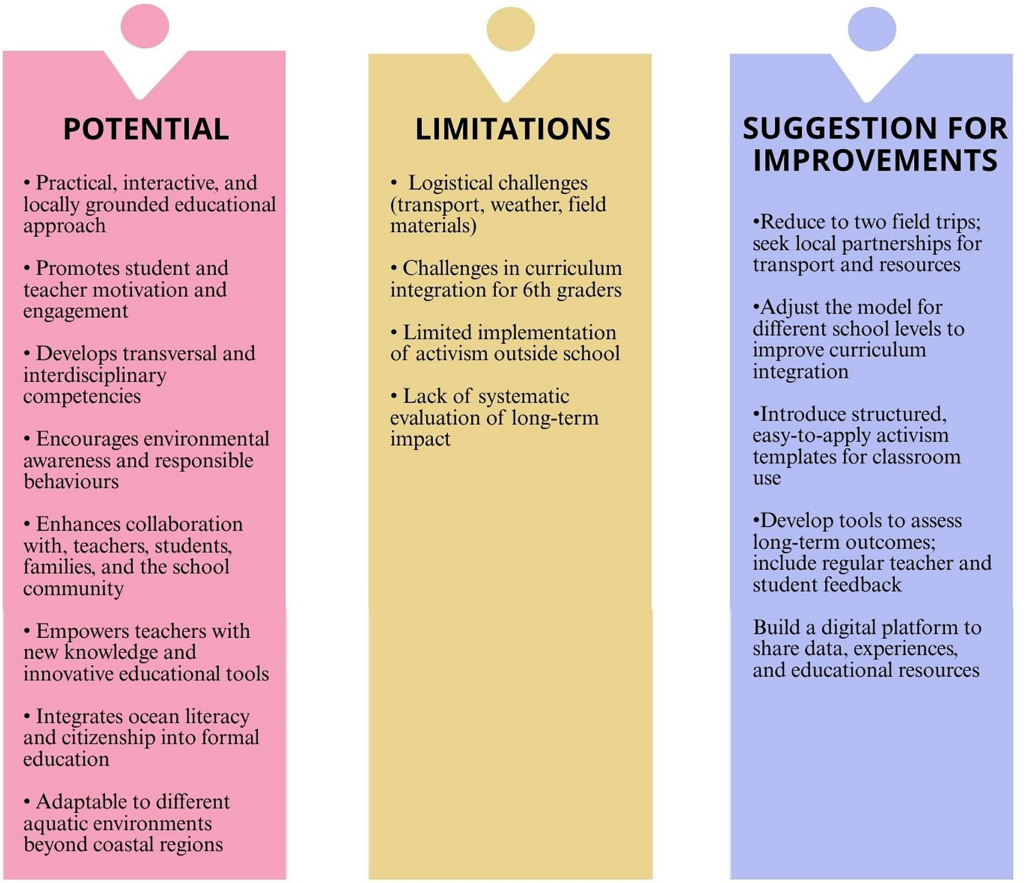


Figure 11. Systematisation of the pedagogical model's potential, limitations, and suggestions for improvement.

Beyond these practical outcomes, the study offers theoretical insights into how ocean citizenship can be meaningfully cultivated in schools. Grounded in experiential and transformative learning theories, the model nurtures students' ecological identity and agency, highlighting its relevance for advancing "blue" curricula and contributing to global efforts such as the Ocean Decade and the 2030 Agenda. The study underscores the value of integrating environmental citizenship into national curricula and calls for further research on its long-term effects across educational stages.

As this was a small-scale pilot study, the findings should be viewed as preliminary but valuable for refining the model and informing future applications. The results also point to critical success factors — such as teacher motivation and student engagement — as well as barriers, including logistical constraints and limited opportunities for activism beyond the classroom. Future efforts should therefore focus on adapting the model for broader dissemination, strengthening its integration across educational levels, and developing strategies that enable sustainable activism and community engagement.

Acknowledgements. We deeply thank the schools, teachers, students, and supporting institutions for their invaluable contributions and dedication, which were crucial for the success and enrichment of this research on ocean citizenship.

Financial support. This research was funded by a Ph.D. fellowship from FCT — Portuguese Foundation for Science and Technology, grant number 2022.10641.BD, and by National Funds through FCT — Portuguese Foundation for Science and

https://doi.org/10.1017/aee.2025.10092 Published online by Cambridge University Press

Technology, I.P., under the scope of UIDEF — Unidade de Investigação e Desenvolvimento em Educação e Formação, UIDB/04107/2020, https://doi.org/10.54499/UIDB/04107/2020.

Ethical standards. The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Instituto de Educação, Universidade de Lisboa (on the 26 of January 2022).

References

Aristeidou, M., Lorke, J., & Ismail, N. (2022). Citizen science: Schoolteachers' motivation, experiences, and recommendations. *International Journal of Science and Mathematics Education*. https://doi.org/10.1007/s10763-022-10340-z

Asikin, N., Suwono, H., Sumitro, S., & Dharmawan, A. (2025). Teaching ocean literacy in science education: A systematic review. *Environmental Education Research*, 1–26. https://doi.org/10.1080/13504622.2025.2490227

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *The Journal of the Learning Sciences*, *13*(1), 1–14. http://www.jstor.org/stable/1466930

Boaventura, D., Neves, A.T., Santos, J., Pereira, P.C., Luís, C., Monteiro, A., Cartaxana, A., Hawkins, S.J., Caldeira, M.F., & Ponces de Carvalho, A. (2021). Promoting ocean literacy in elementary school students through investigation activities and citizen science. *Frontiers in Marine Science*, *8*, 1–11. https://doi.org/10.3389/FMARS.2021.675278

Bonney, R., Phillips, T.B., Ballard, H.L., & Enck, J.W. (2016). Can citizen science enhance public understanding of science? *BioScience*, *66*(6), 477–488. https://doi.org/10.1093/biosci/biw070

Buchan, P. M., Evans, L. S., Pieraccini, M., & Barr, S. (2023). Marine citizenship: The right to participate in the transformation of the human–ocean relationship for sustainability. *PLOS ONE*, *18*(3), e0280518. https://doi.org/10.1371/journal.pone.0280518

Capps, D.K., & Crawford, B.A. (2013). Inquiry-based professional development: What does it take to support teachers in learning about inquiry and nature of science? *International Journal of Science Education*, *35*(12), 1947–1978. https://doi.org/10.1080/09500693.2012.760209

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

Carrigan, M., Wells, V., & Athwal, N. (2023). 'I'd never cook it now': an exploration of intergenerational transference and its role in facilitating family food sustainability. *European Journal of Marketing*, *57*(5), 1352–1379. https://doi.org/10.1108/EJM-10-2021-0804

Crawford, B.A. (2012). Moving the essence of inquiry into the classroom: Engaging teachers and students in authentic science. In B.J. Fraser, K.G. Tobin & C.J. McRobbie (Eds.), *Second international handbook of science education* (pp. 129–144). Springer. https://doi.org/10.1007/978-1-4020-9041-7_11

Dobson, A. (2007). Environmental citizenship: Towards sustainable development. In A. Dobson & D. Bell (Eds.), *Environmental citizenship* (pp. 280–296). MIT Press.

Fauville, G., Payne, D.L., Marrero, D.G., Lantz-Andersson, A., & Crouch, F. (2019). *Exemplary practices in marine science education*. Springer. https://doi.org/10.1007/978-3-319-90778-9

Fletcher, S., & Potts, J. (2007). Ocean citizenship: An emergent geographical concept. *Coastal Management*, *35*(4), 511–524. https://doi.org/10.1080/08920750701525818

Freitas, C., Venzo, P., Bellgrove, A., & Francis, P. (2024). Diving into a sea of knowledge: Empowering teachers to enhance ocean literacy in primary schools through an ocean education training program. *Environmental Education Research*, *31*(2), 262–283. https://doi.org/10.1080/13504622.2024.2357342

Freitas, M.R., Lima, F.P., Silva, P.M., & Monteiro, I. (2023). The role of storytelling and interactive learning in fostering ocean literacy. *Journal of Environmental Education*, *54*(3), 320–334. https://doi.org/10.1080/00958964.2023.2169207

Garcia-Vazquez, E., Palacios-Abrantes, J., & Vazquez, A. (2022). Enhancing marine conservation through ocean citizenship: The role of education and engagement. *Marine Policy*, *140*, 105030. https://doi.org/10.1016/j.marpol.2022.105030

Gravemeijer, K., & Cobb, P. (2013). Design research from the learning design perspective. In T. Plomp & N. Nieveen (Eds.), *Educational design research, Part A: An introduction* (pp. 72–113).

Guest, H., Lotze, H.K., & Wallace, D. (2015). Youth and the sea: Ocean literacy in Nova Scotia, Canada. *Marine Policy*, *58*, 98–107. https://doi.org/10.1016/j.marpol.2015.04.007

Halversen, C., Schoedinger, S., & Payne, D. (2021). *A handbook for increasing ocean literacy: Tools for educators and ocean literacy advocates*. National Marine Educators Association.

Hugo, N. (2022). Children as agents of change for the future. In H. Séraphin (Ed.), *Children in sustainable and responsible tourism* (pp. 189–199). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80117-656-920221014

IOC-UNESCO. (2022). A new blue curriculum – A toolkit for policy-makers. Paris. (IOC Manuals and Guides90). Available at https://unesdoc.unesco.org/ark:/48223/pf0000380544.locale=en

Kelemen-Finan, J., Scheuch, M., & Winter, S. (2018). Contributions from citizen science to science education: An examination of a biodiversity citizen science project with schools in Central Europe. *International Journal of Science Education*, *40*(17), 2078–2098. https://doi.org/10.1080/09500693.2018.1520405

Kelly, R., Fleming, A., Pecl, G.T., Richter, A., & Bonn, A. (2020). Social license through citizen science: A tool for marine conservation. *Ecology and Society*, *25*(1), 11. https://doi.org/10.5751/ES-10704-240116

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Krasny, M.E., & Tidball, K.G. (2015). *Civic ecology: Adaptation and transformation from the ground up*. MIT Press.

Lakeman Fraser, P., & Richardson, B. (2023). Engaging teachers in citizen science: Reflections and recommendations. *Journal of Science Communication*, *22*(1), A02, Retrieved from JCOM.

McKinley, E., & Burdon, D. (2020). Understanding ocean literacy and ocean climate-related behaviour change in the UK-work package 1: Evidence synthesis. Final report produced for the Ocean Conservation Trust and Defra, 96p.

McKinley, E., Burdon, D., & Shellock, R. J. (2023). The evolution of ocean literacy: A new framework for the United Nations Ocean Decade and beyond. *Marine Pollution Bulletin*, *186*, 114467. https://doi.org/10.1016/j.marpolbul.2022.114467

McKinley, E., & Fletcher, S. (2012). Improving marine environmental health through marine citizenship: A call for debate. *Marine Policy*, *36*(3), 839–843. https://doi.org/10.1016/j.marpol.2011.11.001

Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, *1997*(74), 5–12. https://doi.org/10.1002/ace.7401

Mioni, E. (2022)."Percorsi nel Blu" ("Blue Paths"): A long-lasting project to integrate ocean literacy and marine citizen science into school curricula. *Mediterranean Marine Science, 23*(2), 405–416. https://doi.org/10.12681/mms.27152

Murray, L., Breheny, M., Cumming, R., Erueti, B., Mooney, M., Nash, K.L., Severinsen, C., & Shanly, J. (2023). How does learning about the future of the ocean impact children's emotional wellbeing? Insights from ocean literacy educators in Aotearoa New Zealand. *People and Nature*, *5*, 1622–1635. https://doi.org/10.1002/pan3.10528

National Oceanic and Atmospheric Administration - NOAA. (2024). Ocean literacy: The essential principles and fundamental concepts of ocean sciences for learners of all ages. Silver Spring MD. https://doi.org/10.25923/dym5-4y14

Peasland, E.L., Henri, D., Morrell, L.J., & Scott, G.W. (2021). Why do some students opt out of fieldwork? Using expectancy-value theory to explore the hidden voices of non-participants. *International Journal of Science Education*, *43*(7), 1045–1064. https://doi.org/10.1080/09500693.2021.1923080

Ponte, J.P., Carvalho, R., Mata-Pereira, J., & Quaresma, M. (2016). Investigação baseada em design para compreender melhor as práticas educativas. [Design-based research to better understand educational practices]. *Quadrante*, *25*(2), 77–98.

Ritch, E.L., & Brownlie, D. (2016). Doing it for the kids: The role of sustainability in family consumption. *International Journal of Retail & Distribution Management*, *44*(11), 1100–1117. https://doi.org/10.1108/IJRDM-08-2015-0136

Santoro, F., Santin, S., Scowcroft, G., Fauville, G., & Tuddenham, P. (2017). *Ocean literacy for all: A toolkit*. UNESCO.

Schio, C., & Reis, P. (2024a). Design of a pedagogical model to foster ocean citizenship in basic education. *Sustainability*, *16*, 967. https://doi.org/10.3390/su16030967

Schio C, & Reis P. (2024b). Implementation of a Pedagogical Model of Ocean Citizenship: Students' Perspective. *Australian Journal of Environmental Education. 40*(5), 863–885. https://doi.org/10.1017/aee.2024.57

Severin, M.I., Akpetou, L.K., Annasawmy, P., Asuquo, F.E., Beckman, F., Benomar, M., Jaya-Ram, A., Malouli, M., Mees, J., Monteiro, I., Ndwiga, J., Neves Silva, P., Nubi, O.A., Sim, Y.K., Sohou, Z., Shau-Hwai, A.T., Woo, S.P., Zizah, S., Buysse, A., . . . **Catarino, A.I.** (2023). Impact of the citizen science project COLLECT on ocean literacy and well-being within a north/west African and south-east Asian context. *Frontiers in Psychology*, *14*, 1–17. https://doi.org/10.3389/fpsyg.2023.1130596

Sterling, S (2001) Sustainable Education – Re-Visioning learning and change, Schumacher Briefing no6. Schumacher Society/Green Books, Dartington. ISBN 1-870098-99-4. https://www.greenbooks.co.uk/sustainable-education

Sterling, S. (2003). *Whole systems thinking as a basis for paradigm change in education: Explorations in the context of sustainability*. University of Bath.

UNESCO. (2021). *The United Nations Decade of Ocean Science for Sustainable Development (2021–2030) Implementation Plan*. https://unesdoc.unesco.org/ark:/48223/pf0000377082

Von Braun, J. (2017). Children as agents of change for sustainable development. In A. Battro, P. Léna, M.S. Sorondo & J. von Braun (Eds.), *Children and sustainable development* (pp. 1–12). Springer. https://doi.org/10.1007/978-3-319-47130-3_2

Whitfield, S., Beauchamp, E., Boyd, D.S., Burslem, D., Byg, A., Colledge, F., Cutler, M.E.J., Didena, M., Dougill, A., Foody, G., Godbold, J.A., Hazenbosch, M., Hirons, M., Ifejika Speranza, C., Jew, E., Lacambra, C., Mkwambisi, D., Moges, A., Morel, A., . . . **White, P.C.L.** (2019). Network environmentalism: Citizen scientists as agents for environmental advocacy. *Global Environmental Change*, *55*, 57–67. https://doi.org/10.1016/j.gloenvcha.2019.01.004

Winks, L., Ward, M., Zilch, J., & Woodley, E. (2020). Residential marine field-course impacts on ocean literacy. *Environmental Education Research*, *26*(7), 969–988. https://doi.org/10.1080/13504622.2020.1758631

Winn, W., Johnson, P., & Klett, R. (2006). The impact of field trips and public engagement on marine awareness. *Environmental Education Research*, *12*(4), 487–500. https://doi.org/10.1080/13504620600943201

Yang, J.C., Shein, P.P., Lin, H.-J., & Lin, W.-J. (2024). Beyond the shore: Nurturing future marine biodiversity citizen scientists through Coastal Marine Science Fieldwork programme. *International Journal of Science Education*, 1–26, https://doi.org/10.1080/09500693.2024.2404162

Zampas, G. (2013). Educating children to educate their families: Information, knowledge and experience diffusion within the family for sustainable lifestyles. [PhD thesis], University of Leeds.

https://doi.org/10.1017/aee.2025.10092 Published online by Cambridge University Press

Appendix A — Post-Teacher Training Evaluation Questionnaire (October 2021)

Post-Teacher Training Evaluation Questionnaire

1.Do you feel that you have acquired new knowledge and skills during the training? If so, which ones?

2. What was the most significant learning experience in the training?

3. On a scale of 1 to 10, what level of ocean knowledge do you feel you have acquired during the training?

4. Do you consider the content covered by the training to be aligned with the second cycle curriculum?

5. Do you feel confident in addressing the theoretical ocean-related content with your students that has been covered so far in the training?

6. Do you feel confident in leading the practical coastal monitoring activities with your students at the beach?

7. What challenges or difficulties do you think you might face in implementing the coastal monitoring program?

8. How do you envision potential outcomes (projects, actions, etc.) from this pedagogical model at your school and/or within your community?

9. What is your level of motivation to implement this pedagogical model with your students?

10. Would you like to leave any additional comments?

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Appendix B — Post-First Field Trip Evaluation Questionnaire (March 2022)

Post-First Field Trip Evaluation Questionnaire

1. How was your first experience conducting the coastal monitoring activities with your students? Highlight both positive and negative aspects.

2. Did you feel confident in conducting the coastal monitoring activities? Please indicate any difficulties experienced.

3. How did the students react in the field? Were they engaged and motivated?

4. What were the main challenges you encountered during the field trip?

5. Please indicate any support you received from the school or local authorities in obtaining field materials and organizing school transportation.

6. How was the data analysis conducted with the students afterward at school?

7. Was the content and data collected during the field trip used across different subjects in the curriculum? Please describe any projects or assignments carried out.

8. Can you identify the integration of the coastal monitoring program content into the curriculum? In which areas?

9. If you have already conducted a second coastal monitoring activity, was there any significant difference compared to the first? In what aspects?

10. Please provide any suggestions for changes or improvements in the program's implementation that you consider relevant at this stage.

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Appendix C — End of School Year Evaluation Questionnaire (June 2022)

End of School Year Evaluation Questionnaire

Regarding Your Learning Process:

1. What do you consider to be the most significant learnings from the pedagogical model?
2. What were the biggest challenges encountered throughout the implementation of the model?
3. Would you like to continue implementing the model in the next school year?
4. What would you do differently in the coming years?

Regarding the Training:

1. Do you feel you have received sufficient knowledge for the implementation of the model?
2. Do you feel you had sufficient support from the trainer?
3. Do you consider the number of proposed activities to be carried out during the training to have been: insufficient; sufficient; excessive.
4. In your opinion, what could be improved in the training?

Regarding Student Learning:

1. Do you believe that the pedagogical model has brought new knowledge and skills that contribute to the development of ocean citizenship in students?
2. What moment(s) do you believe were most significant for the students?
3. In which aspect(s) did you observe that students had the most difficulty?
4. Regarding the socio-environmental issues observed in the field, did you carry out any concrete action with the local community?
5. Do you feel that, in some way, students shared their experience/learning from the project with their families?

Regarding the Future of this Educational Program in Portuguese Schools:

1. Based on your experience implementing the model, do you believe it is possible to build a community of practice among schools that constitutes an active Ocean Guardians Network in Portuguese education?
2. What strategies or pedagogical and technological tools do you believe are necessary for the establishment of this network among schools?

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Cite this article: Schio, C., & Reis, P. (2026). Evaluating Teachers' Experiences Piloting an Ocean Citizenship Pedagogical Model. *Australian Journal of Environmental Education* **42**, 817–839. https://doi.org/10.1017/aee.2025.10092

https://doi.org/10.1017/aee.2025.10092 Published online by Cambridge University Press