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# Setting Sail for Resilience and Ocean Sustainability

Alun Morgan [1] and Charlotte B. Braungardt [2]

[1] Plymouth Institute of Education—School of Society and Culture, University of Plymouth, UK
[2] Challenging Habitat, UK

**Correspondence:** Alun Morgan (alun.morgan@plymouth.ac.uk)

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## Abstract

This article makes a valuable contribution to the emerging field of marine social sciences by focusing on the potential contribution of learning theory and praxes in promoting ocean literacy, marine identity, and marine citizenship. These are advocated as important social dimensions of the changes and outcomes required to promote sustainability and resilience of marine environments and, by extension, terrestrial environments, across a range of scales from local to planetary. This is because the factors that compromise marine resilience are largely anthropogenic, and a consequence of the negative outcomes of human disassociation from the ocean. From another perspective, the article is equally concerned with how to promote personal resilience and ocean stewardship as positive personal and social outcomes exhibited by people, especially young people. A synergy is noted between outdoor adventurous education and inquiry-based science learning in marine contexts, with sail training being identified as particularly effective as a marine-oriented experiential learning approach and context. These insights are exemplified through a case study of sail training programmes developed and operated in the UK. Preliminary findings from trainee questionnaires support the contention that sail training is a powerful vehicle for personal growth across the range of learning dimensions (upward, outward, inward, and downward personal growth). Feedback also indicates the development of ocean literacy, marine identity, and marine citizenship amongst some participating trainees which, together, promote personal resilience and a commitment to marine stewardship (advocates of and active agents for promoting ocean sustainability).

## Keywords

environmental and sustainability education; marine citizenship; ocean literacy; outdoor education; sail training

## 1. Introduction

This work is motivated by the insight that a healthy and sustainable planet, and ultimately human well-being, is dependent on the marine environment and that the actions of humanity are compromising the health and resilience of this life support system, which must change (Intergovernmental Oceanographic Commission, 2021). However, this perspective remains largely restricted to a relatively small sector of society, including academics, practitioners, and policymakers working and researching at the forefront of human-(marine)environment relations. In order to change the attitudes and behaviours of the wider public, a sea-change in the relations between the greater part of humanity and the environment—the marine environment specifically—is required.

The designation of 2021–2030 as the United Nations Decade of Ocean Science for Sustainable Development represents a welcome moment in this urgent and necessary process. The associated seven visions for a future resilient and healthy ocean represent a framework for such a renewed human-marine relationship (Intergovernmental Oceanographic Commission, 2021). In particular, Outcome 7 expresses the need for "an inspiring and engaging ocean where society understands and values the ocean in relation to human well-being and sustainable development" (Intergovernmental Oceanographic Commission, 2021, p. 19) and promoting ocean literacy is seen as an important social outcome of the UN Decade. This is, however, predicated on the need to address the UN Decade's Foundational Challenge 10:

> Ensure that the multiple values and services of the ocean for human well-being, culture and sustainable development are widely understood and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean. (Intergovernmental Oceanographic Commission, 2021, p. 23)

This demands suitable exploratory and explanatory frameworks in order to identify appropriate interventions, which might facilitate the transition of people from a situation of non-engagement to one of awareness and engagement with human-marine relations (Glithero et al., 2024). Initially, such growing awareness was largely driven by natural scientists, who identified the knowledge required to make people ocean-literate from a scientific perspective (National Marine Educators Association, 2013). More recently, there has been an accompanying "blue turn" in the sociological, arts, and humanities disciplines (McKinley et al., 2020; Popova et al., 2023), this journal itself being an important marker in this respect. This has given rise to a range of marine environmental communication strategies aimed at bridging the gap in awareness (Lindland & Volmert, 2017), and to new and emerging humanistic and sociological concepts such as ocean citizenship (S. Fletcher & Potts, 2007), marine citizenship (Buchan et al., 2023), and marine identity (Buchan et al., 2024). There has also been a similar turn in the realms of human health and development, with physical and mental health benefits of being near, on, or in the water being increasingly recognised (Britton & Foley, 2021; MacIntyre et al., 2019; Nichols, 2015) alongside the possibility for deeper, more existential, and spiritual dimensions of human-aquatic relations (e.g., Shaw & Francis, 2014).

Crucially, what remains acknowledged yet relatively under-theorised is a focus on the *learning* dimension—at the individual and collective/social levels. This article contends that deeper learning is required, driven by direct experiential and inquiry-driven learning engagements, and aims to contribute to these efforts by building on learning theory and praxis already apparent within the field.

## 2. The Contribution of Significant Learning and Development Praxes

### *2.1. Dimensions of Learning and/or Personal Growth*

In this section, we broadly map out human dimensions across which learning might occur, by drawing on emerging work at the intersection between psychology (environmental, developmental, and evolutionary), psychotherapy (including ecotherapy), sports and leisure studies, and education (outdoor, experiential, adventurous, environmental, etc.; Fink, 2013, p. 7). Whilst making general observations, we focus specifically on how these insights might be related to the affordances of human-marine relations.

#### 2.1.1. Experiential Learning

Experiential learning represents a broad and complex field, comprising many currents (Roberts, 2012). Arguably, learning, or experience of any kind, can only take place as an emergent property of three inextricable dimensions of experience (Falk & Dierking, 2013): the physical setting (indoors or outdoors), social context, and intrapersonal or mindset. The transaction between the outer setting (interpersonal/social and/or physiographic contexts) and the inner context is achieved through the experiencing (and by extension learning) individual.

The notion of the "experiencescape" (O'Dell & Billing, 2005) represents an emergent property of these three contexts. From this perspective, "the particular attributes and affordances of the place are crucial; but so, too, are the subjectivities (motivations, perceptions, responses, etc.) of the 'experiencing subjects' " (Morgan & Freeman, 2022, p. 86). One can distinguish between experiencescapes that are everyday and those that are strange or unfamiliar, typically distant "awayscapes" (Morgan & Freeman, 2022). The latter are often seen as potentially effective for transformative learning precisely because of their unfamiliarity. Residential experiences and expeditions present a range of "challenges of being 'away' from: home, supportive friends and familiar territory; and being 'relocated' into a (potentially) challenging: physical environment; social environment (including living communally and completing tasks in groups); and travelling long distances" (Morgan & Freeman, 2022, p. 86). It is precisely because these challenges require effort to overcome and afford the opportunities for encountering the unknown that they present such a powerful learning context (Bell et al., 2010). This article is concerned with a specific experiencescape (seascape) and awayscape (a sail training vessel; Brown, 2016; Roe & Stead, 2022, p. 350).

Beatley (2017, p. 126) presents the range of opportunities for seascape encounters as a "blue pyramid." The base represents local, short-term, and accessible opportunities to engage with the blue environment, such as taking a walk along the coast, going for a swim, or fishing from the shore. Ascending the pyramid involves increasingly lengthy and immersive, but less frequent, experiences likely to involve increasing travel to faraway seascapes, including potentially offshore and out of sight of land. This model is particularly relevant in this article since sail training represents an activity towards the apex of the pyramid. This makes it arguably more costly (in time, finances, and resources), raising important challenges in terms of scaling up and exclusivity. However, we argue that it is particularly effective for promoting deep, meaningful, and transformative learning engagements with the marine environment, providing suitable efforts are made to make it accessible and inclusive.

### 2.1.2. Directions of Personal Growth and Development

The simple framework utilised by Stott et al. (2015, p. 224) derived from their work on youth expeditions indicates that positive growth or learning outcomes can occur in four dimensions:

1. Upward personal growth (realising potential): increased confidence, physical and social resilience, self-reliance, and ability to overcome challenges.
2. Outward personal growth (learning about others): improved social skills.
3. Inward personal growth (learning about self): improved emotional stability and better able to reflect on events.
4. Downward personal growth (learning about the environment): increased environmental appreciation and awareness.

The first and third dimensions relate to personal development (emotional intelligence, self-esteem, and self-efficacy; Peterson & Seligman, 2004; Schiro, 2008). It also implies pursuing *eudaimonia*—achieving the highest level of personal development or flourishing, such as the upper levels of Maslow's (2013) hierarchy of need: self actualisation and self-transcendence (these contribute to personal resilience). The second dimension concerns learning to relate to other people, i.e., developing interpersonal, intercultural, or social understanding. These represent complementary and synergistic orientations of growth—learning about and with others drives personal growth or maturation, and vice versa. It is usual to combine or conflate them as personal and social development or spiritual, moral, social, and cultural development. Claims as to the positive learning potential concerning these three dimensions represent key justifications for sail training as a vehicle for youth development (E. Fletcher & Prince, 2017; McCulloch et al., 2010; Prince & Fletcher, 2020).

The fourth growth orientation relates to the environment, which can include seascapes. This can be experienced at the local scale of the "nearby" or "place-based," but can also involve abstractly learning about scales beyond the local, extending to the global. Environmental and sustainability education (ESE) and inquiry-based approaches to environmental learning are likely to emphasise this downward/external dimension. Scientific inquiry (e.g., learning about natural processes and systems), particularly if undertaken experientially through fieldwork, is a key orientation in ESE, which can help to identify characteristics leading to optimal ecosystemic health and/or issues that threaten the resilience of the environment. Alternatively, more affectively oriented and expressive approaches to ESE drawing on the arts and humanities have been developed. Ultimately, intellectual and affective engagement is seen as the necessary precursor to agency and environmental citizenship.

### 2.1.3. Domains and Dimensions of Learning and Growth

Educational psychology typically distinguishes between three main domains, each of which can be a focus for learning: the cognitive (intellectual), affective (emotional), and psychomotor (embodied/sensorial experience), through which behaviour is expressed. Such distinctions hide the interrelatedness of these three domains (Beard & Wilson, 2006). Nevertheless, the distinctions can be helpful analytically. For example, Rieckmann (2017) used a similar formulation in considering the range of learning opportunities related to the Sustainable Development Goals (SDGs; United Nations Development Programme, n.d.):

> The cognitive domain comprises knowledge and thinking skills necessary to better understand the SDG and the challenges in achieving it. The socio-emotional domain includes social skills that enable learners to collaborate, negotiate and communicate to promote the SDGs as well as self-reflection skills, values, attitudes and motivations that enable learners to develop themselves. The behavioural domain describes action competencies. (Rieckmann, 2017, p. 11)

Various models have been proposed to account for the processes that lead to environmental behaviour change (Akintunde, 2017). Furnishing people with the requisite information is insufficient to engender behaviour change. Nor is it sufficient merely to locate oneself in nature. Lumber et al. (2017) suggest that additional pathways for deeper engagement are required. This relates to recent work in positive psychology and nature connection, which identifies the salutogenic benefits of physical access to, and engagement with, green and blue spaces (e.g., Donnelly & MacIntyre, 2019; Newton, 2007). The concept of the blue mind (Nichols, 2015) supports the particular benefits of engagement with aquatic environments, and there are many autoethnographic accounts of the deep and meaningful engagements people have next to, on, in, and underwater, including marine environments (e.g., Brown & Humberstone, 2016; Morgan, 2019). Many of these accounts relate to *hedonic* pleasures of embodied engagement with the natural, and specifically aquatic, environment; others relate to more *eudaimonic* growth.

### 2.1.4. Knowledge, Skills, Attitudes, and Values

Another analytic approach much utilised in educational theory identifies knowledge, skills, attitudes, and values (KSAV) as different targets or outcomes of learning. Formal schooling often emphasises transmitting content and/or procedural knowledge in designated *indoor* spaces (classrooms) that can be replicated in assessment situations. This relies on extrinsic instrumentalist motivations to compel such learning and does not always promote engagement and attitudinal or behavioural change. Informal learning, by contrast, can take place in any context and is:

> Not just for advancing academic study but also for personal and social development. It…seeks to promote human flourishing by acknowledging and extending the lived experience of learners, establishing and pursuing *their* wants and needs as the basis for developing their agency. (Morgan & Freeman, 2022, p. 84, emphasis added)

Informal learning allows learners to freely choose the content and approach of the learning undertaken for intrinsic reasons, which is particularly relevant in relation to this article in terms of "environmental free-choice learning" (Falk et al., 2009).

The values dimension can form a specific focus. Two broad approaches are discernible (Halstead, 1996). Values clarification seeks to allow people to develop a personal understanding of, and response to, particular issues such as are encountered through inquiry and debate. This approach is pertinent to complex socio-scientific issues (Levinson, 2006; Ratcliffe & Grace, 2003), such as ESE and coastal and marine citizenship. Character development, in contrast, relates to the idea of pursuing *eudaimonia*, achieving one's full authentic potential and promoting particular character traits or virtues (Peterson & Seligman, 2004). Claims to support character development and resilience represent a major justification for sail training.

## *2.2. Educational Approaches That Intersect*

### 2.2.1. Outdoor Adventure Education

Some argue that interaction with the natural environment, particularly in the context of adventurous activities, can facilitate the development of character and virtues, such as courage, endurance, resilience, persistence, self-control, and self-mastery. Typically, outdoor adventure education (OAE) activities "include a small-group atmosphere, interaction with an outdoor or natural setting, a purpose-driven dynamic for achieving specific goals, an uncertainty of outcome, and a sense of achievement on completion of the experience" (Ewert & Sibthorp, 2014, p. 3). Context and setting are important, typically involving:

> [A] juxtaposition of beautiful and aesthetically pleasing scenery combined with a challenging and demanding physical environment combined with a critical and novel social environment…[which] can provide not only challenge and excitement but also connection to nature, places for reflection and quiet solitude. (Ewert & Sibthorp, 2014, p. 34)

Of particular importance in many models of OAE is the inclusion of real or perceived risk and/or challenge, which is deemed crucial in the promotion of personal growth. Thus, participants are required to move beyond their comfort zone to discover hidden dimensions of themselves, whilst simultaneously increasing their physical fitness and well-being. Such a perspective lies at the heart of many formulations of OAE and expeditionary learning (Stonehouse, 2010), of which sail training is a special instance (Marshall et al., 2020). Indeed, the particular logistics of life aboard, a necessarily cramped and self-sufficient vessel at sea in a dynamic, challenging, and unfamiliar environment, are likely to promote insights into the need for collaboration, prudent use of resources, resilience, and problem-solving—a microcosm of the virtues required for a more sustainable world. Other dimensions of character and virtue promoted by intimate engagements with the natural world may include: ecological sensitivity attunement and attentiveness; temperance, frugality, and far-sightedness; and wonder, reverence, benevolence, and compassion (Sandler, 2006, 2007). Opportunities to engage with the marine environment afford particularly edifying experiences not possible otherwise, such as engaging with marine wildlife in their natural habitat, spectacular seascapes, sunrises, and bioluminescence.

A purely risk-driven OAE approach has come under criticism as being overtly masculinist and elitist, prioritising exceptional achievements, leading to often negative environmental or cultural impacts. More recent formulations are more conscious of issues of equality, diversity, inclusion, and community, to pay due attention to the local ecosystems through place-responsive practices and engagements, and the need to reduce carbon footprints (Brown & Beames, 2017).

Much OAE practice is limited to short activities within a day-long or perhaps longer residential program. However, a particularly powerful OAE strategy is to undertake an extended expedition into relatively wild environments, especially if undertaken using traditional, non-motorised modes of transport (Henderson, 2010), including sail, which affords being closer to, and beholden to, the natural, elemental forces (wind, tides, currents, etc.).

#### 2.2.2. Socio-Scientific Inquiry-Based Learning

There is a long-standing tradition of undertaking scientific expeditions, notably since the Age of Enlightenment, which developed into their use as an educational vehicle for promoting scientific literacy in the 20th century (Stott, 2010). More recently, greater emphasis has been placed on education for environmental citizenship (Hadjichambis & Paraskeva-Hadjichambi, 2020) through socio-scientific inquiry-based learning, community service learning, civic ecology education, and place-based and problem-based learning. Such approaches have the potential for a range of positive outcomes, namely: enhanced knowledge and skills concerning scientific topics and scientific inquiry; interest in science, nature, and the environment; an associated motivation to, and sense of self-efficacy in participating in scientific activities and debates; and behaviour change and stewardship—local through to global (Bonney et al., 2016; Phillips et al., 2018).

Such approaches have increasingly been used in relation to the marine environment, and in order to promote ocean literacy, marine identity, and marine citizenship, through "coastal and marine citizen science" (Cigliano & Ballard, 2017; Fauville et al., 2019). Many such initiatives are understandably oriented towards the base of the blue pyramid, i.e., typically shore-based activities in coastal localities. Some might involve near-shore and underwater activities, such as snorkelling and scuba diving (Cigliano & Ridlon, 2017). There is, however, an emerging recognition of the particular value of using vessels as a learning platform capable of going further, and for longer, offshore and accessing seascapes/awayscapes higher up the blue pyramid. The use of sailing vessels for this work lessens environmental impacts.

This article advances the contention that sail training presents a suitable context and strategy for combining in a synergistic manner the benefits of adventurous outdoor education and inquiry-based scientific learning in a maritime context to promote ocean literacy and marine citizenship. The following section seeks to support this contention through the presentation of a case study.

## 3. Case Study: Ocean-Focused STEAMS Education Aboard Tall Ship Pelican of London

### *3.1. Background*

The tall ship Pelican of London is a UK-based sail training vessel operated by a not-for-profit youth development organisation. The impact evaluation data obtained from the Pelican of London trainees is used here with the express agreement of the organisation, which meets three core objectives (personal growth, career development, and ocean literacy) through residential sail training programmes that engage young people in the age range of 14 to 25.

Voyages aboard Pelican are typically six to ten days in duration and have a complement of seven professional crew, six to nine volunteer crew, and up to 30 trainees. The latter come from a broad range of backgrounds and include many young people who experience challenges in daily life, may it be socio-economically, neurodiversity, or societal marginalisation.

### 3.2. Programme Development

The integration of ocean-focused STEAMS (science, technology, engineering, arts, maths, and sustainability) education and sail training aboard Pelican is an innovative attempt to utilise the synergies between residential OAE, ESE, and socio-scientific inquiry-based learning in supporting youth development, ocean literacy, citizenship, and identity. The concepts and factors underpinning this educational approach are summarised in Figure 1.

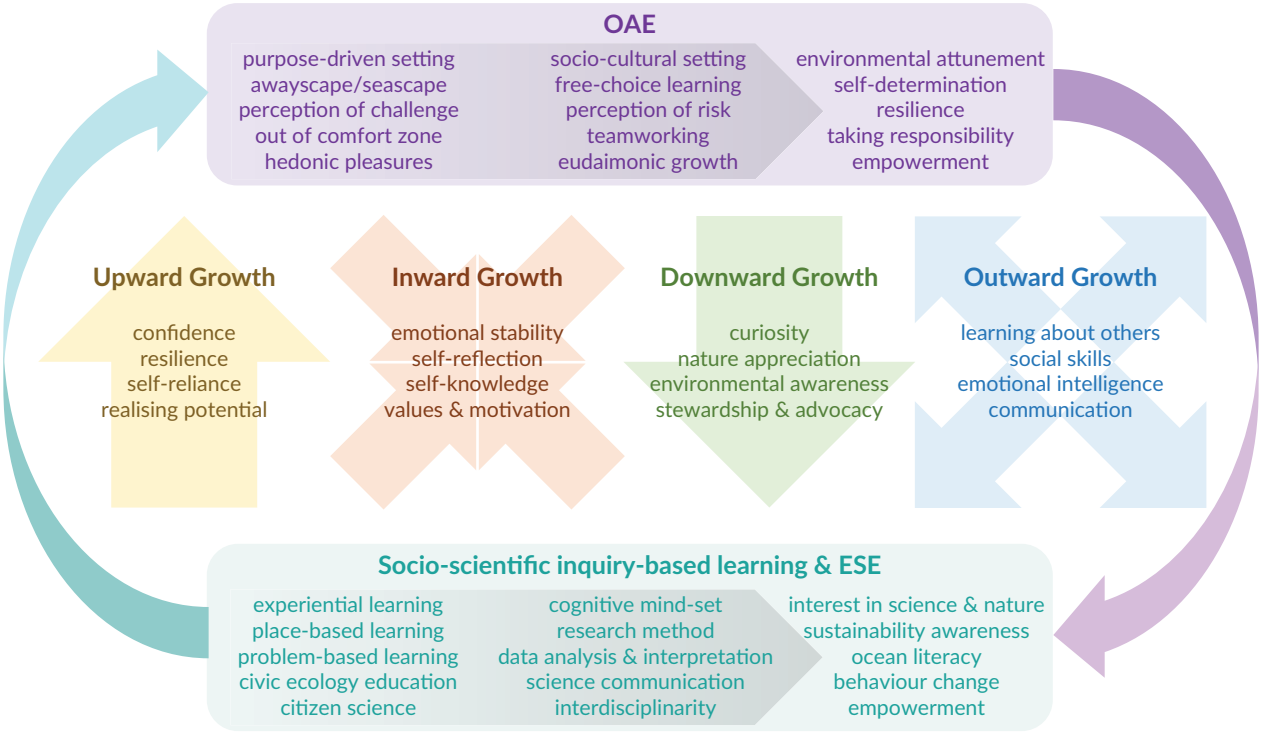


**Figure 1.** Synergies between OAE, socio-scientific inquiry-based learning, and ESE promote upward, inward, downward, and outward personal growth, with desirable outcomes in the context of this case study. Note: Based on Bonney et al. (2016); Marshall et al. (2020); Phillips et al. (2014); Sandler (2007); Stott et al. (2015).

At first glance, tensions between the hierarchical structure on a sail training vessel and developing self-reliance and empowerment may be detected, which also extend to the discipline required in scientific enquiry. Within the case discussed here, these tensions are envisioned to be resolved by the upward personal growth effected by the training programme, lasting beyond the time on board.

The integration of STEAMS education into sail training on Pelican originated with the ambition to better utilise the potential of being at sea by enhancing the ocean literacy and marine identity of trainees, with the aim to promote marine citizenship. An experienced marine scientist and expeditionary educator (co-author), developed and delivered a series of ocean science pilot voyages between 2019 and 2021. Based on these experiences and with the typical length of the summer voyages (7–10 days) and different audiences in mind, the projects Ocean Awareness, STEAMS at SEA, and Ocean Science were established in 2022.

Our approach utilises the potential for transformative experiential learning in the seascape of a residential voyage on a sail training vessel. The synergies of youth expeditions that promote upward, outward, inward,

and downward personal growth (Stott et al., 2015) with learning opportunities through STEAMS education was seen as a potentially powerful pathway towards behavioural change and marine citizenship (Figure 1). In this context, the principles of ESE and inquiry-based learning were combined with the UN SDGs (United Nations Development Programme, n.d.) to guide the development of workshops, experiments and citizen science activities that also encourage creative expression and complement the sail training objectives:

- The ship's crew encourage trainees to look after their own and each other's health and well-being (SDG 3 "good health and well-being"), embrace diversity and gender equality (SDG 5 "gender equality" and SDG 10 "reduced inequalities"), and showcase a wide range of professional pathways (SDG 8 "decent work and economic growth").
- The education programme introduces atmospheric processes and impacts of anthropogenic climate change (SDG 13 "climate action") and explores the ocean (eco)system (SDG 14 "life below water"). It includes human impact studies and encourages reflection on personal choices and behaviours (SDG 12 "responsible consumption and production"). Learning to generate quality data for citizen science projects empowers ocean advocacy and stewardship beyond the voyage.
- Training and education goals are achieved through hands-on experience with a range of sailing and STEAMS challenges, experiments, design competitions, and observations that support knowledge and skills acquisition for people with different learning styles (SDG 4 "quality education").

The extent and depth to which this is achievable depends on the voyage model, age, and educational interests of the trainees:

- Ocean Awareness voyages add value to young people's sail training experience through having a scientist in residence on board, who offers voluntary participation in science outreach activities. Scientists in residence may pursue their own interests and engage trainees by leading discussions and introducing data collection for citizen science projects.
- STEAMS at SEA voyages incorporate a programme of activities into the daily sail training routine. Led by an experienced STEAMS educator, all trainees take part in workshops involving scientific observations, experiments, and calculations in subject areas that are relevant to their experience at sea.
- Ocean Science voyages are a more research-oriented variant of STEAMS at SEA. Trainees are introduced to the scientific research process and design and execute research projects in small groups, from asking a questions to disseminating the outcomes of their investigation.

Since 2022, three Ocean Science, 10 STEAMS at SEA, and 24 Ocean Awareness voyages have taken place, involving approximately 70, 250, and 600 trainees, respectively. The voyage models differ in resource requirements in terms of the pedagogic experience of the science lead, equipment, and time set aside for STEAMS within the training programme.

Citizen science activities are a valuable part of all voyages, as they engender discussions of ocean conservation, introduce concepts of quality control, provide valuable data, and empower individuals to take citizen science into their daily lives and communities. Little equipment and training are needed and their potential for developing ocean literacy, marine identity, and marine citizenship is high. The STEAMS and Ocean Science voyages extend the personal development facilitated by sail training and citizen science by enhancing key employability skills and boosting confidence in academic subjects through immersive

experiential learning. In this, cognitive, socio-emotional, and behavioural learning objectives (LOs) related to the UN SDGs are realised, with the focus on the former while on board and longer-term aims for the latter two. To illustrate this within UN SDG 14 (after Rieckmann, 2017, p. 38):

- Cognitive LO: development of understanding of basic marine ecology, food web relationships, and the role of the ocean in climate regulation through learning while on board.
- Social-emotional LO: maturing of the learning that took place on board through further engagement post-voyage, resulting in the ability to show others the impact of human activity on oceans and reflect on their own consumption and waste management choices.
- Behavioural LO: post-voyage, feeling empowered, and motivated to take informed action (e.g., debate and campaign for conservation; identify and source sustainable products).

Achieving such LOs requires a more experienced expeditionary educator, who is comfortable with the flexibility and adaptability necessary when working with diverse groups, and challenging and changing conditions at sea. In addition, equipment that enables the study of ecosystems (e.g., plankton net, microscopes, hydrophone, and underwater camera), oceanography (e.g., current meter, sonar, and sediment grab), chemistry (e.g., laboratory and analytical instrumentation), meteorology (e.g., weather station), and more, is necessary for facilitating experiments and observations that support this deeper learning.

### *3.3. STEAMS Practice Onboard*

The provision of a flexible, engaging, and hands-on learning environment that is distinct from the classroom is particularly important for young people with negative experiences in formal learning environments. The informal educational setting on Pelican affords the application of free choice learning principles. For example, for a session of around 45 minutes, a small group of trainees could be given the choice between undertaking meteorological observations and learning how to read the sky or to experimentally explore the impact of rising atmospheric $CO_2$ levels on ocean chemistry and ecosystems. The former is relevant as weather directly shapes our experience on board, while the latter brings together several strands of knowledge related to examining phytoplankton under the microscope, discussing ocean circulation, and the ocean's role in climate regulation. Free choice learning can be extended to focused interaction with crew of specific expertise (e.g., bosun, engineer, cook, navigator, and medic) and the trainee-led development of research projects on STEAMS at SEA voyages.

Along the shoreline, a recorded beach clean may be undertaken alongside searching for shark and ray egg cases, commonly known as mermaid's purses. Both are citizen science projects for the Marine Conservation Society and the Shark Trust UK, respectively and can be readily combined with some other beach activity, such as swimming, relaxing over lunch, or a ball game. This affords playful learning and informal discussions about sources and management of waste; sustainable consumption behaviour; the varied reproductive strategies of sharks, rays, and skates; fishing and consumer choice and the role of top predators in ecosystems. The use of technology, such as an underwater drone and instruments that measure water currents, pH, dissolved oxygen, or the abundance of phytoplankton, allows deeper exploration of physical, chemical, and biological ocean systems, while also engaging young people who are interested in industrial design and engineering.

### 3.4. Preliminary Study of Impact

For several years, SYF asked trainees to complete pre- and post-voyage questionnaires to gain feedback on training programmes. Most post-voyage questionnaires were completed within two weeks of voyages and can be considered as showing short-term perceptions and outcomes. In addition, written feedback provided deeper insights. The completion of the questionnaires included a declaration of consent to the data being anonymised and used for marketing and research purposes. Informal feedback presented in this article was used with the individual's consent for such purposes.

The data of SYF questionnaires from the years 2023 and 2024 were included in the analysis for this study and comprised of six sections:

1. Asking about confidence in situations, such as meeting new people and working in a team (Likert scale: Not at All, A Little, So So, Quite a Lot, and A Lot);
2. Asking about anxiety about situations, such as climbing heights and taking responsibility (Scale as in Section 1);
3. Asking about their feelings, for example about physical and mental health (Likert scale: Bad, Ok, So So, Good, and Very Good);
4. Responding to statements, for example, "I find it easy to express my thoughts and feelings to others" (Scale as in Section 1, 2024 only);
5. Asking about post-voyage outcomes and reflections, for example, being more interested in ocean science or feeling more self-confident (Scale as in Section 1, 2023 only);
6. Questions to be answered in free text (post-voyage), such as "I really enjoyed…" and "I wasn't happy about…";

To evaluate learner gain, respondents of both, pre- and post-voyage questionnaires were aligned. In 2023, 35 pre-voyage and 33 post-voyage responses to the SYF questionnaire were submitted, with $n = 16$ individuals completing both. Of $n = 67$ pre- and $n = 41$ post-voyage responses in 2024, $n = 18$ individuals matched.

Questions in Sections 1 to 5 were converted into a numerical format (1–5). For Sections 1 to 4, the difference between post- and pre-voyage responses for individuals was calculated in such a way that a shift to a positive outcome is marked by a positive number (learner gain [LG]) and a shift to a more negative response calculated as below zero (negative LG). Answers to questions in Section 6 and similarly formulated questions posed to students by teachers at collaborating colleges in the Plymouth Ocean Science Voyage (2022, 2023, and 2024), as well as informal feedback were considered in the context of intended learning outcomes of ocean-focused STEAMS education on Pelican of London.

## 4. Findings and Discussion

We are aware that the small sample size in relation to the total number of participants impacts the validity of quantitative data analysis carried out here and therefore, this study is considered strictly preliminary. A research project funded by Sail Training International is developing more comprehensive social research tools for assessing the efficacy of on-board ocean science education, which will be utilised from 2026 onwards.

### 4.1. Short-Term Learner Gain

The analysis of LG for respondents of questionnaires in 2023 and 2024 ($n$ = 34) indicated that the perceived improvement was strongest in relation to others (outward growth) and nature (downward growth; Figure 1 and Table 1). Responses to "I feel it easy to express my thoughts and feelings to others" and "I feel connected to nature and enjoy outdoor activities" scored the highest average improvements (LG 0.44). Trainees also felt less anxious about taking on leadership roles (LG 0.32) and identified more strongly with the statement "I feel comfortable in social situations and interacting with peers" (LG 0.31), "[I] gained confidence dealing with conflict" (LG 0.24), and their "ability to handle challenging situations" (LG 0.21), indicating that the challenges, outward and upward growth commonly associated with OAE resulted in the development of agency and empowerment (Figure 1).

**Table 1.** Average learner gains for respondents to Sections 1 to 3 ($n$ = 34, 2023 and 2024) and Section 4 ($n$ = 18, 2024) to pre- and post-voyage Seas Your Future questionnaires.

| Section 1: I feel confident about… | Average LG | Section 3: How do you feel about… | Average LG |
|---|---|---|---|
| Meeting new people | 0.18 | Your mental health | –0.09 |
| Getting on with a group of strangers | 0.06 | Your physical health | –0.21 |
| Speaking in a group | 0.18 | Your feelings of happiness | –0.11 |
| Dealing with conflict in a group | 0.24 | Your feelings of confidence | 0.21 |
| Dealing with authority figures, e.g., teacher/supervisor | 0.17 | | |
| Working co-operatively in a team | 0.12 | | |
| Understanding other people's point of view | 0.06 | | |
| **Section 2: I feel anxious about…** | **Average LG** | **Section 4: How do you identify with these statements…** | **Average LG** |
| Seasickness | 0.33 | I feel confident in my ability to handle challenging situations | 0.21 |
| Heights | 0.27 | I often struggle with feelings of stress and anxiety | –0.06 |
| Taking on a leadership role | 0.32 | I feel comfortable in social situations and interacting with peers | 0.31 |
| Meeting strangers | 0.21 | I find it easy to express my thoughts and feelings to others | 0.44 |
| Being in confined spaces | 0.31 | I feel connected to nature and enjoy outdoor activities | 0.44 |
| Taking responsibility | –0.06 | I feel supported and understood by my friends and family | 0.06 |
| Severe weather | 0.30 | I have a positive outlook on life and the future | 0.06 |
| Lacking ability to undertake tasks | 0.03 | I feel in control of my life and decisions | 0.06 |
| | | I struggle with self-confidence and self-esteem | 0.19 |
| | | I find it difficult to manage my emotions and reactions in challenging situations | 0.19 |

The trainees' self-assessment with respect to parameters external to the sail training environment (e.g., feeling supported and understood by friends and family, a positive outlook on life/future, and mental health, stress, and anxiety) showed little change on average (LG ±0.0x) in the short term. On the other hand, free text responses of some individuals, who started from a position of low scores and had positive LG in almost all elements of the questionnaire indicate significant inward and upward growth (Figure 1) and ocean literacy and marine Identity formation:

> I genuinely can't explain to you how much better I feel now. I feel so positive and joyful, which I haven't felt since childhood. (P., 2024)

> I was able to understand how our actions have a detrimental effect on sea life, providing me with a deeper appreciation of the ocean's fragile ecosystem. (B., 2024)

> The Pelican of London made me feel so special from seeing beautiful sunsets, spirited dolphins playing around the boat and exploring the sea using an underwater camera and I long to feel this feeling again! (L., 2024)

Results show average negative LG (loss) for questions about feelings of happiness (LG = 0.11) and physical health (LG = 0.21). Whether such responses are related to enhanced awareness of self (inward growth) after the voyage or are genuine, long-term negative impacts cannot be discerned here and are particularly important to elucidate and understand using improved and longitudinal research tools.

### *4.2. Post-Voyage Outcomes and Reflections*

The high average score for the statement "I would recommend the voyage to others" of 4.5 (maximum 5.0) indicates high satisfaction with the overall experience (Table 2). It also sets a benchmark, against which other scores may be measured. The personal growth and skills development questions scored slightly higher (3.7 to 4.4) than the aspects related to interest in environmental issues and water-related activities (3.6 to 4.0). Nevertheless, the results indicate raised interest in topics relevant to ocean literacy somewhere between "So So" and "Quite a Lot," with the highest scores given by participants in Ocean Science voyages (caveat: very small sample size).

**Table 2.** Average response per respondent to Section 5 in the post-voyage Seas Your Future questionnaire from 2023 ($n$ = 33).

| Section 5 post-voyage questionnaire | Average score |
|---|---|
| I would recommend the voyage to others | 4.5 |
| I am more confident with others/new friends | 4.0 |
| I feel more self-confident | 3.7 |
| I have learnt new/more sailing skills | 4.4 |
| I am better able to tackle problems | 4.0 |
| I am more interested in the environment/climate change | 3.6 |
| I am more interested in ocean science | 3.7 |
| I have more interest in water-related activities | 4.0 |

Regrettably, only two questions regarding the impact of ocean-focused STEAMS education on trainee interest in environmental topics were included in the SYF questionnaire, and efforts to address this in the current sailing season are underway.

Free text answers in Section 6 of the questionnaire can be categorised into four main categories that relate to the potential for upward, inward, downward, and outward growth (Figure 1):

- Building relationships (e.g., playing games, making friends, and positive encounters with crew);
- Experiencing nature (e.g., being at sea, night sky, sunsets, and seeing dolphins);
- Learning, skills, and knowledge (e.g., teamwork, sailing, and science);
- Leaving the comfort zone (e.g., climbing, snorkelling, being outside, and being with people).

However, this summary hides the general, often exuberant, tone of the free-text answers ("The whole experience was fantastic" and "It was the best opportunity I have ever had"). The aspects of being on board that respondents were not happy about related to a much narrower range of issues, such as seasickness, lack of sleep, sharing, and cleaning bathrooms and a dislike of some fellow trainees. Many responses were simply "N/A."

Answers to the question "Would you tell us how you might use your sailing experience please, your future thoughts and intentions?" demonstrated a shift in thinking that indicates significant personal growth and the development of marine identity and marine citizenship in some:

- Maritime careers (e.g., Royal Navy, marine engineering, and merchant navy);
- Science careers (e.g., ocean science, nature conservation, marine biology, and sustainability);
- Attributes and skills for CV (e.g., teamwork, responsibility, commitment, problem-solving, leadership, and adaptability);
- Personal skills (e.g., building friendships, socialising, communication, conflict resolution, confidence, and listening);
- Sailing (e.g., navigation, knots, and sail-setting applied to recreational sailing);
- Opened horizons (e.g., explore more, travel, breaking glass ceilings, and do new things).

Answers to "How do you think you have changed since the voyage?" confirmed the positive impact the experience had on many with respect to self-awareness, confidence, willingness to take on new challenges (and risks), and exchanging ideas with people, all of which shone through already. Some trainees stated that their anxiety and stress levels have diminished since the voyage. An example for both: "The most significant was learning to live in the present and not allow my nerves to hold me back from pursuing life-changing opportunities" (R., 2024).

Few respondents were unsure or stated that they had not changed. At times, change and a sense of agency may be recognised only with considerable delay, as shown by trainee T. (2022), who did not initially provide feedback, but told their former teacher that the life lessons learned on board contributed to his applying to university in 2025.

### *4.3. Potential Learning Outcomes of Ocean-Focused STEAMS Education*

#### 4.3.1. KSAV Related to Science

Given that KSAV related to ocean-focused STEAMS education are central to this case study and existing questionnaires lack granularity, outcomes for trainees focusing on downward growth for ocean literacy and marine citizenship are examined in more detail. For this purpose, learning outcomes (LOs) proposed by Phillips et al. (2018) for citizen science were modified (Figure 2) and trainee feedback was mapped against them in an attempt to provide a starting point for the development of suitable research tools that evaluate STEAMS-related short- and longer-term outcomes for trainees on Pelican of London. Among these six LOs, four can be considered as instantaneous:

- Questionnaire data indicates that participation in the voyage has raised interest in ocean science and environmental issues, with a number of trainees thinking about pursuing scientific or maritime careers (Figure 2, LO-A).
- Development of self-efficacy related to STEAMS activities or marine citizenship (LO-B) was observed by science leads on board, rather than evidenced through the questionnaires, as it results from practising skills and learning about the nature of science enquiry. Emphasising the interconnectedness of STEAMS subjects and working in interdisciplinary teams are the foundation of training on board (LO-D).
- A different set of questions is required to assess the understanding trainees gain on board (LO-E), but informal conversations and feedback indicate that some trainees of STEAMS at SEA and Ocean Science voyages make progress in this respect.

The remaining two LOs (Figure 2) can only be evaluated with longitudinal studies:

- At times, we hear from teachers that former trainees are pursuing study or apprenticeships in STEAMS subjects (e.g., marine biology, marine engineering, medicine, and physics), evidencing motivation

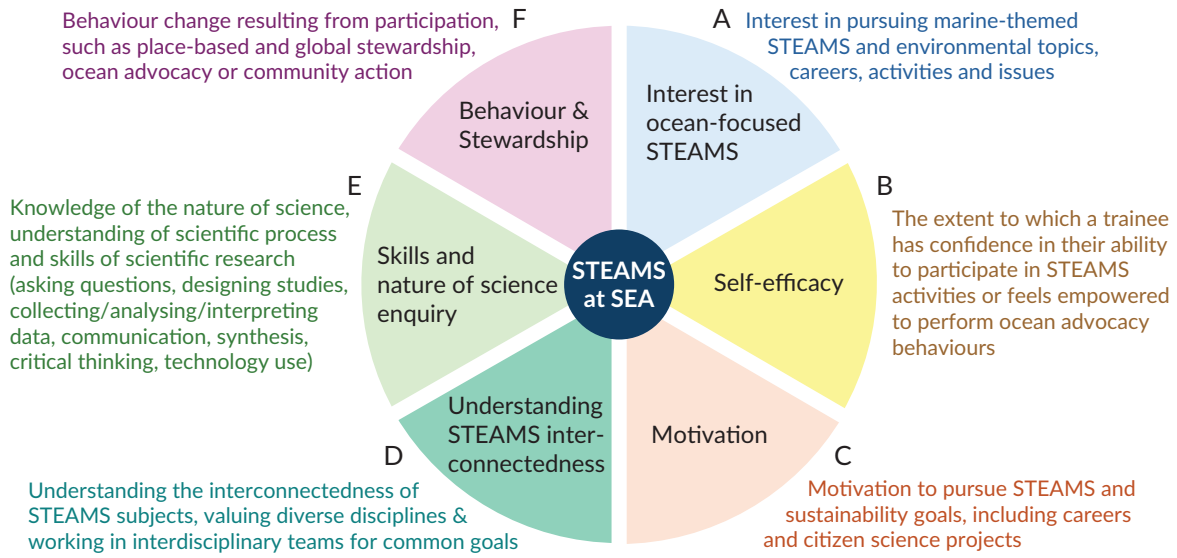


**Figure 2.** Potential learning outcomes of ocean-focused STEAMS education on sail training vessels. Notes: Based on Phillips et al. (2018, p. 10;used with permission); capital letters refer to the text.

(LO-C). However, more detailed enquiry is needed to ascertain how much this is the result of voyage participation.
- While some participants express intentions to change their behaviour while on board, only follow-up studies can elucidate the longer-term impact on marine citizenship (LO-F).

#### 4.3.2. Deeper Connections

Beyond the personal development and specific science-related gains, some participants indicated having profound positive emotional experiences within the seascape. Many trainees mention that their "favourite thing" is seeing the Milky Way and constellations, watching beautiful sunrises and sunsets, seeing wildlife at close quarters, and discovering bioluminescence at night. Sometimes this was expressed in an almost spiritual nature, suggesting transformative learning at the level of self-actualisation and self-transcendence. Two quotes are exemplary in this respect:

> Later that night the sky was clear and we could see the Milky Way which was fascinating. It really got me thinking about how big the universe is and how small I am compared to it all. It made me realise I could dream as big as I wanted to and there's nothing stopping me in life but myself. Above us was the Starlink satellite and below us were the dolphins swimming through the bioluminescent plankton. (A., 2023)

> I think my most memorable moment was when I was at the helm of the ship, it gave me a sense of purpose and trusted with responsibility. Then, all of a sudden, many dolphins appeared out of nowhere and started jumping out of the water as they swam behind the ship. I felt they were interacting with me, making me part of their world. I was filled with joy and happiness. (K., 2023)

These profound and potentially life-changing experiences are seen to be crucial for developing marine identity and promoting environmental behaviour change and stewardship (marine citizenship).

While this would happen on other sail training voyages, these experiences are being reinforced by strong messages and active participation in ocean-focused STEAMS education. For example, the joy of watching dolphins is transformed into knowledge and understanding by learning how to identify species and collecting data for marine mammal conservation organisations—this represents a synergy between the inward and downward growth dimensions noted in Figure 1. During surveys of two or more hours, wildlife is counted, and identified and parameters pertaining to the ship's and animal movement, their behaviour, and environmental conditions are recorded. The mundane task of scanning the water for sightings becomes part of learning how to conduct scientific data collection with diligence and quality control, and that no sighting is valuable data, too.

## 5. Conclusion

This study makes a valuable, albeit as yet tentative, contribution to the ongoing efforts in the marine social sciences to explore and promote the following research priorities identified by McKinley et al. (2022): ocean literacy, citizenship and behaviour change, valuing and connecting with the marine environment, and stakeholder engagement and participation. As "total institutions" (McCulloch, 2013; Zurcher, 1965)

comprising a micro-community with limited privacy and no opportunity to absent oneself, vessels demand the development of a convivial mode of existence and self-sufficiency for extended periods and therefore required to make careful choices around consumption (of food, water, and fuel). These represent real-world challenges of resilience and sustainability in a micro-context that provides lessons beyond life onboard. A sailing vessel also provides ample opportunity for intimate engagement with the elemental environment and very different perceptions of space and time, all of which can promote self-reflection, self-actualisation, and transcendence (Reason, 2016).

The preliminary findings of the 2023–2024 season suggest that the STEAMS voyages promote positive learning outcomes in all four dimensions (upward, outward, inward, and downward personal growth). Most obviously, the study is consistent with findings for positive outcomes related to personal/character/resilience and social development (E. Fletcher & Prince, 2017; Hunter et al., 2010; Marshall et al., 2020; McCulloch et al., 2010). What this study highlights more explicitly are the potential positive learning outcomes related to the downward dimension of "knowing about the environment." An explicit, and innovative, focus of the STEAMS voyages is on the development of KSAV in relation to science generally, and marine science specifically. Evidence gathered in this preliminary study suggests that there is real benefit in this respect of the experiential inquiry-based science approach in the context of an authentic engagement with the seascape and the residential awayscape of a sail training vessel.

However, environmental knowledge can also be seen from a more personal, subjective, and affective orientation. Consistent with deeper affective, experiential engagements with the seascape afforded by being on the water for extended periods, particularly under sail, are also reflected in comments made by some trainees. Being immersed more profoundly in elemental forces provided some trainees with arguably transcendent experiences, which are potentially transformative and likely to enhance their development as stewards of the natural world, especially the marine environment.

Perhaps most importantly, the preliminary study provides sufficient, albeit tentative, evidence in support of the anticipated synergies between the more traditional OAE dimension of the voyages and the relatively recent integration of a more overtly inquiry-based environmental science dimension. Together, these combined elements appear to drive development in all dimensions in a mutually reinforcing manner. Thus, it is apparent from the self-report of trainees engaged in the various SYF programmes that their knowledge, attitudes, and identities both towards themselves (self-efficacy, resilience, etc.) and in relation to the marine environment (ocean literacy, ocean citizenship, and identity) have been significantly and enhanced in a manner which is complementary and synergistic. Thus, trainees emerge as more developed and resilient individuals and social agents capable of advocating for the protection and regeneration of the marine environment (ocean sustainability).

It is unfortunate that, to date, these synergies have not represented a major orientation for investigation, and this study represents the first, tentative steps towards addressing this gap. This article highlights the need for a more extensive exploration that can delve deeper into the synergies and can be extended to provide insight as to the longer-term impact of marine science-oriented sail training voyages. This represents an exceedingly fruitful direction for future work and one which will make a valuable contribution to the social marine sciences and efforts to promote much-needed positive human–marine relations.

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## Conflict of Interests

Charlotte B. Braungardt works freelance as Head of Science for the sail training organization that operates Pelican of London and Alun Morgan is an Ambassador for Pelican of London.

## Data Availability

Data can be made available on request to the authors.

## Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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## About the Authors

Alun Morgan is a senior lecturer at the University of Plymouth, UK where he leads courses and undertakes research in relation to Environmental and sustainability education, outdoor learning, place-based learning, and expeditionary learning. He has a particular interest in ocean literacy, marine citizenship, and sail training.

Charlotte B. Braungardt is a freelance environmental scientist who specialises in science communication and research through her consultancy Challenging Habitat. Her career spans process engineering in Germany, a PhD in metal biogeochemistry, and an associate professor at the University of Plymouth. In 2021, she left academia to set up her consultancy Challenging Habitat.