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Research Article

# Impacts of participation in scientific activities on marine tourists' engagement and individual learning outcomes

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ABSTRACT

The participation of marine tourists in scientific activities or citizen science (CS) has been studied from various angles, to evaluate its benefits to science, management, policy, conservation, and tourism development. One of the main questions arising is whether this activity has positive impacts on participating tourists in the short and long term. This study measured the effects of participation in scientific activities on marine tourists, with an emphasis on relevant expected outcomes including experiential and reflective engagement, and individual learning outcomes. Using a case study of kelp forest monitoring by marine tourists in Cape Town, South Africa, a questionnaire survey was conducted between 2021 and 2022 to assess the short-term impact of participation in scientific activities by marine tourists, namely snorkelers and divers (n = 111). Their perspective was compared with that of tourists engaging in similar activities without a scientific component (n = 100). The results indicated that marine tourists participating in scientific activities were more reflectively engaged compared with regular tourists. Individual learning outcomes including interest; content, process and nature of science knowledge; and behaviour and stewardship were also more heightened for this group. This study confirms that participation in scientific activities has positive effects on marine tourists, but also suggests that tourists not yet participating in these activities can be fertile ground for recruitment in tourist programmes revolving around science and research with multiple potential benefits.

*Mamagement implications:* This study shows how CS based on simple tasks can effectively engage marine tourists and pique their interest in CS. This introduction can result in a further commitment to more complex CS projects which can be offered to tourists. Organisations and businesses engaging marine tourists through CS should consider the relevance of direct contact with nature and enjoyable, immersive experiences that can make CS impactful. The design of CS programmes for marine tourists should incentivise/reward participation and create a sense of inclusion in the scientific process through an open dialogue and feedback, to legitimise CS and make the experience more authentic.

## 1. Introduction

### 1.1. Science as part of marine tourism

In the post-COVID-19 era, coastal and marine tourism is characterised by renewed enthusiasm to spend time near or in marine environments (Maharja et al., 2023; Marconi et al., 2023); this is accompanied by a growing appreciation for efforts to make marine tourism more environmentally sustainable through various interventions, including tourists' engagement and education (Butler et al., 2023; Wilks, 2023a). The United Nations Decade of Ocean Science for Sustainable Development 2021–2030 (UN Ocean Decade) supports Blue Tourism, which is defined as a low-impact activity with benefits to communities, environments and tourists (World Bank, 2022, p. 9). Many forms of marine tourism have the potential to align with the UN Ocean Decade's agenda, as well as Sustainable Development Goals (SDGs) such as SDG 14 – Life below water. These include dive tourism, ecotourism and scientific tourism (Butler et al., 2023; Wilks, 2023b). The latter incorporates tourists' participation in scientific activities, such as the collection of data, into the marine tourism experience, which could be scuba diving, snorkelling, marine wildlife watching or other (Dionisio et al., 2022; Lück & Porter, 2022; Lucrezi et al., 2022a, 2022b, p. 260).

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Participatory research or citizen science (CS) is increasingly integrated into the marine tourism industry in areas from polar to tropical (Butler et al., 2023; Cusick et al., 2020; Sloane & Pröbstl-Haider, 2019; Taylor et al., 2020). The engagement of marine tourists in CS can yield important positive results, not only concerning data quality and contributions to science but also in general for civic engagement and satisfaction (Adler et al., 2020; Butler et al., 2023; Kelly et al., 2020; Peter et al., 2019). Cheung et al. (2022) and Dionisio et al. (2022) argue that there is great potential in engaging tourists in science because they are a heterogeneous group looking for experiences that range from superficial to profound, and this potential ought to be explored.

There are several examples of successful marine tourism offerings involving CS. In tropical and temperate regions, where coastal and marine tourism can have serious direct and indirect effects on the environment, studies have shown how tourists' participation in CS minimises impacts and is proactive in preserving natural resources (Branchini et al., 2015; Butler et al., 2023; Cerrano et al., 2017; Dionisio et al., 2022; Gray et al., 2017; Mieras et al., 2017; Schläppy et al., 2017). For example, Branchini et al. (2015) evaluated the effectiveness of a CS programme in the reefs of the Red Sea, as a tool to collect valuable data and increase the environmental awareness of scuba diving tourists. The authors state that the programme successfully recruited many volunteers and that publishing project findings aided in raising public awareness of environmental and biodiversity concerns.

In colder regions, such as the Arctic and the Antarctic, tourism offers including scientific participation have also proved to be successful and are highly encouraged to enhance learning through the integration of hands-on activities into the tourism experience (Cajiao et al., 2022). An example is the FjordPhyto initiative, which uses vessels as platforms for data collection by travellers in the Antarctic region (Cusick et al., 2020). Cusick et al. (2020) confirmed that the data obtained by travellers under this initiative gave vital insights into phytoplankton composition in nearshore waters while boosting tourist happiness through engaging experiences. Taylor et al. (2020) examined Arctic expedition cruise travel patterns and discovered that active engagement by visitors in research might change the tourist gaze by offering a better awareness of the area they are seeing and a more complete feeling of place. For example, an ice-filled landscape may appear "pristine" to many tourists, but cruise passengers sampling Arctic coastlines for marine debris may have their perspective changed by a greater awareness of how interconnected the Arctic is with more temperate regions of the world (from which a large proportion of the global waste stream emanates) and how humans have impacted even the planet's most remote environments.

### 1.2. Impacts of participation in citizen science on marine tourists

The engagement aspect of CS has been investigated by pioneers in the field (Aristeidou et al., 2017; Phillips et al., 2018, 2019). However, there is a call for further research focusing on "measuring" public engagement in CS (Dionisio et al., 2022; Phillips et al., 2019). This is due to the multiple dimensions characterising engagement, the nature of CS initiatives, and whether these are part of tourism or volunteering (Druschke & Seltzer, 2012; Meschini et al., 2021; Van Brussel & Huyse, 2019; Walker et al., 2021a). CS participation often encompasses cognitive, emotive, social, behavioural, and motivational elements (Phillips et al., 2018, 2019). As part of marine tourism experiences, people normally can interact with wildlife, enjoy the natural landscape, practise activities like diving which allow them to be in closer contact with the water and marine ecosystems, and receive education and interpretation (Garrod & Wilson, 2003; Nicoll et al., 2016; Zeppel & Muloin, 2008). When CS is embedded in these experiences, there can be several specific positive outcomes including experiential engagement, reflective engagement, and individual learning outcomes (Ballantyne et al., 2011a; Clark et al., 2019; Phillips et al., 2018); these are the central constructs of this study.

#### 1.2.1. Experiential and reflective engagement

Experiential engagement was first developed in human-related philosophical aspects by Buber (1970), who drew attention to the "I-thou" relationship. He explained how knowledge of "me" results from internalisation of an exterior "you" (De Quincey, 2000). Human beings, according to Buber, must relate to what is there as an object ("I-it" relationship) or as another person ("I-thou" relationship). As a result, the core of a human being is a relationship, as a mutual engagement of interior presences (De Quincey, 2000). Experiential engagement has been explored in marine tourism studies (Apps et al., 2018; Ballantyne et al., 2011a, 2011b, 2018; Hughes et al., 2011; Lee et al., 2015; Yerbury & Weiler, 2020). Ballantyne et al. (2011a) defined experiential engagement in the marine tourism context as the excitement of seeing live animals, having a good view of the animals, seeing plenty of wildlife activity, having an engaging experience, having an enjoyable experience, and feeling a sense of wonder (p. 1247). If correctly managed, experiential engagement in marine tourism has the potential to alter individual pro-environmental habits (Ballantyne et al., 2011b; Clark et al., 2019; García-Cegarra & Pacheco, 2017) and encourage more sustainable behaviours (Ballantyne et al., 2018). Experiential approaches, such as immersive experiences in which participants focus on investigation and problem-solving in real-world settings, may influence changes in knowledge, skills, attitudes, intentions, and behaviours (Stern et al., 2014, 2017).

Reflective engagement is a concept developed in the education field. For Dewey (1997), reflective thinking "impels serious, systematic inquiry, belief in evidence, and demands an active, persistent, and careful consideration of any belief or supposed form of knowledge" (p. 9). In the tourism field, reflective engagement plays an important role in understanding tourists' level of engagement with attractions and perceptions (Budarma & Suarta, 2017; Taheri et al., 2014; Walker & Moscardo, 2014). For instance, emotional response has been studied in marine tourism to measure visitor experience through reflective engagement (Ballantyne et al., 2011b; Chen et al., 2019; Clark et al., 2019; Storksdieck & Falk, 2020). One goal of marine tourism is to educate visitors about environmental challenges, as well as the measures required to preserve ecosystems and biodiversity (Ballantyne et al., 2011b). As stated by Curtin and Kragh (2014), first-hand experience with nature may elicit emotional reactions that may result in a caring bond. Wonderment, astonishment, and involvement can foster long-lasting sensory impressions, emotional affinities, new environmental knowledge and interests, and treasured memories, all of which might shape future marine tourism experiences (Curtin & Kragh, 2014). Reflective engagement is thus defined as cognitive and affective processing of an experience, such as feeling an emotional connection with marine environments, reflecting on new ideas about ecosystems, discussing new information with companions, experiencing something surprising or unexpected, and feeling sad or angry about environmental problems (Ballantyne et al., 2011a, p. 1247).

In the context of marine tourism, experiential and reflective engagement are especially relevant in predicting pro-environmental attitudes and behaviour. Tourists who have reported greater experiential (e.g. getting closer to animals, feeling a sense of wonder, seeing animal activity) and reflective engagement (e.g. making an emotional connection with animals, reflecting on and learning new information about wildlife) can have more pro-environmental intentions than those who have not (Ballantyne et al., 2011b; Hoberg et al., 2021; Walker & Moscardo, 2014). Tourism studies featuring experiential and reflective engagement have primarily investigated the relationship between recreation experiences and tourist behaviour (how to produce changes in environmental knowledge, attitudes, and engagement in environmentally sustainable practices) or attempted to identify factors that best predict the long-term impacts of tourism experiences (Ballantyne et al., 2011b; Clark et al., 2019; Hoberg et al., 2021; Hunt & Harbor, 2019; Lee et al., 2015; Mayes, 2017; Walker & Moscardo, 2014). These studies have emphasised the importance of emotional and cognitive connection

through experiences. They have also highlighted the need for tourism managers to maximise the positive long-term impact of these experiences by encouraging tourists to emotionally connect with what they are seeing, respond thoughtfully to the threats facing marine environments, reflect on these ideas, and discuss them with their companions.

In the context of marine tourism involving CS, research has dealt with various components of experiential and reflective engagement. Meeker (2014) investigated why tourists chose to volunteer with Blue Ventures, Belize, and what lasting consequences their involvement had on their lives when they returned to their home country, focusing on experiential and reflective engagement effects. Tourists chose the programme because it coupled diving with the ability to volunteer for what they thought to be a worthwhile cause and to develop their personal skill set. The most often reported behavioural adjustments included a desired shift in resource use practices (reducing seafood intake), following reflective engagement involving their experience of the reality of reducing commercial species' populations. Some volunteers expressed a desire to spread the word about alternative, more sustainable fish markets, after reflecting on the state of fish stocks. Experiential engagement, including procedural learning, influenced volunteers' perceptions of their involvement in making a meaningful contribution through biological data collection, as well as their motivation to increase their career opportunities through skills development.

Dean et al. (2018) examined the effects of marine users attending marine CS events (Reef Citizen Science Alliance, Australia) with a focus on the effects of experiential and reflective engagement including learning facts and procedures, empowerment, introspection, connection, surprise, wonder, enthusiasm, negative emotions, and social situations. CS experiences were associated with procedural learning, enthusiasm, empowerment, negative feelings regarding environmental issues and reflection among volunteers, with some engagement characteristics impacting the desire to share knowledge, increased support for marine conservation and CS, and intentions to adopt a new habit. Kelly et al. (2019) explored a marine CS programme, Redmap Australia, with a focus on aspects of experiential engagement including building relationships. They looked at how marine users connect with and legitimise one another, and how this relates to relationship formation, to offer insight into how the idea of social licence may be established or facilitated through the CS experience. The study's findings showed that systems like Redmap have great potential to operate as a mechanism that promotes positive social ties and social licence, possibly leading to behavioural change and environmental stewardship.

#### 1.2.2. Individual learning outcomes

Phillips et al. (2018) argued that the learning outcomes of CS (including interest; self-efficacy; motivation; content, process and nature of science knowledge; skills of science inquiry; and behaviour and stewardship) serve as appropriate beginning points for evaluating participation outcomes and benefits to individuals and science. Several studies have shown that participation in CS including simple tasks in field-based and familiar settings, accompanied by narratives, emotions, perceptions, beliefs, values, and social interaction (Carrick et al., 2022) can have positive learning outcomes, at least over the short term. Participation can enhance interest in science and make people think more positively about it (Kelemen-Finan et al., 2018). Similarly, it can result in a higher sense of self-efficacy or one's confidence in the ability to participate in similar activities in future and, in the context of environmental and marine CS, conservation actions as well (Merenlender et al., 2016; Opara, 2013). The concept of self-efficacy is closely tied to that of motivations to further engage in CS over the long term; research has demonstrated how participation can drive people to seek similar opportunities again, especially when they have felt that the CS activities have been authentic, meaningful and successful (Lüsse et al., 2022).

Concerning the content, process and nature of science knowledge, participation in CS by marine tourists has been demonstrated to raise awareness of issues under investigation, when participation leads to learning and increased understanding (Brossard et al., 2005; Hesley et al., 2017; Marshall et al., 2012; Schaffer & Tham, 2019; Walker et al., 2021b). One of the main reasons to participate in marine CS is knowledge acquisition (Hermoso et al., 2021). This is followed by intentions to develop personal knowledge and skills and to become more ecologically conscious, or to progress one's career by obtaining experience (Hermoso et al., 2021; McAteer et al., 2021; Meschini et al., 2021; Thiel et al., 2014). Participants in CS can gain skills in data collection but also general science skills (e.g. procedural skills, critical thinking) that can be applied to everyday life, which are referred to as skills of science inquiry (Carson et al., 2021; Lüsse et al., 2022; Sickler et al., 2014).

Ultimately, participation in CS can support positive intentions to engage in pro-environmental behaviours and environmental stewardship, which can be tied to other individual learning outcomes such as knowledge. For example, Branchini et al. (2015) tested the effectiveness, of diving tourists' participation in reef monitoring CS in the Red Sea, in increasing environmental knowledge. They discovered that involvement boosted both knowledge of coral reef biology and ecology as well as awareness of the effects of human conduct on the ecosystem. The authors found that, if individuals are aware of the ecological characteristics of creatures or how their activity affects the reefs, they may be more concerned about the health of natural resources and more attentive to avoid erroneous actions such as touching or interfering with species when diving (Branchini et al., 2015). Kelly et al. (2020) recently reviewed marine CS projects worldwide (primarily in Europe, North America and Australia) involving a variety of participants including tourists. They discovered that CS participants profited most from information exchange and learning, as well as participating in an enjoyable activity and becoming a part of a community. Marine CS projects brought people closer to the seas and increased worldwide ocean literacy. Furthermore, participants conveyed project outputs to the public (science dissemination), illustrating the relevance of citizen scientists in sharing research with larger community groups. Similarly, Earp and Liconti (2020) examined 120 marine CS projects involving various types of tourist participants. They discovered that, through participating in these programmes, individuals gained knowledge and a sense of responsibility for the influence of anthropogenic activities on marine habitats. These impacts might then be used to encourage marine stewardship and conservation activism.

#### 1.2.3. Research gaps

Marine CS can be a helpful forum for connecting marine tourists to ocean habitats, but participants should not be expected to automatically support ocean preservation or conservation management (Kelly et al., 2019). Obtaining a social licence through marine CS necessitates cultivating meaningful connections with participants and winning their trust through involvement, education, information exchange, conversation, and openness (Kelly et al., 2019). Tourists seek experiences ranging from the mundane to the sublime. As a result, project design must consider participant variety based on their characteristics (e.g. demographic, psychographic, behavioural, geographic), the type of tourism they engage in (e.g. length of stay, preferred activities), and product offerings (e.g. geographic location, price, type) (Schaffer & Tham, 2019). Furthermore, tourist operators and personnel play an important role in ensuring successful engagement (Schaffer & Tham, 2019).

While CS projects may affect participants' abilities and lead to enhanced self-efficacy, interest in the environment, and a range of other personal effects, there is a need for more research on the participant outcomes of CS initiatives, including non-knowledge outcomes such as experiential and reflective engagement, and individual learning outcomes (Peter et al., 2019). For example, Walker et al. (2021b) analysed 549 papers on CS applications in the water sciences and discovered that 24% of them made no mention of participant or community benefits, while 70% made no mention of negative repercussions. It was unclear whether negative consequences were judged inconsequential, were not aroused, or the initiatives were wholly joyful experiences. In

time-consuming, boring, and difficult-task projects, there was no discernible influence on participation. These factors are frequently highlighted as potentially demotivating for participants, lowering or interfering with engagement (Canfield et al., 2016; Farnham et al., 2017; Walker et al., 2021b).

There are some gaps concerning the effect of marine CS in general, marine tourists' participation in CS, and behavioural changes following participation. For example, to have measurable effects, the design of the CS project should take into account the time necessary for participants to become actively engaged through hands-on experiences, and for participants to reflect on these experiences by themselves or share their knowledge and emotions with others (Ballantyne et al., 2011a; Ballantyne & Packer, 2009; Hughes et al., 2011; McAteer et al., 2021; Simmons & Fielding, 2019). Marine tourism experiences including in-water activities (e.g. diving, snorkelling) and wildlife interactions including a CS component could positively impact tourists' environmental knowledge, relationship with nature, wellbeing, personal environmental responsibility, attitudes, and behaviours towards the marine environment and wildlife (Ballantyne et al., 2011a). Research could test the effect of these experiences, including reflective and experiential engagement, and individual learning outcomes.

### 1.3. Aim of the study

This study aimed to assess the impact of marine tourists' engagement in scientific activities, focusing on an evaluation of experiential engagement, reflective engagement, and individual learning outcomes. The case study for this research was the involvement of marine tourists in snorkelling and scuba diving activities with a scientist in the kelp forests of Cape Town, South Africa. The assessment was conducted by comparing engagement factors between marine tourists involved in scientific activities, and marine tourists involved in similar activities (snorkelling and scuba diving in kelp forests at the same location) but without a scientific component. The study hypothesised that short-term experiential engagement, reflective engagement, and individual learning outcomes would be heightened among marine tourists engaged in scientific activities compared with those engaged in regular marine tourism activities.

## 2. Method

### 2.1. Case study – snorkelling and diving in Cape Town, South Africa

The extensive coastal area of South Africa is an important tourism destination for domestic and international visitors (Gounden et al., 2020; Saayman & Saayman, 2010). Here, coastal and marine tourism is critical for economic development (Bob et al., 2018). Marine tourism featuring CS in South Africa is not uncommon as it is valued as an instrument for sustainable tourism development including edu-tourism, as well as marine conservation and management (Alexander, 2012; Cilliers, 2022; Hulbert, 2016; Lucrezi et al., 2022b; Potts et al., 2021; Sowman et al., 2011; Van Tonder et al., 2017). Cape Town is one of the most important marine tourism destinations in South Africa (Frey & George, 2010; Munien et al., 2019). Here, kelp forests (forests of large brown macroalgae mostly of the order Laminariales) are becoming an intriguing tourist attraction for scuba divers, free divers and snorkellers, especially after the Oscar-winning Netflix Original documentary *My Octopus Teacher* raised global awareness about this biodiverse ecosystem (Reid, 2020). The kelp forests of Cape Town are located in the Table Mountain National Park Marine Protected Area where various conservation and monitoring activities are required for species such as penguins and cat sharks (Sowman & Sunde, 2018). Kelp forests provide ecosystem services such as habitat, food, coastal protection, and recreation (Blamey & Bolton, 2018; Steneck & Johnson, 2014; Teagle et al., 2017). South African kelp forests have been under pressure from wastewater pollution, the expansion of alien species, grazing by sea urchins, and overfishing of commercially important species associated with kelp (Blamey & Bolton, 2018; Lindberg et al., 2020; Morris & Blamey, 2018). Thus, kelp monitoring could help to understand responses to these pressures, and tourism involving scientific monitoring activities could be valuable for the marine protected area.

Simon's Town, in Cape Town, hosts an organisation catering to tourists and researchers and offering a CS programme involving snorkellers and divers in the identification and monitoring of cat sharks in kelp forests (Cape RADD, 2020). Typically, these activities are carried out in the form of a half-day tour guided (Fig. 1) by one or two scientists, who brief groups of up to ten tourists for about half an hour, before a dive or snorkel of about 1 h. During the dive, tourists are encouraged to spot or take pictures of sharks and compile waterproof slates containing information about species dwelling in kelp forests (Fig. 1). After the dive, tourists are debriefed, and their observations are entered into a database managed by the organisation. Tourists are encouraged to subscribe to the organisation's newsletter by leaving their email addresses so that they can be kept informed regarding the organisation's projects and activities. Supporting this type of tourism activity could yield positive outcomes including the engagement of tourists in edu-tourism, benefits to tourism business models, and the collection of data that can be readily shared with marine protected area authorities (D'Agnessa & Lucrezi, 2022; Lucrezi et al., 2022b).

### 2.2. Questionnaire structure

The data were collected using two structured questionnaire surveys, each containing 43 items. The first questionnaire (Appendix A) targeted tourists at the organisation in Simon's Town offering snorkelling or diving tours with a scientist (from here on referred to as Group 1). The second one (Appendix B) targeted tourists at a dive centre in Simon's Town, who were not involved in scientific activities (from here on referred to as Group 2). The two questionnaires were the same except for the wording of some items, which had to be different depending on whether participants belonged to Group 1 or Group 2.

The structure of the questionnaires was based on work conducted by Ballantyne et al. (2011a, 2011b) and Clark et al. (2019) to assess experiential and reflective engagement; and Phillips et al. (2018) to assess individual learning outcomes. The questionnaire contained a first section covering some demographic information including gender, age, and country of residence. The second section covered 12 items measuring tourists' level of experiential and reflective engagement using a Likert scale of agreement (from 1 = strongly disagree to 5 = strongly agree and 6 = I don't know/Not applicable, e.g. "The experience was engaging", "I felt an emotional connection with the wildlife species I saw"). The third section included 21 items measuring individual learning outcomes using a Likert scale of agreement (interest – three items, e.g. "I am interested in reading about coastal monitoring and other marine conservation activities"; self-efficacy – three items, e.g. "I feel that I have the basic skills to participate in other activities like this one"; motivation – three items, e.g. "I feel motivated to participate in similar activities in future"; content, process and nature of science knowledge – four items, e.g. "I have improved my understanding of facts about kelp forests"; skills of science inquiry – three items, e.g. "This activity has made me more inquisitive about phenomena affecting the coast and ocean"; and behaviour and stewardship – five items, e.g. "This activity motivates me to join a marine conservation group or similar"). This section also included ten items focusing on environmental knowledge with a focus on kelp forests (e.g. "I understand that kelp forests have cultural value"), with the same scale of agreement being used.

### 2.3. Sampling

The population under investigation included tourists visiting the organisation offering snorkelling or diving with a scientist in kelp forests (Group 1), and tourists visiting the dive centre offering regular tourism


**Fig. 1.** Map of the study site, with pictures of scientific activities and marine wildlife sightings offered to the marine tourists who participated in this study.

activities in kelp forests (Group 2) around Simon's Town. The questionnaire was dispensed in hard copy to tourists following their experience, from October 12, 2021 to March 25, 2022. This study was conducted during the COVID-19 pandemic and national lockdown, although by 2021 tourists from some countries were allowed to enter South Africa. As a result, convenience sampling was used to collect the data. Sampling was conducted during the week and on weekends, to capture as many participants as possible. A total of 111 tourists participated from Group 1 and 100 from Group 2. These samples were deemed representative of the populations of visitors to the selected establishments at the time of the study.

### 2.4. Data analysis

The data were analysed using the software TIBCO Statistica (Version 14.0.0.15, 2020). The demographic profile of the participants and their answers were first outlined using descriptive statistics (mean, standard deviation, standard error). Confirmatory exploratory factor analyses (CEFA) and reliability tests were performed on the data to assess whether the concepts assessed in this study (experiential and reflective engagement; and individual learning outcomes including interest, self-efficacy, motivation, science knowledge, skills of science inquiry, and behaviour and stewardship) had validity and internal consistency (Cronbach α) (Nunnally & Bernstein, 1994; Stevens, 2012). Cross-tabulations (Pearsons χ2) and Mann-Whitney U tests were computed to compare demographic data between Group 1 and Group 2, while Analysis of Variance (ANOVA) was used to compare factor scores between Group 1 and Group 2. Spearman's correlation analysis ($r_s$) was performed to highlight significant correlations between demographic parameters and factor scores. Since there was no significant correlation between demographic variables and factor scores, none of the demographic variables had to be included in ANOVA regardless of whether they were significantly different between Group 1 and Group 2.

## 3. Results

The general demographic profile of the participants in this study is presented in Table 1. Participants from Group 1 included 54% females and 46% males. Most (59%) originated from South Africa, followed by 14% from the USA and 27% from other countries, mainly Europe. Their average age was 37 years. Participants from Group 2 included 33% females and 67% males. Most were South Africans (62%), followed by 22% from the USA and 16% from other countries, mainly Europe. Their average age was 39 years. Comparisons of demographic data show that gender was the only variable that significantly differed between the two groups, with more males representing Group 2 compared with Group 1.

**Table 1**
Participants' profile (N = 211).

| Variable | Group 1 | Group 2 | Comparison test |
|---|---|---|---|
| Gender (%) | 54% female<br>46% male | 33% female<br>67% male | Pearson $\chi^2$ 9.46, $P = 0.002$ |
| Origin (%) | 59% South Africa<br>14% USA<br>27% other | 62% South Africa<br>22% USA<br>16% other | Pearson $\chi^2$ 0.14, $P = 0.71$ |
| Age (y) | Mean = 37<br>Min-max = 18-77<br>SD = 12.6<br>SE = 1.19 | Mean = 39<br>Min-max = 16-69<br>SD = 12.9<br>SE = 1.30 | Whitney U = 5354, $P = 0.66$ |

The results of CEFA and reliability tests on the items in the questionnaire are given in Table 2. The factors extracted through CEFA had loadings exceeding the cut-off value of 0.40 in all instances (Stevens, 2012). Cronbach's alpha (α) values demonstrated strong factors' reliability, well above the threshold of 0.60 established by Nunnally and Bernstein (1994). The factors were significantly and positively correlated with one another, with coefficients ($r_s$) ranging from 0.37 to 0.68 (Table 3).

Experiential and reflective engagement were two separate factors and received positive scores from both groups. The participants had an exciting, enjoyable, and meaningful experience with plenty of interaction with people and wildlife. The experience allowed them to reflect on environmental matters and discuss them with others. Experiential engagement (pooled mean = 4.48, standard deviation = 0.60) was stronger than reflective engagement (pooled mean = 4.06, standard deviation = 0.80), with no significant difference in factor scores between the two groups. Reflective engagement received a significantly

**Table 2**
Results of CEFA on experiential engagement, reflective engagement, individual learning outcomes (interest, self-efficacy, motivation, content, process and nature of science knowledge, skills of science inquiry, and behaviour and stewardship), and environmental awareness and knowledge (N = 211).

| Factor | Skewness | Kurtosis | Factor loading | Eigenvalue | Variance explained | Cronbach alpha (α) | Average factor score (mean ± SD) Group 1 | Average factor score (mean ± SD) Group 2 | ANOVA test |
|---|---|---|---|---|---|---|---|---|---|
| *Experiential engagement* | | | | 4.44 | 63% | 0.90 | 4.42 ± 0.71 | 4.55 ± 0.44 | MS = 0.96, F = 2.66, $P = 0.10$ |
| Saw wildlife | −1.46 | 2.66 | −0.68 | | | | | | |
| Plenty to do | −1.31 | 1.60 | −0.75 | | | | | | |
| Enjoyable experience | −3.11 | 13.33 | −0.88 | | | | | | |
| Wonder and awe | −1.61 | 3.08 | −0.79 | | | | | | |
| Exciting | −2.18 | 6.15 | −0.83 | | | | | | |
| Engaging | −2.25 | 5.99 | −0.86 | | | | | | |
| Staff assisted | −2.38 | 7.21 | −0.77 | | | | | | |
| *Reflective engagement* | | | | 2.96 | 59% | 0.83 | 4.16 ± 0.81 | 3.94 ± 0.78 | MS = 2.47, F = 3.90, $P = 0.04$ |
| Reflecting on new ideas | −1.26 | 1.35 | −0.76 | | | | | | |
| Emotional connection | −1.14 | 0.65 | −0.85 | | | | | | |
| Sad/angry about problems | −0.80 | −0.34 | −0.80 | | | | | | |
| Surprising and unexpected | −0.74 | −0.02 | −0.74 | | | | | | |
| Discussed activity | −1.29 | 1.46 | −0.69 | | | | | | |
| *Learning outcomes* | | | | | | | | | |
| *Interest* | | | | 2.37 | 79% | 0.87 | 4.26 ± 0.86 | 3.95 ± 0.93 | MS = 5.17, F = 6.48, $P = 0.01$ |
| Want to learn more | −1.06 | 0.68 | −0.85 | | | | | | |
| Interested in reading | −1.12 | 0.76 | −0.92 | | | | | | |
| Want to know more | −1.13 | 0.64 | −0.89 | | | | | | |
| *Self-efficacy* | | | | 2.13 | 71% | 0.79 | 4.37 ± 0.77 | 4.25 ± 0.68 | MS = 0.81, F = 1.54, $P = 0.22$ |
| Confident to participate | −1.86 | 4.76 | 0.87 | | | | | | |
| Have basic skills | −1.72 | 3.63 | 0.89 | | | | | | |
| Good results | −0.84 | 0.14 | 0.76 | | | | | | |
| *Motivation* | | | | 2.12 | 71% | 0.79 | 4.34 ± 0.85 | 4.16 ± 0.70 | MS = 1.63, F = 2.67, $P = 0.10$ |
| Participate in future | −1.46 | 2.82 | −0.83 | | | | | | |
| Complex activities | −1.18 | 0.80 | −0.86 | | | | | | |
| Volunteer | −1.19 | 0.72 | −0.83 | | | | | | |
| *Science knowledge* | | | | 2.52 | 63% | 0.80 | 4.33 ± 0.75 | 3.77 ± 0.71 | MS = 16.68, F = 31.30, $P < 0.001$ |
| Facts | −1.06 | 0.70 | −0.71 | | | | | | |
| Importance of research | −1.04 | 0.78 | −0.83 | | | | | | |
| Methods for monitoring | −0.97 | 0.26 | −0.86 | | | | | | |
| Rigour in research | −0.88 | 0.31 | −0.77 | | | | | | |
| *Skills of science inquiry* | | | | 1.96 | 65% | 0.73 | 4.08 ± 0.91 | 4.02 ± 0.69 | MS = 0.17, F = 0.26, $P = 0.61$ |
| Technology | −0.99 | 0.37 | 0.84 | | | | | | |
| Training | −1.01 | 1.24 | 0.84 | | | | | | |
| Inquisitive | −1.42 | 2.62 | 0.74 | | | | | | |
| *Behaviour and stewardship* | | | | 3.73 | 75% | 0.91 | 4.26 ± 0.93 | 3.94 ± 0.85 | MS = 5.08, F = 6.39, $P = 0.01$ |
| Environmental footprint | −1.62 | 2.65 | −0.79 | | | | | | |
| Marine conservation | −1.37 | 1.68 | −0.88 | | | | | | |
| Marine conservation group | −0.82 | −0.17 | −0.88 | | | | | | |
| Civic action for ocean | −0.98 | 0.28 | −0.88 | | | | | | |
| Change life | −1.25 | 0.98 | −0.89 | | | | | | |
| *Knowledge* | | | | 6.92 | 69% | 0.95 | 4.41 ± 0.78 | 4.26 ± 0.60 | MS = 1.18, F = 2.41, $P = 0.12$ |
| New appreciation | −1.41 | 2.39 | −0.73 | | | | | | |
| Kelp not plant | −1.38 | 1.12 | −0.66 | | | | | | |
| Kelp not in tropics | −1.54 | 2.24 | −0.76 | | | | | | |
| Kelp produces oxygen | −1.91 | 5.03 | −0.88 | | | | | | |

(*continued on next page*)

**Table 2** (*continued*)

| Factor | Skewness | Kurtosis | Factor loading | Eigenvalue | Variance explained | Cronbach alpha (α) | Average factor score (mean ± SD) Group 1 | Average factor score (mean ± SD) Group 2 | ANOVA test |
|---|---|---|---|---|---|---|---|---|---|
| Kelp habitat | −1.84 | 4.04 | −0.88 | | | | | | |
| Kelp shelter for fish | −2.30 | 7.83 | −0.89 | | | | | | |
| Kelp wave buffer | −1.76 | 3.56 | −0.92 | | | | | | |
| Kelp economic value | −1.43 | 2.47 | −0.87 | | | | | | |
| Kelp cultural value | −1.43 | 1.71 | −0.83 | | | | | | |
| Kelp removal | −1.82 | 3.96 | −0.87 | | | | | | |

Based on scale of agreement: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

**Table 3**
Correlations ($r_s$) between demographic data and factor scores extracted from CEFA (N = 211).

| | Gender (1) | Age (2) | Origin (3) | Experiential engagement (4) | Reflective engagement (5) | Interest (6) | Self-efficacy (7) | Motivation (8) | Science knowledge (9) | Skills of science inquiry (10) | Behaviour and stewardship (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2** | −0.08 | | | | | | | | | | |
| **3** | 0.05 | −0.13 | | | | | | | | | |
| **4** | −0.06 | −0.03 | 0.10 | | | | | | | | |
| **5** | 0.08 | 0.07 | −0.06 | **0.56** | | | | | | | |
| **6** | 0.01 | 0.13 | −0.04 | **0.37** | **0.64** | | | | | | |
| **7** | −0.05 | 0.02 | −0.05 | **0.45** | **0.52** | **0.59** | | | | | |
| **8** | −0.08 | 0.01 | −0.07 | **0.39** | **0.53** | **0.64** | **0.68** | | | | |
| **9** | 0.03 | −0.03 | −0.02 | **0.40** | **0.56** | **0.58** | **0.55** | **0.64** | | | |
| **10** | 0.01 | −0.07 | 0.05 | **0.40** | **0.51** | **0.43** | **0.48** | **0.59** | **0.58** | | |
| **11** | −0.05 | 0.00 | 0.01 | **0.38** | **0.51** | **0.59** | **0.48** | **0.64** | **0.56** | **0.53** | |
| **Knowledge (12)** | −0.11 | −0.08 | 0.03 | **0.44** | **0.46** | **0.50** | **0.44** | **0.56** | **0.56** | **0.43** | **0.63** |

Bold values indicate significant correlations at $P < 0.05$.
The variable 'Gender' was made binary where 0 = Male, and 1 = Female.
The variable 'Origin' was made binary where 0 = From outside South Africa, and 1 = From South Africa.

higher score among Group 1 compared with Group 2 (Table 2). Thus, people who had participated in scientific activities had been more reflectively engaged than regular tourists.

Individual learning outcomes were successfully grouped into six reliable factors, all of which received positive scores. Self-efficacy was strongest (pooled mean = 4.31, standard deviation = 0.73), followed by motivation (pooled mean = 4.25, standard deviation = 0.78), interest (pooled mean = 4.11, standard deviation = 0.91) behaviour and stewardship (pooled mean = 4.11, standard deviation = 0.90), content, process and nature of science knowledge (pooled mean = 4.06, standard deviation = 0.78), and skills of science inquiry (pooled mean = 4.05, standard deviation = 0.81). Environmental knowledge with a focus on kelp forests, which represented a standalone factor, was relatively high (pooled mean = 4.34, standard deviation = 0.70). In summary, tourists who had participated in scientific activities in kelp forests were confident about their experience and what they had gained from it; they were motivated to participate in the same activity in future; they wanted to know more about kelp forests, marine conservation and science; they felt motivated to participate more actively in marine conservation; they improved their understanding of kelp forests and coastal monitoring techniques; they felt that in future they would require less training to participate in a similar activity; and they had knowledge of the ecosystem services of kelp forests. Notably, also those who had participated in regular tourism in kelp forests felt that their experience made them interested in coastal monitoring, environmental matters and stewardship, and generally more knowledgeable about kelp forests. Despite the similarities between the two groups, three individual learning outcomes had significantly higher average scores for Group 1 compared with Group 2. These were interest; content, process and nature of science knowledge; and behaviour and stewardship. This means that tourists who had participated in scientific activities were substantially more interested in the scientific process, had a better understanding of coastal monitoring techniques; and were more strongly motivated to actively participate in marine conservation and stewardship.

## 4. Discussion

The demographic profile of the participants generally reflected the profiles described in the literature on marine tourists participating in simple scientific activities involving contact with nature, social interactions, and post-experience reflection (Cilliers, 2022), as well as marine users such as scuba divers in South Africa (Lucrezi, 2021a; Lucrezi & Cilliers, 2023). The participants' origin (mainly South Africa) represented the travel and tourism reality at the time, which was during the COVID-19 pandemic with many international tourists not allowed to travel to South Africa.

The experiential engagement results for both Group 1 and Group 2 were highly positive, emphasising that the tourism experience, regardless of participation in scientific activities, was appealing, entertaining, interactive, and exciting (Ballantyne et al., 2011a, 2011b; Clark et al., 2019). A recent evaluation by Stern et al. (2017) recognised the significance of experiential engagement, which allows marine tourists, including those participating in scientific activities, to learn and practise skills in an active, hands-on, engaged manner. Experiential engagement, such as immersive encounters where participants focus on exploration and problem-solving in real-world contexts, may ultimately effect changes in knowledge, skills, attitudes, intentions, and behaviours (Stern et al., 2014, 2017). The present study confirmed that marine tourists' experiential engagement was not negatively affected by participation in scientific activities (Dean et al., 2018; Kelly et al., 2019; Locritani et al., 2019; Meeker, 2014) but was just as positive as for regular marine tourists.

Interestingly, experiential engagement was stronger than reflective engagement, which is not new in the literature (Ballantyne et al., 2011a; Chen et al., 2019; Clark et al., 2019; Storksdieck & Falk, 2020).

Experiential engagement and reflective engagement are two different ways in which individuals engage with an experience, and they can have varying levels of depth and focus. Experiential engagement emphasises elements like enjoyment and immediate satisfaction, while reflective engagement involves a deeper and more thoughtful approach to the experience (Kim et al., 2017). Experiential engagement is often associated with a more surface-level or hedonistic approach to an experience. It involves seeking immediate gratification, enjoyment, and fun in the activity and focuses on the pleasurable aspects of the experience without delving into a deeper understanding or reflection on the underlying processes or outcomes (Cilliers, 2022; Lucrezi et al., 2022b). This may explain why experiential engagement would be a stronger short-term outcome of a regular marine tourism experience (Group 2) compared with reflective engagement.

Nevertheless, reflective engagement yielded high scores for both Group 1 and Group 2, with the experience giving the participants an emotional connection to marine creatures and a desire to ponder new ideas about the marine environment. Notably, Group 1 was more reflectively engaged than Group 2. This suggests that this group was more thoughtful and contemplative about the marine environment compared with the regular tourism group. Reflective engagement involves a deep level of involvement with the experience, as it entails critical thinking, introspection, and a genuine interest in understanding the underlying principles, causes, and consequences of the activity; thus, individuals who engage reflectively are more likely to question, learn, and grow from their experiences (Ballantyne et al., 2011a; Clark et al., 2019). However, it is essential to acknowledge that both experiential and reflective engagement have their merits. Experiential engagement could be an entry point for individuals to become involved in activities, while reflective engagement can lead to a more profound understanding of the subject matter and a more significant impact on conservation (Ritchie & Ellis, 2010).

Concerning individual learning outcomes, the results of this study show that in both groups the scores were relatively high, although some notable differences emerged between Group 1 and Group 2. Regarding interest, while among Group 2 there was a willingness to learn more about kelp, coastal environments, and research in the marine environment, Group 1 was significantly more enthusiastic about learning more about kelp and coastal ecosystems, marine environments, marine environmental research and coastal monitoring. This indicates that their participation in CS sparked a stronger curiosity and desire to learn about the ecosystem under investigation and its conservation. While research has shown that marine tourism activities can spark interest in learning more about the marine environment and ways to preserve it (Apps et al., 2018), the results of this study confirm that, after participating in marine CS activities, tourists show a keener interest in supporting similar initiatives and engaging in future environmental projects (Lucrezi et al., 2022b). They also highlight the potential role of marine CS as a crucial form of voluntourism, where people willingly contribute to, and financially support, conservation initiatives and wildlife protection efforts through participation in scientific research.

Participants from both groups displayed relatively strong self-efficacy. Group 2 committed to engaging in future similar marine tourism initiatives. Group 1 felt secure in engaging in kelp-based CS because they knew they possessed the necessary abilities. They also felt that, by participating in marine CS, they had indirectly helped conservation. One of the reasons for self-efficacy being similar between the two groups may be that the level of skills and abilities required to carry out the activity, namely snorkelling or diving, was similar, and participants from Group 1 were only involved in simple tasks including taking pictures and writing on a waterproof slate, which did not require any complex training. It must be noted, however, that not all marine CS projects involving tourists are the same, with some calling for more time, more training, and more demanding tasks from participants, which could result in varying levels of perceived self-efficacy before and after the experience (Lucrezi et al., 2022b).

Concerning motivation, respondents from both groups were keen to participate in marine tourism activities and marine conservation but also volunteer in scientific activities. This is consistent with studies of marine tourism activities, including ones involving participation in the scientific process. For example, in a study by Lucrezi (2021a), divers' and free divers' incentives to dive in kelp were met by rich experiences, which were also defined by an increase in environmental knowledge and respect. These characteristics, combined with observations and learning experiences, can reflect a sense of nature bonding motivating a willingness to participate in marine conservation and CS (Gkargkavouzi et al., 2019; Haywood et al., 2021).

Content, process and nature of science knowledge significantly differed between the two groups, with Group 1 displaying higher values. This is understandable since Group 2 was not involved in scientific activities and suggests that the involvement of Group 1 in scientific data collection contributed to a better grasp of scientific concepts and methodologies. However, respondents from Group 2 still agreed to have improved their understanding of the importance of research in coastal habitats. While Group 1 showed more positive results, the average factor score was slightly lower compared with other factors, highlighting some uncertainties about understanding facts about kelp, scientific methods to collect kelp data, and the importance of collecting them properly. This is congruent with research showing that while marine CS may successfully demonstrate gains in topic knowledge, there is still a long way to go before it can confirm significantly increased scientific process comprehension, especially when scientific tasks remain very basic and simple (Phillips et al., 2018). This aspect is important as it can encourage or discourage future interest and participation in CS among marine tourists. There is widespread interest in CS among marine tourists, although this may not necessarily translate into actual participation due to a feeling of inadequacy and a perceived lack of understanding of the scientific process (Hermoso et al., 2021; Lucrezi & Cilliers, 2023). Since many potential participants are drawn to CS because they feel they will acquire scientific knowledge and skills, it is important to ensure that the engagement remains empowering regardless of the ease or complexity of scientific tasks (Hermoso et al., 2019; Martin et al., 2016a, 2016b).

Values for skills of science inquiry were good for both groups, with the tourist activities piquing interest in marine environmental phenomena, technology and training in gathering marine monitoring data. For Group 2, this unexpected outcome despite participants' only going for a dive can be explained by the briefing including information about the purpose and goals of marine research in the area. This could have primed participants to pay closer attention to the environment during their dive and to appreciate the research being conducted locally to preserve the area. The immersive experience of being in the marine environment itself might have triggered curiosity and a desire to learn more. Seeing marine life up close, witnessing ecosystem dynamics, or encountering environmental challenges like pollution can be eye-opening and motivate individuals to seek information and contribute to research efforts (Lucrezi & du Plessis, 2022; Wood et al., 2022). Factors such as the natural beauty of coastal habitats and the opportunity to interact with knowledgeable dive guides or scientists could have heightened participants' interest and understanding. Positive values for skills of science inquiry among Group 1 are also a novel positive finding that differs from other studies where engagement in CS was inadequate to raise awareness of how scientific research is carried out (Jordan et al., 2011; Phillips et al., 2018; Price & Lee, 2013). Education is an important aspect of CS project design since learning and training are key motivations for joining projects (Hermoso et al., 2019; Lucrezi et al., 2018, 2022b; Martin et al., 2016a, 2016b). Skills of science inquiry can also be guaranteed when the participation of marine tourists in CS is passive or remote, through information and communications technology enhancing flexibility, communication, organised communication management and overcoming barriers in public participation (Lucrezi, 2021b).

Behaviour and stewardship values among both groups demonstrated

a constructive attitude towards decreasing footprints and being proactive towards the marine environment, for example by raising awareness or participating in litter clean-ups. However, Group 1 manifested significantly higher behaviour and stewardship attitudes. The tourists who engaged in CS activities were more inspired to join a marine conservation group and take civic action for the marine environment, attempting to modify behaviours in favour of marine conservation and sustainability. They were motivated to make changes in their lives to promote marine conservation. This outcome is linked with literature findings showing that CS-based tourism not only involves citizens in the scientific process but also urges them to take constructive environmental action (Lucrezi & Cilliers, 2024; McKinley et al., 2017). As stated by McKinley et al. (2017), CS promotes scientific and environmental literacy and impacts public participation in pro-environmental activities. These findings highlight the desire of specific groups to contribute to coastal management, as well as the importance of eliminating gaps between research and management and society to boost public participation in stewardship initiatives such as marine CS.

The participants from both groups were knowledgeable about kelp, its role in ecology, and its economic significance. However, there were some uncertainties, particularly regarding biological characteristics, geographic distribution, cultural significance, and interactions with other marine species. People interested in marine-based activities such as tourism and recreation, marine conservation, and research have been demonstrated to be motivated to participate in marine volunteering primarily for ecocentric reasons (e.g. helping marine conservation), but also for self-development and knowledge acquisition (McAteer et al., 2021). While it may have been expected that marine tourists participating in CS would have displayed more sophisticated environmental knowledge related to kelp forests, this was not the case. This finding calls for more attention towards designing CS experiences for marine tourists to contain detailed environmental information beyond simple concepts that could be conveyed during regular tourism experiences.

### 4.1. Management implications

The results of this study have several implications for the design, marketing and management of marine tourism activities involving CS, and provide information that can help bridge the gap between marine tourism and scientific activities. For example, this study showed how tourists' engagement in simple in-water and ocean-based CS activities can yield positive individual outcomes that are likely to support further commitment to participation in CS, conservation, and possibly ocean stewardship. Organisations and companies offering these activities to tourists should consider the importance of CS blending simple scientific tasks with the fun element of being in the water and close contact with nature, to introduce tourists to science and possibly later propose more elaborate CS offerings (e.g. involving more complex tasks). An introduction to "simple" CS can be a way to put tourists in contact with science and empower them to acquire the self-efficacy needed to embark on more complex and demanding CS projects. This gentle introduction to CS can give tourists a "taste" of CS and allow them to feel comfortable becoming part of the scientific process so that future participation will be more likely. Additionally, it can allow organisations and businesses to develop new CS products and offerings with different levels of complexity, both to meet the demands of scientific research (and often those of governance authorities, such as marine protected areas benefiting from CS-generated data) and to adapt to growing and potentially loyal markets.

This study also confirmed the importance of coupling CS activities with nature-based outdoor experiences in close contact with nature, in this case, diving and snorkelling. Research has demonstrated how this blend can result in strong positive engagement outcomes (Branchini et al., 2015; Kelemen-Finan et al., 2018; Lucrezi et al., 2022b; Lüsse et al., 2022). According to recent research on the potential involvement of recreational divers in kelp research, recreational commitment, attraction to the biodiversity and uniqueness of kelp, and unique experiences characterised by exploration and wildlife observation can positively influence participation (Lucrezi, 2021a; Lucrezi & du Plessis, 2022). Organisations and businesses offering CS to tourists should take care to ensure that projects provide opportunities for enjoyment and contact with nature, taking advantage of those activities that tourists tend to be attracted to and are likely to make the experience more pleasant. CS programmes could heighten those elements of ocean-based recreation and tourism that make people participate in the first place (e.g. wellbeing, nature connectedness, escapism, fun, being with family and friends) (Lucrezi & Du Plessis, 2022). They can do so by enriching the CS experience with the provision of new knowledge of ecosystems and ecological processes, gamification of the CS experience where possible, making the tasks as immersive into the ecosystem as possible, fostering a sense of adventure in the experience, creating tasks that need to be carried out as part of a team, and providing post-experience socialisation time among participants.

Divers are known to be good potential participants in marine CS, as confirmed in this study (Hermoso et al., 2021; Lucrezi et al., 2022a). They make excellent candidates because they are ideally positioned to contribute to marine conservation due to their unique access to underwater ecosystems. Several studies have highlighted their involvement in various CS activities, showcasing the valuable role they play in advancing our understanding of marine environments (Cerrano et al., 2017). Hands-on involvement provides divers with a sense of ownership in marine conservation efforts. This and other studies underscore the benefits of in-water marine tourism with scientists as a means of both educating and fostering a deeper connection with nature through a heightened awareness of marine ecosystems, which can lead to increased conservation efforts and responsible tourism and recreation practices (Hermoso et al., 2021). Considering that divers often like to use CS participation to challenge themselves and develop in their sport (Lucrezi et al., 2022a), it would be important to ensure that programmes specifically involving them contain tasks matching that willingness to be challenged, and that they are not perceived as too boring or characterised by too passive participation.

This study also showed that marine tourists not participating in CS can have a good attitude towards potential participation if the right conditions are created to stimulate interest. At the case study location, for example, organisations offering scientific experiences with tourists are located close to dive centres and collaborate with them, through co-promotional strategies and logistical support. This proximity and collaboration offer a unique opportunity to connect tourists with scientific research, creating a more comprehensive and immersive experience for those involved. For example, an open and collaborative dialogue between tourist centres offering CS and those such as dive centres, surf clubs, kayak clubs and wildlife viewing operations, can ensure that regular tourists are made aware of the research and conservation efforts in the local area and the opportunities for them to be part of these efforts while on holiday or conducting recreational activities.

While this study emphasises the positive effects of marine tourists' participation in scientific activities, possibly inspiring new marketing avenues for tourism companies, several factors ought to be considered, which have also been discussed in previous similar studies (Lucrezi, 2021a; Lucrezi & Cilliers, 2023; Lucrezi et al., 2022a). An example is the need to be associated with a legitimate entity (e.g. university, or national park's board) to address specific research and scientific questions through the engagement of tourists, thus making the experience authentic and scientifically legitimate. Tourists participating in CS have specific motivations and expectations that need to be met for engagement to be successful; examples include the desire to acquire skills, to know that their contribution has tangible outcomes for conservation, to receive feedback or acknowledgement, and to have a value-for-money experience (Lucrezi et al., 2022b). Therefore, organisations and businesses offering CS to tourists need to ensure that the science conducted

by tourists is properly discussed with them before, during and after the experience, and that outcomes and outputs of the project are clearly and transparently communicated when available (e.g. via websites and social media), to create a sense of achievement and accomplishment based on the data collected. This type of communication loop can incentivise participants. In cases where people expressly wish to acquire new skills and receive some recognition for participation, it is important to formalise the completion of CS activities with certificates and qualifications (e.g. research diver qualifications).

## 5. Conclusions and study limitations

This study focused on evaluating the effects of marine CS involving tourists on short-term experiential and reflective engagement and individual learning outcomes, with CS in the kelp forests of Cape Town, South Africa as a case study. The results confirm the value of CS as an instrument to improve the connections between people and the ocean, in line with the objectives of the UN Ocean Decade and SDG14 – Life below water. The study also emphasises the tight connection between nature-based outdoor recreation and tourism that can be enriched with meaningful activities for science and conservation, and the potential for people to embrace environmental (ocean) stewardship. CS participation through simple tasks can be an effective way to introduce tourists to the world of scientific research for the management and conservation of marine environments. It can also support stewardship of environments that tourists value for tourism and recreation and therefore want to see preserved. The comparison of two groups of tourists, one participating in CS and one participating in regular marine tourism activities, suggests that enhancing the tourism experience through CS may not be a difficult task and could easily spark tourists' interest in CS, resulting in positive outcomes such as interest in science and pro-environmental behavioural intentions. Overall, marine CS activities could result in a win-win-win situation for sustainable marine tourism, marine conservation, and scientific research.

This study has several limitations that must be considered in the interpretation of the findings and in planning future research on the effects of engaging marine tourists in CS. First, there are several aspects of the method of research that call for cautious generalisation of the findings. For example, the study was conducted in a localised geographical area; it involved a specific group of marine tourists (snorkellers and divers); it revolved around participation in relatively brief and simple-task scientific activities; and sampling occurred during the COVID-19 pandemic, resulting in the demographic profile of the participants not necessarily reflecting the real marine tourism market of the study location. Second, while the findings of the study suggest that the involvement of marine tourists in CS was positive and enhanced compared with similar tourist groups not participating in CS, it cannot be unequivocally concluded that it was involvement in CS that influenced the participants' responses. A pre-post study would have more robustly confirmed or disconfirmed the hypothesis that participation in CS positively affects marine tourists' engagement. Third, the study only measured three demographic variables although it is known that other variables not included here can significantly affect tourists' engagement in scientific activities. Last, this study only dealt with the short-term effects of marine tourists' engagement in scientific activities, while future research should strive to measure long-term effects.

## CRediT authorship contribution statement

**Serena Lucrezi:** Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Mike Barron:** Writing – review & editing, Methodology. **Antonietta d'Agnessa:** Writing – original draft, Methodology, Investigation, Data curation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jort.2024.100849.

## Data availability

The authors do not have permission to share data.

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