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| Referee: 1 | Answer |
| The first is the lack of pre-analysis data in the paper... However, nowhere in the Ocean Literacy section is there a discussion of the actual ocean literacy in the public. It would be important to set the stage for the current lack of education on the central question of the paper, and how it is creating the problems we are seeing. Without it, the paper has a problem that has no clear metric. As such, it is unclear why we need new tools to increase literacy. I believe adding statistics or any metrics showcasing the lack of literacy to be important in this section. | I added in this metric in the last paragraph of the introduction: In a study by the Ocean Conservation Trust in the United Kingdom, for example, they found that – as recent as in 2022 – still only 29% of the respondents said they had very good or good awareness of global challenges, and only 29% of respondents found the principle “The Earth has one big ocean with many features” to be completely true – with in fact 15% finding this principle to not be at all true (Ansell 2022). |
| the choice of focusing solely on high school students from coastal cities limits the generalizability of the findings. It is likely that students in coastal villages are going to be more aware of oceanic issues than most. The sample of convenience is easy to establish, but it needs to be established in the paper. | We added this sentence:We chose to focus on high school student because of their category of “future generations”, notifying that they too are stakeholders within the context of pollution and solutions thereto. This is also clearly stated by Heads of State and Government and high level representatives that met at the United Nations Conference on Sustainable Development in Rio de Janeiro from 20 to 22 June 2012 *and renewed their commitment to sustainable development no only for the present but also for future generations* (United Nations 2012). In addition, one of the drivers of the movement towards more ocean literacy was the lack of ocean topics on core curricula in the formal K-12 education system (Cava et al. 2005).And The placement of these schools in coastal cities in Norway was a sample of convenience, with the main research partners located in these three cities that are relatively large in population size in Norway (2nd, 4th and 16th largest)[[1]](#footnote-1). |
| Moreover, I believe the conclusions taken from the outcomes of the games need to be qualified according to whom the players were and their coastal location in Norway. | Ok – will update |
| the methodology section needs to explain the game design choices made by either the authors or House of Knowledge.  My understanding from reading this section is that the game was designed in collaboration between SINTEF Ocean and House of Knowledge. The section spends a lot of time explaining the game itself, but little explaining the game design choices beyond the section between lines 274 and 277 explaining the logic of the game. | This section is now greatly expanded with the logic and development further detailed.  |
| For example, lines 285 and 286 mentions how the contextual cards are developed using sustainable development goals. There is no mention, however, of where these goals are coming from. Are they informed by a specific body of knowledge or literature? If yes, please specify and link to your game design choices. If no, please explain how they were generated and how they link to the game design. | This was already partially explained but we expanded and moved this section so it would be more visible: *The logic behind the choice of these* four SDGs were *based on the expertise of* the research team at the game conceptualization stage. They were selected through a process of coding all the SDGs and their *targets* in terms of their relevance and efficacy either for regulating the harvesting of jellyfish or the prevention of plastic pollution *and chose for inclusion the SDGs that had elements of both pollution and sustainable use of marine resources included. At the target level of detail, the cards chosen were not difficult to choose qualitatively. The relevant targets were also specified on the back side of the cards so that the participants could read and understand this choice.* |
| Another unspecified game design choice comes between lines 295 and 297. The authors explain that they asked the student players to rank order their most important goals. What justifies this design solution? What was the theoretical thinking behind this choice? This part could have been done many different ways. Please justify why you made the choice you made. | We expanded on this now:In the Serious game, the students had to select the three most important goals from their perspectives and rank them in terms of importance in the context of assessing microplastic pollution and jellyfish blooms and their effects on coastal communities in Norway. This was a choice made based on the three interconnected forms or concepts of learning relevant when using serious games to develop knowledge that frame this development, namely sociality, situatedness and experientiality, with a special focus on the two latter – namely situatedness - where situations produce knowledge through action and players have to actively engage with a situation that can be considered closer to reality than that created through passive forms of learning; and experientiality – or learning by having an experience, and having a requirement of reflecting on and analysing this experience. In this case, they were in an experimental decision-making situation of the game and asked to make rational choices based on the knowledge at hand.  |
| My third main point rest on the learning aspect of the paper. Namely, the linkage between the theoretical section on learning and the results section needs to be bolstered. As it stands, both sections feel disconnected despite some minimal linkage her and there. The learning section on page 5 places emphasis on sociality, situatedness, and experientiality. These concepts need to be linked to the empirical section in a more systematic way using the survey responses of the participants. | I connected these session better, with first changing the introduction to the three concepts and then following through on these in the discussion session:First – under the heading “Learning and Knowledge”:There are three forms of learning that become especially relevant when using serious games to develop knowledge, as these differentiate the learning that occurs in games from most other forms of learning activity. These three interconnected forms or concepts are *sociality*, *situatedness* and *experientiality,* and the results of the gaming session presented for the purposes of this study will reflect upon these. And second paragraph under “Discussion”:Keeping in mind the three forms of learning that the literature considers relevant when using serious games to develop knowledge, namely *sociality – where more or better learning occurs when the learning situation includes collaborative social interaction including both dialogue with peers and content experts*; *situatedness -*  where situations produce knowledge through action and players have to actively engage with a situation that can be considered closer to reality than that created through passive forms of learning; and *experientiality – or learning by having an experience, and having a requirement of reflecting on and analyzing this experience*. For the purposes of this study, we wanted to bring more awareness and contextualization to the concept of SDGs and as such, we gave background information about the case of microplastics rising in the ocean and jellyfish blooms happening in selected areas of the world, including in Norway. The latter was done for the participants to gain knowledge and have a background in a real environmental problem, to which the SDGs can be related specifically, linked to both situatedness and experientiality, mixed with sociality.  |
| , I would like to see more of the pre-knowledge of the players in this section to better demonstrate that there was some learning. Lines 331-333 says many groups changed their priorities after playing. Why? Do you have a debrief of this? | Unfortunately, as we state in the conclusion, there was no pre- and post-test done for this study. I did add this information, though the relevance of the results are limited but now also reported on in the results section. The game started with each participant filling out a questionnaire focusing primarily on demographics, but also four questions on their background knowledge and experience with both jellyfish and pollution. The survey was taken on their phones prior to the game starting and there was not post survey to assess learning, which we acknowledge would have greatly enhanced this study.**Results section now starts with this:** The pre-game survey showed that only 20% of the players had had no experience at all with jellyfish, and almost 70% considered them a natural part of the ocean environment though 25% considered them dangerous. In terms of plastic pollution, all players were either moderately worried (18%), very worried (41%) or extremely worried (41%).**We also state at after table 1 that:**Since there was no post-game survey, the results only showed the baseline data for these groups. However the, qualitative data reflects their learning and at the end of the session, the students were asked to give oral feedback on the experience to work with marine plastic pollution and jellyfish blooms in a Serious games format to gain some understanding on whether or not they had gained an increase in ocean literacy as expressed by the seven principles presented by (Pantò 2019b).There are also examples of this throughout, like this one:The group from Bergen said that their choice to prioritize SDG 14 was “*based on what we have been through now*”, demonstrating that they had gained more knowledge and arguably increased their ocean literacy in the process of playing the game and ranking the SDGs accordingly with the knowledge they gained through the gaming session.And Each group discussed, and mentioned that, for example, “I knew nothing about jellyfish [before playing the game]”. |
| there’s a reference for example on line 359 to one player’s not truly understanding what the economic argument was. That’s a good empirical marker to then see changes after having played the game. Was there a debriefing survey to ask players why they repositioned their game after playing? If yes, it would be important to add more of this information in the results section. | See examples above!  |
| I think the introduction could provide an overview of the findings to help guide the readers. A couple sentences could fit well after lines 86-88. | I added this at the end of the introduction: This article will set out by examining ocean literacy and serious games as an innovative methodology towards increasing ocean literacy. We first discuss the concept of Ocean Literacy, followed by a focus on the pedagogy of gaming. After this we present the game itself, and report on results from three gaming sessions with high school students in three different regions of Norway, and the narratives from these to exemplify the efficacy of using Serious games for Ocean Literacy. We conclude by considering the applicability of using this game as an educational tool for Ocean Literacy in the majority world as well, and with participants that are not part of the formal educational system.  |
| A couple of lines explaining why you choose students from coastal cities might be useful (lines 257-258). Was this a sample of convenience? In any case, please explain your choice. | See above |
| Line 261 adding a one sentence description of what the snowball method is would be useful. | Added this sentence: The students were recruited using the snowball method (Biernacki and Waldorf 1981), a convenience sampling method used when samples of participants with the target characteristics are note easily accessible to the research group, and existing subjects recruit further subjects to the study among their acquaintances until data saturation has been reached (Naderifar, Goli, and Ghaljaie 2017). The quality of the results sampled from this group far outweighs the relatively small number, as is often the case in qualitative research studies where large samples can be ineffective and do not provide the detailed and contextual information wanted by the researcher. |
| Lines 271-272 did you notice any differences in how players learned in the online game versus the physical one? If so, it might be interesting to put a few lines explaining what those where and what it might mean. | No, not really – it was just more difficult to facilitate for us as researchers – but the results were the same. The discussions were hindered the way that it is for online discussions though.  |
| Referee: 2 |  |
| The early definitions of OL cited at the start of the paper are highly contested and come from a knowledge deficit perspective… if only we tell people stuff about the ocean, their behaviour will change…. it would be useful to acknowledge this critique in the paper. | I changed the sentence leading up to the list of principles to reflect this:While acknowledging that these principles are critiqued for not encompassing among others the contributions that Indigenous perspectives and worldviews (MacNeil et al. 2021), for the purposes of this study we will frame our study around these: |
| This signals the OL can be an approach strategically deployed by marine policy makers to support certain outcomes for coastal communities facing defined challenges. The explicit use of OL as a means of shifting community views (often euphemistically called education or capacity building), which is potentially quite controversial depending upon the positionality and approach of the OL ‘educator’, should be noted in the paper. | I rewrote the sentence in the introduction to reflect this important perspective:Research has demonstrated that the ocean is fundamental for life on Earth and human prosperity, and learning and sharing knowledge to sometimes shift community perceptions through education or capacity building around ocean literacy is critical, though it should be noted that it arguably also can be considered controversial, depending on the approach or positionality of the ocean literacy educator. |
| Further discussion on the possible role of serious games as a tool for widespread action to tackle plastic pollution would strengthen the paper. For example, there are unanswered questions about the scaling of the approach, how it might work outside the formal education sector, and how it might work in countries of the global majority. | I added this sentence in the end of the introduction:We conclude by considering the applicability of using this game as an educational tool for Ocean Literacy in the majority world as well, and with participants that are not part of the formal educational system.And expanded upon this in the conclusion. Thank you for this suggestion.  |

1. Population statistics Norway 2023: <https://www.ssb.no/statbank/table/05277/tableViewLayout1/> [↑](#footnote-ref-1)