

We sincerely thank Reviewer 2 for the thoughtful and detailed feedback. We appreciate your recognition of the improvements made to the manuscript and your valuable recommendations for further refinement. Below we provide a point-by-point response to each of your comments. All page and line numbers provided below refer to the revised version of the manuscript with tracked changes.

General Comments

Reviewer comment:

The grammar and spelling still need considerable improvement and are not yet at a publishable level. This includes correcting typos, grammar, and sentence structures; using appropriate linking words; ensuring consistent comma usage; removing double periods (lines 164 and 309); and unifying the capitalization of game titles (e.g., line 289). Also, check Figure 1 for typos. Write out numbers below ten and apply this rule consistently. For example, in line 191, "twenty-two" is written out, while "5" in the line above is written as an Arabic numeral.

Author response:

Thank you for this observation. We have carried out a comprehensive revision of the manuscript to correct grammatical and spelling issues, ensure consistent formatting (including punctuation and capitalization), and improve sentence flow and readability. Specific corrections were made to lines 164, 289, and 309. Figure 1 has also been corrected for typographical errors. We have also standardized the use of numbers, writing out those below ten consistently throughout the text. However, in cases where a sentence begins with a number, we have followed the journal's editorial guidelines and spelled out the number, as this is the recommended practice for formal academic writing (page 7, line 282).

Methodology

Reviewer comment:

I do not support your claim that methodological triangulation was used. What is described as a literature review appears to be primarily the references used in the discussion and results sections to support arguments, rather than an independent research method. Since the study does not employ a systematic or structured approach—such as a systematic review, scoping review, or meta-analysis—to synthesize existing knowledge, it appears that only two research methods were applied (content analysis and expert focus groups). Therefore, it would be more accurate either to remove this reference to methodological triangulation, explicitly conduct a structured literature review, or adjust the wording to clarify that data triangulation (i.e., incorporating different sources of information on the same topic) was used instead.

Author response:

We appreciate this clarification. The reference to “methodological triangulation” has been removed from the manuscript. We have clarified that the study employed two main qualitative research methods (expert interviews and content analysis) in Abstract (page 1, line 11-12), Introduction (page 3, line 126-127) and Materials and methods (page 5, line 207), and Conclusions (page 19, line 830).

Reviewer comment:

I recommend that you eliminate sentences 202–204: "For this reason, we endeavored to include specific questions, eliminating those that were similar, avoiding questions that were too open-ended, and focusing on those that allowed for a relevant response to the topic of study." In my opinion, this sentence does not add meaningful information

Author response:

As suggested, these sentences have been removed from the manuscript.

Results

Reviewer comment:

Paragraph 259–262: *Be cautious when stating that the games exhibit a "great diversity" of characters based on the descriptions in the text. If the race and ethnicity of the main characters are not specified, the claim may not be well-supported. Additionally, simply allowing players to choose between a male and female character does not constitute "great diversity" and fails to acknowledge non-binary identities. It would be more accurate to state that the games include some representation—for instance, by featuring a protagonist with a mobility impairment or including characters from different backgrounds. This is especially relevant given your statement in line 408: "Few games consider multicultural and inclusivity aspects."*

Author response:

We thank the reviewer for this valuable comment. In response, we have revised the paragraph to provide a more accurate description of character representation. Specifically, we replaced the original statement "*highlight the great diversity present in the games analysed*" with "*acknowledge the limited representation present in the games analysed*", and clarified the limitations by explicitly mentioning the lack of broader representation regarding race, ethnicity, and non-binary identities (page 10, lines 397-402).

Reviewer comment:

Section 4.3.XXX: *Ensure that it is clear to the reader that the points listed in the first paragraphs of each subchapter reflect the opinions of the experts rather than universally accepted facts. Additionally, improve readability by incorporating linking words.*

Author response:

We have revised the introductory paragraph of each subsection in Section 4.3 to explicitly indicate that the points presented reflect expert opinions (page 14, line 578, and page 15 lines 626 and 637). We have also added linking words to improve overall readability and cohesion.

Reviewer comment:

Line 270: *"Three out of six games" is not the majority.*

Author response:

Thank you for pointing this out. The sentence has been corrected to avoid the inaccurate use of the term "majority" (page 11, line 406).

Reviewer comment:

Figure 2: *It is unclear why Figure 2 stands alone rather than being included in one of the expert response tables. Please delete the figure and integrate the information into Table 3.*

Author response:

We have removed Figure 2 and integrated its information into an updated version of Table 3, as suggested.

Reviewer comment:

Tables 2 and 3: *The table descriptions should be made more informative to better convey the content they present. Ideally, a table title should clearly state what the table contains while providing a brief summary of its contents. The column title "Importance" is ambiguous, as it suggests a qualitative measure rather than a numerical representation of expert agreement. A more precise title would be "Expert Agreement (%)" or "Proportion of Experts (%)." Additionally, consider whether Tables 2 and 3 could be combined to save space by presenting them side by side.*

Author response:

We thank the reviewer for this valuable suggestion. In response, we have revised the titles and descriptions of Tables 2 and 3 to provide more informative summaries. The column previously titled "Importance" has been renamed "Expert Agreement (%)" to accurately reflect the data.

Although the tables have not been merged, they are now displayed side by side to improve space efficiency and facilitate comparison without compromising clarity.

Reviewer comment:

I also do not fully understand how you arrived at the response numbers in Tables 2 and 3, given that Table S9 appears to display all expert responses. For example, how did you determine that "Character – Socializer" received five responses and "Character – Explorer" received three when Table S9 suggests only two responses were recorded? Please clarify.

Author response:

We have clarified in the text that Tables 2 and 3 are based on the full set of coded responses obtained through thematic analysis, which included semantic grouping of similar expert answers. Table S9 and S10 presents selected examples and does not include all responses. This clarification has been added in Results section (page 11, line 452-453) and in description of Table S9 and S10 (see Supplementary materials).

Discussion

Reviewer comment:

Thank you for restructuring this section; it is a significant improvement. However, this section still lacks clarity. Some parts focus too heavily on reiterating the research results rather than analyzing their implications and interpretations. The discussion should clearly summarize the key findings in relation to the research questions and critically reflect on them.

Author response:

We sincerely thank the reviewer for their valuable feedback and for highlighting the need to improve the clarity of the discussion section. In response, we have carefully revised this section to ensure it clearly addresses the research questions and provides a more critical interpretation of the results.

Specifically, we have:

- Structured the Section 5.1 to directly respond to the first research question, focusing exclusively on how serious games communicate and educate about natural hazards.
- Revised the Section 5.2 to address the second research question, clearly outlining the recommended educational and communicative elements that serious games should incorporate to improve DRM.

To support these revisions, we have also incorporated several new references that reinforce the theoretical and empirical grounding of the discussion. These have been added to the updated References section (page 21, lines 1352-1354; page 22, lines 1402-1404; page 22, lines 1405-1406).

Reviewer comment:

Additionally, the discussion lacks an in-depth comparison to existing research, which would strengthen your arguments. A few specific areas that could be expanded include:

- *The debate over whether a catastrophic or non-alarmist tone is more effective is interesting but remains inconclusive. Rather than simply presenting both perspectives, consider providing insights into how game designers could balance these approaches effectively.*

Author response:

Thank you for this valuable suggestion. In response, we have expanded the relevant section to propose concrete strategies for balancing emotional intensity with player empowerment in game design. The revised text now discusses how serious games might open with immersive, high-stakes scenarios to capture attention and elevate perceived risk, followed by interactive phases that reinforce decision-making and coping strategies. This approach helps foster adaptive engagement and informed mitigation behaviours without emotionally overwhelming players. Relevant literature has also been incorporated to support these recommendations. This clarification has been added in Discussion section (page 18, line 987-993).

- *While you discuss how serious games engage players, you could further explore whether they improve understanding of scientific concepts related to natural hazards. The mention of Bloom's Taxonomy is useful but could be expanded by specifying which cognitive skills these games enhance the most.*

Author response:

Thank you for this insightful recommendation. In response, we have expanded the discussion of Bloom's Taxonomy to specify which cognitive skills are most enhanced by serious games. The revised text now details how games such as Build a Kit and Disaster Master support foundational levels (Remember and Understand), while Stop Disasters promotes Application, Analysis, Evaluation, and even Creation skills by requiring players to design resilient urban environments and prioritize mitigation

strategies under resource constraints. Furthermore, we explicitly connect these cognitive processes to the understanding of scientific concepts related to natural hazards, such as seismic risk interpretation, flood-prone area identification, and responses to changing weather conditions. This provides clearer evidence of how serious games contribute to both scientific literacy and practical decision-making in realistic risk contexts. This clarification has been added in Discussion section (page 16-17, line 803-880).

- *The argument that excessive rewards can be distracting (Chou, 2015) is valid, but it would be helpful to include practical recommendations on how to structure rewards to enhance learning rather than just entertainment.*

Author response:

Thank you for this valuable recommendation. In response, we have expanded the corresponding section to provide specific and practical guidance on how to structure reward systems to enhance learning rather than solely entertainment. The revised text now emphasizes that rewards should be carefully aligned with core DRM concepts and designed to recognise meaningful progress in addressing realistic challenges. We propose a tiered reward structure that offers progressive recognition, small rewards for mastering foundational content and more significant rewards for demonstrating strategic reasoning and complex decision-making (Boyle et al., 2021). Additionally, we suggest incorporating cooperative rewards to celebrate group accomplishments, which can foster social learning and build collective efficacy (Khalili et al., 2021). This ensures that reward systems support both player engagement and long-term knowledge retention (Ouariachi et al., 2019). This clarification has been added in Discussion section (page 18, line 969-978).

- *You mention collective efficacy and community engagement but do not explore in depth how these elements could be effectively integrated into game mechanics. Providing concrete examples from existing games would strengthen this argument*

Author response:

Thank you for this valuable suggestion. In response, we have expanded the relevant section to include concrete examples illustrating how collective efficacy and community engagement can be effectively integrated into game mechanics. The revised text now describes specific strategies used in existing serious games, such as the assignment of community roles and consensus-building tasks (Tanwattana and Toyoda, 2021), spatial co-design exercises that simulate participatory planning (Olivares-Rodríguez et al., 2022), and time-constrained coordination scenarios requiring distributed leadership (Kano et al., 2016). These examples demonstrate how serious games can foster social resilience by embedding collective efficacy directly into their game mechanics. This clarification has been added in Discussion section (page 17, line 887-898).

Conclusion

Reviewer comment:

This section would benefit from deeper reflections on what your research has achieved. The statement that the study provides "new insights" is somewhat vague, be more specific about what is novel in your findings compared to previous research.

Author response:

We thank the reviewer for this valuable comment. In response, we have revised the conclusion section to explicitly state the novel contributions of this research and how they advance current knowledge. Specifically, we have clarified the innovative aspects related to the combination of content analysis and expert perspectives, the identification of key educational and communicative features for DRM education, and the comparative evaluation of online games and mobile apps. These revisions ensure that the contributions of our study are clearly differentiated from previous research and provide specific guidance for future developments in this field.

While you acknowledge the limitations of qualitative analysis, it would be useful to suggest how future studies could address these limitations more concretely (e.g., through experimental studies to measure behavioral changes). The recommendations for future research are relevant but somewhat broad. Instead of simply suggesting further studies on different game elements, propose specific research questions or methodologies that could build upon your findings.

Author response:

Additionally, we have expanded the limitations and future research sections to provide more concrete proposals. Specifically, we suggest that future studies employ experimental or mixed-method designs to enable causal inference and assess behavioral changes resulting from serious game interventions. We also propose specific research questions to guide future work, including:

- How does narrative tone (e.g., catastrophic vs. non-alarmist) affect players' motivation to adopt DRM-related behaviors?
- In what ways do different feedback and reward structures (e.g., immediate vs. delayed) impact decision-making and knowledge retention?
- How do specific gameplay mechanics (e.g., collaborative vs. competitive strategies or resource discovery) shape the development of problem-solving skills in simulated disaster contexts?

These additions aim to offer clearer directions for future research building directly upon our findings. This clarification has been added in Conclusion section (page 19-20, line 1035-1332).

We hope that the revisions undertaken meet your expectations and we remain at your disposal for any further clarification."