

Interactive comment on “Earth Girl Volcano: Characterizing and Conveying Volcanic Hazard Complexity in an Interactive Casual Game of Disaster Preparedness and Response” by Isaac Kerlow et al.

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Dear Chris,

Thank you for taking the time to review the paper, for your thoughtful comments, and for the positive comments on our practice-based research. Some of your statements, however, seem narrow-minded in the context of art-science interdisciplinary collaboration, and we reply with a different point of view regarding a Special Issue on Art and Science.

You raise two major issues (natural disasters and the nature of research) and multiple smaller line-by-line comments. Our responses to the latter are summarized at the end of the document. We have amended the spelling mistakes and clarified statements that needed clarification.

NATURAL DISASTERS

REVIEWER: The authors need to consider the use of the phrase 'natural disaster' as it is often not helpful in communicating hazard risk and many argue is factually incorrect. The hazard, in this case emerging from volcanic activity, is natural but it only becomes a disaster because of human decisions.

AUTHORS' RESPONSE: We have amended "natural disasters" to "natural hazards." We agree that in the context of Earth science natural hazards generally turn into disasters because of human inaction or lack of preparedness. One could argue other points of view but this paper is not the forum for that discussion.

RESEARCH COMMENT

REVIEWER: The reason the review has been difficult is because the manuscript does not fall within the defined scope of Geoscience Communication. It has been submitted as a research article but there is no research question, methodology, and no form of evaluation to assess that the question has been answered. There is a lot of detail about the game and its design but the authors do not address and evidence whether those design choices were successful in achieving the objectives. Under the journal's manuscript descriptions, this manuscript is simply reporting on a public engagement activity. It doesn't fall in the scope of the other manuscript types either.

AUTHORS' RESPONSE: We understand that SCIENTIFIC RESEARCH is based on a specific method that is centered on quantitative data. The parameters of modern scientific research are narrowly defined and have been widely used for over a century. PRACTICE-BASED RESEARCH is another form of research that also generates

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knowledge, and this type of research started to be formulated and formalized at the turn of the 21st century. The later is different from scientific research and it is the de-facto research methodology used in the creative arts. You can learn more details about this approach in this MIT Journals free-access paper: "Practice-Based Research in the Creative Arts: Foundations and Futures from the Front Line" by Linda Candy and Ernest Edmonds. https://doi.org/10.1162/LEON_a_01471

Clearly we failed to bring up in the manuscript the issue of practice-based research. We are now incorporating a few extra lines about that it in the abstract and the conclusions.

The research behind the Earth Girl Volcano game is practice-based research, and the aim of the paper is to document the new knowledge regarding a methodology for creating games. We believe that our unique and original methodology and approach to creating games can have a deep impact in the creation of science-inspired games that people and non-scientists want to play. Designing and producing earth science GAMES that are engaging, based on science, and can help communities to increase understanding and preparedness is a lot more than "simply reporting on a public engagement activity."

We believe that our manuscript belongs in this Special Issue of EGU's Journal of Geoscience Communication because it presents an innovative game design and game methodology that we crafted (i.e. developed, invented) through our practice-based research. Narrowly defined the Earth Girl Volcano game is not scientific research. The aim of our research and manuscript is not to measure the game and/or to provide quantitative information about it. We value quantitative information but that is not what this research/manuscript is about.

Our aim in this paper is to reveal our design methodology. As stated by the reviewer, this game "is extremely well researched, with great consideration to every design and game-play element, a high level of attention to detail, and despite the underlying and background complexity, it creates a simple, intuitive gaming experience, that is fun to

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play over and over again." All that was precisely the aim and the result of our research. Our "simple, intuitive gaming experience, that is fun to play over and over again" was the result of methodical development that placed the player, not the quantitative or technical information, at the center of the process. The paper documents and reflects on that approach.

Academic discussions about the nature of research aside, our goal as artists and scientists is to advance the usefulness of Earth science to average people. It seems narrow-minded to expect artists to behave like scientists, to talk like scientists and to think like scientists. It seems counter-productive to judge the output of art-and-science collaborations merely by the rigid metrics of traditional science. What would then be the point of collaborations between artists and scientists? The whole point of interdisciplinary collaboration is to create a space where experiments can happen, where we can try new ways to create, to think about our process, and to evaluate our results.

"Thinking outside the box" is a bit of a cliché but the Earth Girl Volcano game would not exist if we had followed the traditional "square" scientific quantitative approach to crafting "serious" educational games. Hence the value of our paper in the context of practice-based research and interdisciplinary collaboration.

To conclude, we believe that this article can greatly enhance the value of this Special Issue, and that the work presented is an encouraging example of the innovative results of an exemplary collaboration between artists and scientists in the context of Earth science and hazard preparedness.

LINE-BY-LINE COMMENTS

Editor - stylistically, do game titles need to be italicised? - YES, CLARIFIED by Copernicus Publications, DONE

Line 15 - Add a comma after 'Unfortunately' - DONE

Lines 26-28 - the manuscript does not provide evidence to support this statement and

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should be removed or reworded - FIXED

Line 31 - Add 'are' inbetween 'and' and 'exposed' - DONE

Lines 46-51 - This paragraph repeats what is said in the opening paragraph. Consider merging them. - KEPT AS IS, we like the slight repetition as it reinforces key concepts

Line 46 - hyphenate easy-to-play and easy-to-learn to be consistent with line 32 - DONE

Line 48 - A reference is needed for the ranking here. I think it is the same reference used in line 51. - KEPT, it is the same reference.

Line 86 - Be careful with use of the term 'natural disaster'. Are disasters natural or because of human actions? - DONE

Line 92 - Somewhere in the introduction it would be useful to have a short review of previous hazard awareness games, particularly video games, and place Earth Girl Volcano in context with them. In particular, the video game of Mani et al (2016) has a similar objective but takes a very different approach. <https://www.nat-hazards-earthyst-sci.net/16/1673/2016/> - ADDED a short sentence, but additional extensive information is beyond the scope of the paper

Line 99 - natural disaster again if you wish to change it - DONE

Line 110 - volcanic disaster I would suggest is similar to natural disaster - AGREE

Line 135-136 - Is this rating suggesting the game is well designed to engage this target audience or that it doesn't contain elements that might be inappropriate/harmful for some age groups? The sentence may be misleading due to the sentence immediately before. BOTH, just a statement of fact.

Lines 138-139 - I think there is a missing word(s) after 'stay away' - DONE

Line 143 - Change 'in' to 'on' - DONE

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Lines 146-147 - How relevant is this considering Adobe will be removing all support for Flash at the end of 2020? Are there plans to update to html5 or hosting on itch for example? - DONE, it is a factual statement of present availability, added possible alternatives.

Lines 148-152 - This is a repeat of information provided in the Introduction. - AGREE, but we like it as is for the sake of clarity.

Line 154 - It would be useful to define what is meant by 'a casual game' for readers who may not have any gaming background. - CASUAL GAMES are casually defined throughout the paragraph.

Line 159 - Change 'device' to 'devise' - DONE

Line 160 - Define what is meant by 'adventure' and 'management' games - ALREADY list the key characteristic of each, more details beyond scope of paper.

Lines 212-231, Section 1.7 - This section is really interesting and these insights are valuable. Were these responses recorded in any way that could be used as evidence for this? If not, you need to make it clear that this is anecdotal information from the process and that it is not based on a formal evaluation. Have there been previous studies analysing collaborations between scientists and artists that would support the observations? - LEFT AS IS, thank you, left as is. These are meant as simple side thoughts about the process of interdisciplinary collaboration, to quickly illustrate our general approach. It is not meant to be an exhaustive exploration of interdisciplinary collaboration between artists and scientists. That would be a different paper.

Line 224 - My understanding of gamification is that it is the use of gaming elements as part of something but stopping short of making an actual game itself, so the use of the term here wouldn't be correct. - GAMIFICATION is a general open-ended term, my understanding of gamification includes making actual games, we'd like to keep it inclusive and simple.

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Line 239 - 240 - This statement needs evidencing or removing. - MODIFIED

Line 241 - 'classical theatre' has a specific disciplinary meaning (i.e., the theatre of ancient Greece) that could be ambiguous here. 'Traditional theatre' might be more appropriate. - FIXED, simplified

Line 241 - Theatre usually doesn't have a screen therefore don't have screenplays - script or text would be a more suitable term. - DONE

Line 250 - 253 - These statements could use evidencing by referencing appropriate sources. - BEYOND SCOPE, meant in an anecdotal way. Also these are concept of introductory courses to Storytelling and we want to stay away from explaining and referencing basic concepts of dramatic writing and film production. We'd like to keep the manuscript as focused on the game as possible, and short too.

Line 291 - 292 - This sentence needs evidencing or re-wording, for example replacing 'helps' with 'intends' - DONE

Line 295 - Suggest replacing 'disaster' with 'hazard' in both cases - DONE

Line 316 - How was this observed/recorded? If it is anecdotal, please state that it is - CLARIFIED, methodical

Line 336 - Change 'payer' to 'player' - DONE

Line 392 - 411 - Make it clearer in this section when you refer purely to the in-game effect of the tools and when referring to real-world effects. For the latter, this should be accompanied by supporting evidence (like for Sabo dams in lines 402-403). - FIXED, ADDED info on crossing rivers and community education

Line 412 - Add a comma after 'Initially' - DONE

Line 418 - Change 'loose' to 'lose' - DONE

Line 419 - As a matter of interest, have you tried using a more advanced version with

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all the tools in to run with practitioners? - YES, FYI ONLY [not in manuscript], early in the process we had a build of the game with an extended toolset, but this overwhelmed the large majority of the test-players and we didn't pursue that avenue. We didn't have the resources to build two versions in parallel so we stuck with the limited but easy-to-handle toolset.

Line 426 - Add a comma after 'speaking' - DONE

Line 429 - the tool names are capitalised here but not elsewhere. It doesn't matter if there are or are not capitalised but should be consistent. - FIXED

Line 442 - Change 'cannot mitigated' with 'cannot be mitigated for' - DONE

Line 451 - Add 'the' between 'than' and 'others' - DONE

Line 458 - Move '(also known as check dams)' to the first reference of sabo dams in line 402. - DONE

Line 479 - 480 - It is not enough to say it is well documented, please provide references to this documentation as evidence. - ADDED reference from Al Jazeera News [refuse to evacuate]

Line 481 - 482 - I'm not sure I understand this sentence - does this refer to people who have evacuated from nearby towns trying to find shelter in the town the player is trying to help? - CORRECT, rephrased, hope it is more clear

Line 507 - Remove 'for no good reason' as this could read as they refuse to evacuate until given a good reason to do so. - DONE

Line 514 - Change 'he or she' with 'they' - DONE

Line 532 - Remove 'interactive game'. It is superfluous here and could be read to mean a different version of the game. - LEFT AS IS, for the sake of clarity

Lines 538 - 548 - Do you have formal observations/evaluations for these? If so, please

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provide information on the methodology used. If not, please make it clear these are anecdotal observations. - FIXED, added information

Line 542 - Change 'student' to 'students' - DONE

Line 554 - 555 - Are there studies that show this that can support your belief? [emotional connection] - YES but beyond the scope of paper, we prefer to keep it simple with the use of "believe"

Line 578 - Add a comma after 'hazards' - DONE

Line 578 - Change 'in which' to 'that' - DONE

Line 604 - 609 - All these statements require supporting evidence - how do we know explaining alone does not create emotional response? - EXPANDED, these are our guiding principles, this approach is what helps us to produce what we create, to substantiate the psychology of emotion and learning is beyond the scope of this paper

Line 616 - 618 - Was this observed via a formal methodology or is anecdotal information? - OBSERVED, CLARIFIED in manuscript

Line 629 - I know it seems obvious, but you need to provide evidence that suspense and tension create an emotional connection. - LEFT AS IS, this is Dramatic Writing 101, want to stay away from very basic concepts

Lines 647 - 665, Conclusion - The conclusion is weak and doesn't really say much, but as the manuscript is a detailed description of the design process rather than addressing a research question, this is to be expected. There is reference to user feedback throughout this section - please provide more details of how this was collected and recorded. Has this been a formal evaluation or is it anecdotal? - IMPROVED, CLARIFIED

Line 660 - 661 - It maybe that this is required for publication in Geoscience Communication. If it is decided it is and you wish to continue, I would suggest a focus on how well

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the game manages to create emotional connections for players, and then how well that leads to increased hazard preparedness. - FUTURE WORK, beyond scope of current manuscript

Data/Code Availability - please include in this section where people can access the game (this information is already in the manuscript but should be repeated here. If any of the information was based on formal evaluation, details of the availability of that data should be placed here. - ADDED section Game Availability At time of writing the public can download the English computer version of the Earth Girl Volcano game for Windows and MacOS from <https://earthobservatory.sg/> and <https://art-science-media.com/>. Several localizations of the game for digital tablets are also available at Google Play and the App Store. The early Earth Girl Flash games are available at <http://earthgirlgame.com/> and they require the Flash plug-in. Before the end of 2020 we plan to upload the Flash games to the repository website <https://itch.io/>.

Author contributions - ADDED section Isaac Kerlow conceptualized and designed the Earth Girl Volcano game, supervised the development and production team throughout the process, and wrote the original draft of the published work. Gabriela Pedreros and Helena Albert contributed to the methodology, participated in the validation, and reviewed and edited the published work.

Conflict of interest statement - ADDED section Competing Interests The authors declare that they have no conflict of interest.

ALSO ADDED Video Supplements Two short videos illustrate the features of this game. The Earth Girl Volcano - Game Overview video (1m 30s) provides an introduction to this casual strategy game. Available at <https://vimeo.com/294752004> and also at DOI (pending). The Earth Girl Volcano - Game Demo video (6m 27s) illustrates a sequential gameplay of the game. Available at <https://vimeo.com/305156140> and also at DOI (pending).

Interactive comment on Geosci. Commun. Discuss., <https://doi.org/10.5194/gc-2020-16>, 2020.