



An effectiveness scoring system for risk and uncertainty in serious games for natural hazards

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Serious games (SGs) for natural hazards (NHs) can provide an artificial space for players to understand the risk they face through defined rules and quantifiable results. Here, we deduce a scoring system for natural hazard SGs to understand whether these games introduce and communicate the interplay between social/physical vulnerability, exposure, hazard, and uncertainty (called 'four elements' here forth) to target players. We first identified 48 natural hazard SGs via a critical review of peer-reviewed and grey- literature. From these 48 SGs, we select 22 that were accessible and scored them on a 12-point scale through a two-stage process: (i) identify the indicators (or evaluation criteria) for three risk elements – vulnerability (6 indicators), hazard (7 indicators), and exposure (7 indicators) – along with uncertainty (8 indicators); and (ii) deduce the scores of the games by employing the evaluation criteria on 22 games. Based on the scores, we found that 70% of the 22 SGs could be applied to more than one hazard type (one of the hazard indicators), whilst 52% of the games included social vulnerability and/or critical loss facilities as exposure. About half of the SGs (48%) fostered player unpredictability which means that the focus of most natural hazard SGs is to indicate how decisions taken by one community member can impact the whole community or another individual in a community. Comparing the game scores, four games ranked highest with a score of 9 out of a possible 12; showing that such games can communicate hazard risks into an appropriate context. Games with high scores (above 10 out of 12) can help the people-at-risk (who are the target players in SGNHs) weigh up in their mind the costs and benefits of different actions, empowering communities to take disaster risk reduction, preparedness, and resilience actions.