The Role of Science, Technology, Innovation, Education and Gaming in Building a Culture of Disaster Preparedness with the B-prepared Project

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Abstract. B-prepared builds on a freely accessible massive collaborative knowledge base and data hub, demonstrating its usefulness via three demonstrator applications: a cooperative multiplayer VR serious game, simulating real disaster scenarios for the safest near-real experience; an interactive gamified mobile app with age-appropriate content and enhanced accessibility to people with specific functional needs for the widest possible reach; and an LMS system to effectively and comparably measure preparedness levels achieved by VR and/or mobile users on a unified scale. Players can take different roles to solve puzzle tasks in an immersive experience. Teamplay, collaboration and communication are keys to survival, strengthening the culture of mutual assistance and cooperation in danger.

Keywords: Disaster Preparedness, Game-based Tools, B-prepared, Horizon Europe, Citizen Survival.

1 Introduction: Why B-prepared

Recent disaster events, like the 2021 flood in Germany showed clearly, that even the best alert systems and top first responder organisations can not prevent fatalities and serious damage on property without having prepared the citizens how to act and react during disaster situations and crises, understand alerts and follow instructions. B-prepared offers a cost-effective solution for building a culture of disaster preparedness with a multi-actor approach in realistic historical scenarios.

It is among the EU's policy priorities to build "A resilient EU prepared for emerging threats". Europe has seen major floods and forest fires, while images of people seeking relief from record-breaking heatwaves are becoming commonplace in the past decade.

Between 1980 and 2020, natural disasters affected nearly 50 million people in the European Union and caused, on average, an economic loss of €12 billion per year. Since 2001, the EU Civil Protection Mechanism has been activated more than 600 times and the proportion inside the EU deployments is increasing rapidly. Damage and Loss caused by COVID-19 and the current energy crisis are still under assessment. Still, they might have a similar, if not greater impact than the disasters of the previous four decades. As a result of climate change, the intensity and frequency of disasters are expected to grow further. Given the proliferation of disasters, the increasing magnitude and frequency of adverse events necessitate that ordinary citizens re-emerge as first responders to disasters, just as before professional first responders were created -in the modern sense - in the 18th-19th century. Before their establishment, there were only fragmented and rudimentary first responder organisations. Thus, mainly local people were responding to disasters, regardless of orders by law or based on morality and common sense. The current institutionalised practices, well documented in the ISO22398 standard on societal security exercises, usually require sub-stantive financial and human resources, while involving significant risks, and having their reach severely limited in terms of the number of citizens and the frequency of repetition. As it stands, in case a municipality wishes to improve citizen preparedness related to potential disasters, they might.

- organise discursive workshops or tabletop games,
- prepare leaflets, presentation materials, or narrative videos,
- integrate such materials into school curricula, or
- organise massive, life-like drills.

While these methods have undeniable results, they are severely limited in various aspects, as mentioned above. Experience shows that the live events providing a near-realistic impression are maintained only for first responders, their auxiliaries, and civil protection volunteers, with only rare participation from citizens themselves. Well-developed databases and learning content are available for responsible organisations and first responders, such as the European Commission Disaster Risk Management Knowledge Centre (DRMKC), an award-winning Joint Research Council (JRC) solution, but it does not provide tailored learning con-tent for individual citizens or business organisations. The general approach for all those solutions is that citizens are a large group handled as the subject of first responder efforts. Still, they fail to address the specific needs or individual capabilities. A survey on emergency preparedness of EU citizens involving over 1200 participants showed that although EU populations can participate in emergency response, their preparedness level is low (avg. 22% answered that they are pre-pared). However, there is a significant willingness to prepare (44% responded they intend to prepare). It was also found that national differences significantly affect individual preparedness behaviour and awareness of risks (Filippoupolitis et al., 2015: p. 7). There are learning materials and relevant information (facts and figures) available for the public (UN, EU and national states are all publish-ing such information) as well as information disseminating disaster alert applications (called 112-apps in the EU), such as VÉSZ-HU, NINA-DE, SAIP-FR. There have been projects to create immersive learning environments on disaster preparedness using web-based multimedia, such as Pandora+ in the POP-Alert project for flatscreen or products to increase awareness of disasters by putting the players in first responder roles. However,

neither those solutions, nor traditional information campaigns did significantly increase citizen preparedness. As, they only provided general learning content instead of addressing specific needs either location-based or situation based.

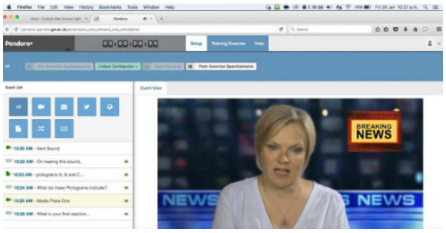

Fig. 1. Pandora (Pandora project, CORDIS 225387).

Fig. 2. Notruf 112 (released on Steam Store, 2016).

The value proposition of B-prepared compared to the state-of-the-art presented above lies in its holistic approach (serious game, gamified application, and knowledge-collaboration platform with a Learning Management System at the same time) and the use of new technologies to engage citizens. Gaming behaviour has changed significantly since 2016, and mobile gaming multiplied its player number (2.5 billion globally in 2020) and revenue ($136 bn in 2020) while flatscreen PC and consoles stagnated. VR headsets of Steam users went up exponentially from a few thousand to almost 4 million between 2016 and 2022. Location-based and gamified mobile applications and VR games provide unprecedented immersive experiences, to a level no flatscreen application, learning material, or multimedia can provide.

From the viewpoints of individual citizens, B-prepared solution represents a significant improvement compared to existing disaster preparedness enhancing products and services such as serious games, relevant learning opportunities, mobile applications and disaster databases. The innovation is obvious and pro-vides easily appreciated advantages to users in the form of a new service.

2 Objectives of the B-prepared Project: How B-prepared?

B-prepared aims to create a collaboration and co-creation ecosystem for enhancing citizen preparedness for disasters and crises via serious gaming, gamified e-learning, and knowledge sharing. It consists of the core platform Disastropedia, a knowledge base of disasters and crises, and repository of relevant game development resources. Game and Learning Management System developers can connect their system to Disastropedia through an API and use it to build their own games. Users can collaborate by co-creating new content, or contributing to existing B-prepared games and, applications or learning content by building mods, maps, missions, or assets. Three demonstrator applications will be available as an open beta to validate the platform's capabilities. VR headset owners can play the serious game "VR-prepared" in Virtual Reality in single- or multiplayer mode to learn what to do during disasters and crises. Smartphone users

can download the “IM-prepared” gamified mobile application on their smartphone to access location-based preparedness content. Anyone with an internet connection will have access to the responsive (web, mobile and VR compatible) “RU-prepared” Learning Management System (LMS).

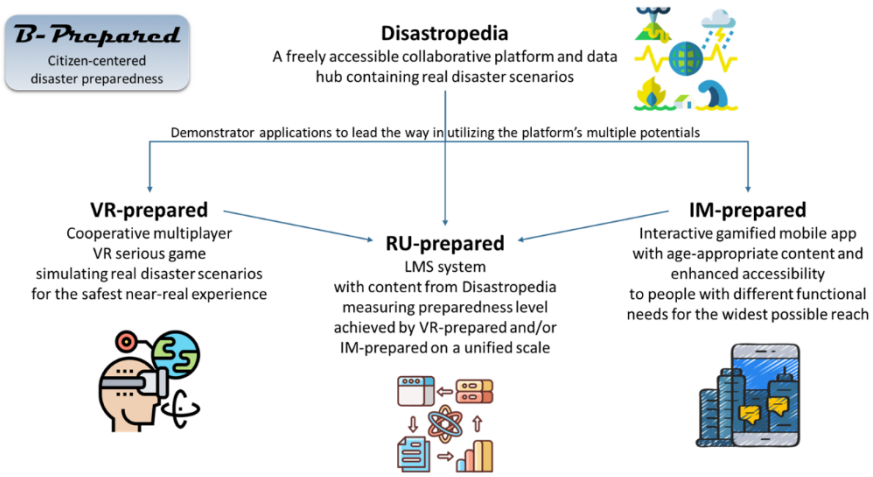

Fig. 3. Concept of the B-prepared ecosystem.

All demonstrators will also address vulnerable groups with special accessibility functions and scenarios, while the collaborative platform enables the creation of additional tailored content for people with specific functional needs. It will result in a citizencentred disaster preparedness enhancement, focusing on empowering people to prepare, prevent and react, thus enhancing their quality of life (Majdik et al., 2023).

In the sense of **Disastropedia**, no existing and EU-wide publicly available knowledge base can simultaneously serve as a social gaming platform, and disaster-related resource repository for the game and learning content development. The European Commission’s Disaster Risk Management Knowledge Centre has almost all the features except being a socialising and gaming platform -it is only for authorised users who are disaster management professionals. The Disastropedia gaps this lack using EKON’s Dynamic Knowledge Management (DKM) technology, a knowledge management system initially developed in an FP7 project and developed further in two H2020 projects.

Regarding **VR-prepared**, there are several VR games with near-real disaster scenarios where players are citizens and not first responders. Still, those are for entertainment purposes and are played in fictional settings. Meanwhile serious games in disaster response are generally focused on first responders (Notruf 112) or acting as authorities (Stop Disasters), VR serious games under development in sister projects within the H2020 program are still focused on first responders only. The VR Serious Game will enable the involvement of citizens in near-real case situations just like field exercises, but without the difficulties, costs, and high risks a real live exercise would include. In

the short run, every mission completed in the VR game and every task performed during attempts will yield experience points to the players, who will gain 'disaster preparedness levels' and badges. This will work as an evidence-based assessment method for their preparedness. Supported by the Disastropedia platform, dozens of institutions, communities, and corporations will see their own serious game scenarios developed building upon our solution. As the serious game will have cooperative multiplayer game mode, players can learn and practice collaboration in such situations, enabling its use for training at organisational levels, including practitioners.

In the case of **IM-prepared**, no gamified mobile applications perform location sensitive gamified training on disaster preparedness. Existing mobile games and learning applications on disaster preparedness for citizens are either survival games (Escape Skyscraper, Disaster Run, Survive), gamified learning applications for children (BabyBus Earthquake) or plain learning applications or information applications for adults (Emergency Preparedness & Disaster Survival, Disaster Ready). LMS-managed learning applications only exist in professional training. B-prepared blends these features into an exciting new product filling the gap. The B-prepared gamified mobile application will offer its users multilingual GPS-controlled interactive walks across existing real physical locations/sites. As a characteristic feature, the app will be built on the same scenarios as the B pre-pared VR games and the LMS services. The mobile application will offer custom-tailored gamified walk packages for each scenario, depending on the player role which the user selects from the predefined profiles. Each walk will consist of several physical locations, and role-specific minigames will be assigned to the locations. The minigames will start automatically as the player approaches the given locations.

For **RU-prepared**, there is no LMS available at this time that covers all educational institutions from elementary schools to universities sharing curriculum and learning content on disaster preparedness. The feature that it cross-measures advancement across all solutions connected to Disastropedia is unique in its nature. RU-prepared will be based on EDU's Gamtred (LMS), that is a software specifically designed for the creation, distribution and management of educational content in a wide variety of fields, including disaster management. It's most important feature that it cross measures advancement across all solutions. It allows experts to distribute educational content across the different digital platforms and to present learning performance analysis in a uniform and meaningful way. The platform will be integrated with Disastropedia, as well as VR prepared and the geo-tracking application IM-prepared through application programming interfaces (APIs) sharing the educational content and receiving the analytics through it (B-prepared consortium, CONOPS, 2024).

3 Impact and Future Progress: When B-prepared?

B-prepared offers a cost-effective solution for building a culture of disaster preparedness with a multi-actor approach in realistic historical scenarios. A large-scale virtual reality hackathon series will demonstrate its features. The open beta will be publicly available as a giveaway, inviting stakeholders via direct out-reach. After closing beta,

the game will be available in a non-profit freemium model where in-game purchases are replaced by in-game donations for relief organizations, with a small percentage kept for maintenance and further development. Such an ecosystem can play a crucial role in enhancing citizen preparedness for hazards and crises that also threaten intangible cultural heritage monuments if evolving to a disaster. Gamified e-learning modules and serious games enable dissemination of accessible and engaging educational content on disaster preparedness and response, including heritage preservation techniques as well as leveraging intangible cultural heritage itself to enhance disaster preparedness. Furthermore, the ecosystem fosters knowledge sharing among communities, experts, and stakeholders, enabling the exchange of best practices, traditional knowledge, and innovative solutions for safeguarding these vulnerable cultural assets for future generations. This holistic approach empowers citizens to be-come active participants in disaster preparedness, ensuring the resilience and preservation of their invaluable intangible cultural heritage.

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