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# Designing for Viral Infection Awareness through PLAYMUTATION

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**Abstract**
Media trust has been one of the greatest societal challenges given viral outbreaks within a new media landscape, amplifying fear-inducing measures, and information avoidance. Although some research has been carried out on the media (mis)use to inform about viral infections, there has been general lack of information on media design to create this awareness. The purpose of this paper is to contribute to establishing practices to develop virus epidemiologic-themed digital games to raise awareness for viral infections in young adults. Using a qualitative development research involving twenty-six informed individuals in microbiology and game design and thirty-four young adults aged between 18 and 35, a set of guidelines within the project PLAYMUTATION were proposed: (i) Validating the information on the transmission of the virus, measures to prevent and treat viral infections as a topic; (ii) Virtual modelling of the viruses physical interactions; and (iii) Showing implicitly the bio-psycho-social consequences, among others. This paper advances the knowledge of connectivity and creativity in times of conflict by simulating game-based scenarios that may prepare players for acting upon future health crises and outbreaks.

**Author keywords**
Digital Games; Viral Infections; Awareness Design; Changing Behaviors.

## Introduction

The past few years have seen increasing animal and human infections worldwide, which heightened the need for information about pathogens, host-pathogens interactions, and their spread in the general population. Over the course of history, humans have been challenged to lead the eradicating these infections (e.g., smallpox), controlling them by massive vaccination (e.g., measles, mumps), or behavior change – e.g., HIV/AIDS awareness. However, human mobility, and misleading media discourses that may impact people's attitudes, fears and behaviors emphasize the urgent need to leverage science-society debates and digitally mediated health communication strategies to educate about microbial and virus infections and viral outbreaks. Fighting against misinformation and overabundance of information about viral outbreaks also sets a priority in youth education, being media design an important dimension to deal with uncertainty, and medium credibility (Knudsen, Dahlberg, Iversen, Johannesson, &Nygaard, 2022). This latter dimension also tends to be highly dependent on media use.

In fact, the use of media and, in specific, digital games may constitute great opportunities to raise awareness of viral infections and impact behavior change (Putri et al, 2021; Furstrand et al.,

2020). In particular, digital games may be a suitable medium for simulating models of infection and dissemination of some pathogens – i.e., easily spread and disseminated airborne viral diseases, comprising a set of pathologies that can be caught by breathing when infected people cough, sneeze, or talk, spewing nasal and throat secretions into the air, beyond touching a contaminated surface that harbors these agents, followed by touching eyes, nose, or mouth that may also result in infection. Some examples of these airborne diseases include COVID-19, the common cold, the common flu, varicella, mumps, and measles. Moreover, games may foster collaborative problem-solving (Li, & Tsai, 2013), stimulate scientific curiosity, and learning about the virus's nature, transmission, and infection (Wang, & Huang, 2021; Lima et al., 2017; Jenson, Taylor, & de Castell, 2011).

In this sense, the aim of the ongoing PLAYMUTATION research project (https://playmutation.web.ua.pt/) is to: (i) Map the use of games in microbiology and media interventions in youngster's attitudes and behaviors relative to viral infections; (ii) Develop and validate the virus epidemiologic-themed digital game interventions (through gameplay and game-it-yourself initiatives); and (iii) Assess the youngsters' attitudes and behaviors relative to viral infections. This paper provides an overview of the game Mutation developed under this project and discuss the role of games to create awareness for health in times of crisis.

The paper is divided into three sections, including the introduction and conclusions: Section 'The Project PLAYMUTATION' presents the aim, approach, and context of the project. Then, the section 'The Digital game Mutation Madness' briefly describes some of the design and development decisions of the game. Finally, section 'Game Design for Situation Awareness for Health in Times of Crisis' discusses the way this media enables the awareness about viral infections and preparedness in times of crisis.

**The Project PLAYMUTATION**

The PLAYMUTATION research project – Virus Epidemiologic-themed Digital Games and Youngsters' Attitudes to Viral Infections aims to analyze the use of digital games to inform about the evolution of viral genomes, transmission, and mutations, as well as to promote self-care and infection prevention in youngsters.

The research question that guides this project is "How can virus epidemiologic-themed digital games raise youngsters' awareness of viral infections?" and, as such, it is divided into three phases. For instance, the research begins with the map of the use of games in microbiology and media interventions in youngsters' attitudes and behaviors relative to viral infections (PHASE 1). Then, a virus epidemiologic-themed digital game is developed (PHASE 2), which will serve as the intervention to assess the youngsters' attitudes and behaviors (PHASE 3).

In a broader sense, qualitative research is followed to understand the main design components of virus disease-themed digital games to raise young adults' awareness of virus diseases. PLAYMUTATION began in March 2022 with the consultation of twenty-six informed individuals in microbiology and game design using a 3-round Delphi method to achieve a consensus relative to the requirements of the game, i.e., the informed individuals were asked about the top-leading actions for raising people's awareness of viral infections and rate the whole suggestions in the following rounds.

The game Mutation Madness was then developed within this project, taking the individuals' perspectives into account. The characteristics of the game are described below with the challenge of balancing players' engagement and learning goals beyond intertwining information accuracy and fiction.

After its development, thirty-four young adults aged between 18 and 35 tested and evaluated the game in terms of the player experience (i.e., surveyed about game learnability, clarity of the goal, reward motivation, perceived self-progress, intention of activity repetition, balancing gameplay, item use and sense of control, involvement) and learning and behavior (i.e., surveyed about ways to fight and prevent viral infections, virus characteristics, mutations, preparedness for viral outbreaks, change in perspective), positive and negative aspects, and areas of improvements.

This ongoing project also involves a second stage in which the participants build their own versions of the game Mutation Madness with accurate and validated data about viral infections. This later stage of the project is grounded in the fact that digital games can be used as a mean for fostering youngsters' self-expression in health crisis and communicate own bias and (mis) representations.

In brief, this research sets out to determine the main design components that Game-based Learning should have to learn microbiology, while generating awareness to viral outbreaks and epidemics. The use of games in citizen science and self-expression in the healthcare domain are presented as the major contributions of this project to Game UX design for health education and science learning.

Moreover, the contributions are aligned with the sustainable development goals of ensuring quality education and good health and well-being with the use of media for increasing knowledge in virus epidemics, and changing behaviors associated with pandemics.

**The digital game Mutation Madness**

The digital game Mutation Madness was developed under the project PLAYMUTATION, aiming to raise young adult's awareness for viral infections. This is a 3d third-person epidemiologic-themed shooter portraying a virologist's attempt to fight against different waves of virus and variants, using different in-game items.

Figure 1 illustrates the gameplay of the game Mutation Madness and acquisition of in-game items using genetic points.


**Figure 1.** Mutation Madness gameplay and acquisition of in-game items

Each game level corresponds to different city scenarios named after essential concepts relative to viral infections, e.g., Cell city in which virus multiply acting as intracellular parasites, and virus-inspired structure RNA Road and Spike Station as viral genomes, and spike proteins (Flint et al., 2015).

Beyond fighting viruses, the player must find the mystery boxes hidden in each level that unlock different pieces of information relative to the Mad Virus. Figure 2 shows the panel 'Virus Research' to complete with the characteristics of the virus such as its structure, family, distribution, modes of transmission, pathogenicity, symptoms, risk factors, and control measures.

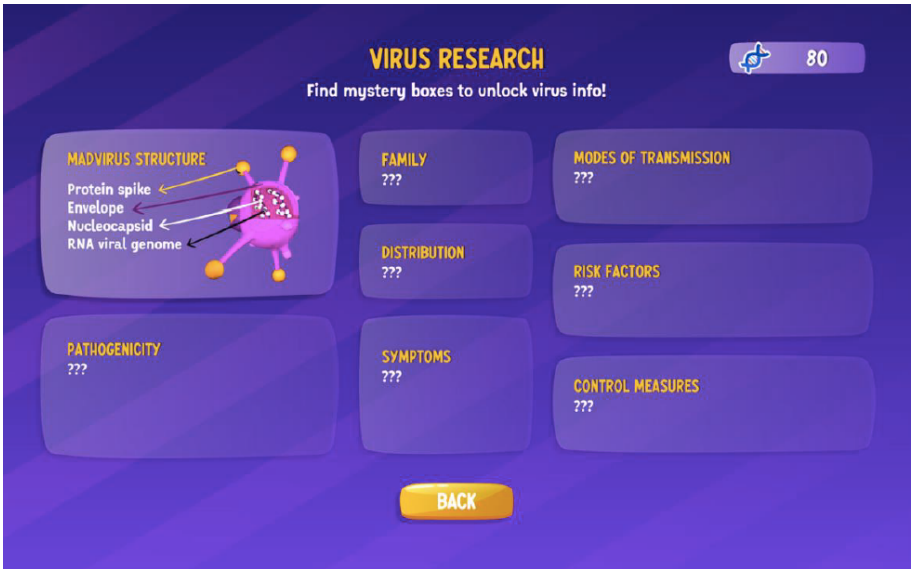


**Figure 2.** The Virus Research Panel

To progress in the game, the player may purchase the following in-game items:

- Disinfectant that refills the virologist weapon and this is particularly important given that it may inactivate viruses and reduce viral transmissions (Lin et al., 2020);
- Vaccine that acts as the player's shield within time-limit constraints. Vaccines induce immune responses and protect the individuals from viral infections. However, these may lose effectiveness given virus mutations (Louten, 2016);
- Paracetamol is used for the player to restore health-related wellbeing. Paracetamols are analgesic and antipyretic that may make the individual feel better during a viral infection and reduce the effects of its symptoms (France, 2022); and
- Antivirals that enable to deactivate nearby viruses, given its role in blocking the life cycle of the virus (e.g., attachment) and prevent its replication (Louten, 2016).

In a nutshell, the game Mutation Madness addresses the following educational content: Virus characteristics and behaviors; Prevention of viral infections; and Emergence of virus mutation and new variants.

**Game Design for Situation Awareness for Health in Times of Crisis**

A major contribution of the project PLAYMUTATION was the proposal of guidelines and practices to inform the process of designing and developing digital games to deal with health crisis scenarios.

When designing a digital platform that intends to generate awareness for a specific situation, one should consider the "perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (Endsley & Jones, 2004, p.13). As such, this is a three-stage process in terms of the user experience, i.e., perception of elements in the environment; analysis of the situation; and projection of future actions (Endsley & Jones, 2004).

Additional challenges are posed when analyzing, producing, and evaluating these artifacts with this purpose like ensuring information accuracy, updating, and putting it into context to prevent possible manipulations or misinformation especially when using a media that both fiction and facts are blended. Hence, the following recommendations are proposed:

- Ensure proximity between information sources and game developers during the initial phase corresponding to requirement analysis and initial validation.
- Carefully use the narrative to inform about the situation to not amplify fear-induced messages, panic, or conspiracy theories. Be aware of public policymaking and communication guidelines relative to crisis scenarios.
- Attend the individual's goal relative to health crisis situations – i.e., awareness of health data, goals interpretation, and prediction to achieve the goals.
- Enable role-playing of health crisis communicators and decision-makers to understand the implications of possible health policy-making and societal measures concerning healthcare crises.

In the specific case of the project PLAYMUTATION, the following recommendations arose either from the involvement of informed individuals and young adults who tested the game *Mutation Madness*: (i) Validating the information on the transmission of the virus, measures to prevent and treat viral infections as a topic; (ii) Virtual modelling of the viruses physical interactions; (iii) Showing implicitly the bio-psycho-social consequences; and (iv) Enabling players to spread the message of these activities in their social networks to increase the outreach. In terms of the game-based learning outcomes, most of the participants emphasized that the game allowed them to learn about the occurrence of virus mutations and possible ways to fight against viral infections.

## Conclusion

This research set out to establishing practices to develop virus epidemiologic-themed digital games to raise awareness for viral infections in young adults. A three-phase qualitative development was, therefore, followed under the ongoing project PLAYMUTATION: 1. Surveying twenty-six informed individuals in microbiology and game design to identify the game requirements; 2. Development of the game 'Mutation Madness'; and 3. Evaluation of the game with thirty-four young adults aged between 18 and 35. Based on the results from the first- and third- phases, a set of guidelines were outlined, including the validation of the information on the transmission of the virus, measures to prevent and treat viral infections as a topic, virtual modelling of the viruses' physical interactions, among others.

In terms of the second-phase relative to the development of the digital game *Mutation Madness*, a game design awareness process was adopted in its development, incorporating associated stimuli to the representation of viruses, comprehension of the situation, future projection, and decision-making towards a set of actions and feedback, in which the learning content was

transmitted implicitly. Beyond applying this process of designing for situation awareness to product design, there is also potential to be extended as the use of media within the city landscape. Participants have revealed that the game enabled to learn possible ways to fight and viral infections, followed with the characteristics of the viruses. Indeed, it demonstrated potential to raise knowledge about viral infections and their virus mutations and variants. Further work is being carried out in the projects PLAYMUTATION2 and YO-MEDIA: Youngsters' Media Literacy in Times of Crisis, in which game development ('Game-It-Yourself' initiatives) is being explored to foster youngsters' self-expression in health crisis and communicate (mis) representations. Games are expected to foster media trust by validating information with specialized individuals in relevant areas to the healthcare crisis, present clearly what results from fiction and reality, present different scenarios, and perspective-taking with possible actions to deal with the crisis.

Finally, it is worth emphasizing that this work advances the use of game design and development activities to self-express in times of crisis, being these contributions essential to understand the role of media development for increasing knowledge and preparedness in times of crisis.

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