GAMIFIED CRISIS FRAMEWORK: THE DEVELOPMENT OF SERIOUS GAMES FOR IMPROVING BEHAVIORS AND SKILLS WHEN FACING MAJOR DISASTERS.

BY

LUIS GRACIANO VELAZQUEZ

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Information and Media – Doctor of Philosophy

2022

ABSTRACT

GAMIFIED CRISIS FREAMEWORK: THE DEVELOPMENT OF SERIOUS GAMES FOR IMPROVING BEHAVIORS AND SKILLS WHEN FACING MAJOR DISASTERS.

By

Luis Graciano Velazquez

Every day all over the world, social, economic, health, environmental and political movements convulse and revolve with no limit. Out of these events, some may gain a status as paradigmatic, events that affect the world, marking a before and after in the territory they affect. There is always a risk to be on the path of a crisis and having to deal with the disaster that follows it. To ameliorate the repercussions of these disasters, people need to have a solid grasp on skills and behaviors that can help them better survive these events, in particular those that become paradigmatic. This study focuses on the potential for video games to be a vehicle for the fomentation of Awareness, Empathy, Knowledge & Skills, and Active Behaviors. To this end, this study proposes the creation of the Gamified Crisis framework (GCF), a guideline for researchers and creators that is based on the characteristics of the phenomena from a complete perspective that includes the societal context, the actor's characteristics, and cultural location, on top of the best practices of risk amelioration, emergency response, and recommendations on how to obtain them. To get insight into the framework's effectivity, this study conducted a qualitative study, divided in a play phase and a

questionnaire phase. The play phase is centered around a game created through the GCF by the title of “Storm Line”, which is directly based on the 2017 hurricane Maria, nurtured by a combination of existing research and the researcher’s firsthand experience conducting field research. The game is presented as a text adventure, a rudimentary but functional Twine prototype. 31 people took part of the study, 3 for in-depth interviews for preliminary questionnaire assessment, and 28 respondents of semi-structured queries. The respondents provided insightful answers that culminated in the codification of the most important themes for them, revealing that not only the framework provides with an experience that successfully conveys its themes of Awareness and Empathy, but that the game in its current state makes a better job at helping them reconsider and affirm their ow practice for Active Behaviors, and Knowledge & Skills. In this study, we also get the insight that for the games developed through the GCF, the production can benefit from more sophisticated games.

This dissertation is dedicated to those that supported and kept me going in times of strife and tribulation.

To my parents, Roberto & Natividad, who were always on my side, helping keep the faith.

To my wife Carli, whose love and understanding gave me a reason to improve myself and whose pursuit of dreams turned into reality inspired me.

To my dissertation and guidance committee, whose constant encouragement helped me navigate my professional life. Manuel Chavez for his constant mentoring and friendship. Adam Sulzdorf-Liszkiewicz, for teaching me how to be an educator on offering me a vision of what my own future could be. To Carrie Heeter and Elizabeth LaPensée, the first people to welcome me to the college, who taught me how serious games work and whose enthusiasm inspire me. And Rabindra Ratan, who showed me that academic life is what we make of it.

To my professors who mentored me and instructed me during the doctoral program and undergrad degree.

To my best friends, Juan Carlos, Jesse, Ryan, Elizabeth, and many others who reminded me to enjoy life.

And to the people of Puerto Rico, who I hope will never have to go through the same tribulations that maria left.

The fight never changes, only the battlefield.

ACKNOWLEDGMENTS

This dissertation is possible thanks to the continued support of the Media and Information Department of the Michigan State University, and the continued support of the Office for International Students and Scholars. The Fulbright-Garcia Robles Scholarship through the Fulbright program.

TABLE OF CONTENTS

LIST OF FIGURES

I.- Introduction: Crisis, Disasters, Emergencies and how to survive

Every day all over the world, social, economic, health, environmental and political movements convulse and revolve with no limit. In the past decade, no country has escaped weather events as they have increased in intensity and frequency. The recent global pandemic also has demonstrated the vulnerabilities of countries, regions, and areas due to unclear and manipulated information. In addition, the lack of tests and vaccines during the early stages of the pandemic caused confusion and undesired behaviors. Active shooter events, especially in the USA, are always possible; civil unrest can emerge at any moment, fueled by social movements, political chicanery, or ill-intentioned actors trying to create harm to further their agendas. Earthquakes and tornados are dangers that, in their historically geographical locations, cannot be dismissed, but also terrorist attacks orchestrated from without and from within could impact any place.

However, out of these hazards, natural disasters have a special place among them. While social, health, political, and economic disasters have predictors and warnings, often, natural disasters do not give clear forewarnings. Models and predictors can be made available, but in the end, the way severe weather impacts a region is up to the last whims of nature,

tracing its routes and blanketing the region with woe and destruction. Other mercifully more sporadic disasters are entirely unexpected and devastate populations without warning. Earthquakes, by far, are the ones that can strike anywhere but are more likely in geological areas where the population, for the most part, has learned how to deal with and survive them.

Growing up in the southeast region of Mexico, right along the Gulf of Mexico, experiencing severe weather and hurricanes were not strange to my family and me. An early memory that I have is of me clinging to my father, who was using a board to get us out of our house. The board was so any debris that could hurt him in the chest-deep water got deflected away from his body. I remember that despite the house being elevated and the water inside not yet reaching a critical level, we had to evacuate. Those memories will become core to me, knowing that we might need to brave the waters and get to safety at any time.

Natural disasters have the propensity to be unpredictable, sometimes giving short warnings to protect communities' lives and property. These events, aberrant and extemporaneous, are increasing in regularity and severity. For instance, hurricanes are hitting regions of the world that

historically have not been affected before, forcing the general population to now consider events that were never part of their zeitgeist to become now a possibility of harm to their livelihoods, family, and community. Furthermore, aberrant weather events are happening more often and out of season. During the summer of 2021, abnormal precipitation caused catastrophic flooding in Europe. While in December of 2021, tornados devastated six states in the central USA, causing significant damage and loss of life (WCPO, 2021).

Moreover, even communities and regions that historically prepare for such events now find themselves fighting a more arduous battle. I remember the aftermath of that flooding. The house had watermarks, some of them taller than I was back then. A few things we failed to secure along the yard had drifted away and lodged into the chain link fence. A few years later, now older, and taller, we saw the water levels rising again. This time we did not evacuate; instead, we already had a plan. My father had brought home empty oil drums, which we used to prop up beds, and, on the beds, we secured the more sensitive and delicate things. We had a strategy, and for years to come, it would be one we would use successfully.

Events are so representative of the case that future events are compared to them. When talking about natural disasters, some are cut from a different cloth; while all-natural disasters can disrupt the normalcy of people, some of these events become paradigmatic. Outbreaks of Ebola or the Covid 19 Pandemic will be part of the shared memory forever. The terrorist attacks on 9/11 are so pervasive in society that there is little need to remind the year it happened, just a month and day. In 1984 the Mexico City earthquake marked a change in the population of the megalopolis, to the point that institutions, schools, and ordinary citizens have an almost instinctual reaction to earthquakes.

Likewise, we can see civil unrest like the 2021 January 6 Insurrection in the US capital, the 1968 student protests and massacre in Mexico, or the 1989 Tiananmen Square protest. More recently, the 2017 Hurricane Maria that landed in Puerto Rico marks a before, and after of how civil and political authorities must respond to an emergency that affects a whole region.

Some of these dangers mentioned strike without warning or provocation, but others have signs leading up to them, and both can be better navigated if people caught on them only know how to react and how to ameliorate the impacts (Lindell & Perry, 2012). Different paradigmatic

events require different skills, but certain connecting elements can be applied to all of them, and those elements are the ones that, if unraveled and correctly discerned, can make a difference for people to better survive these events.

And these events are what is defined as a crisis event, an event whose impact disrupts the normalcy of life in a shocking, often unanticipated way, in which the usual way of life is disrupted, and the status quo suddenly changes (Sellnow, 2021). Crisis by nature are harmful and require immediate response by organizations capable of dealing with them because, when a crisis emerges, all sense of normality becomes uncertain. All the goals and objectives of the society are put in a state of reevaluation of priorities.

What follows a crisis is the state of disaster or catastrophe, all accepted terminologies for the strife and hardships that the population affected by a crisis goes through (Peek, et al., 2021). This state of disaster is marked by the need for institutions to help communities recover from the damages if they want to return to a sense of continuity. They are traumatic and disrupting enough that frequently, the population cannot recover by themselves and must count on that extra support to fully restore normalcy.

At some point during the final years of my living in my hometown in Mexico, I lived alone. I was fourteen at the time and had to spend weeklong periods without my parents or siblings. During one of those weeks, we were hit by yet another storm that flooded the region. Like clockwork, I exercised our usual plan of action. Rolled the empty drums into the house, lifted everything I could, and prepared to weather the storm. Luckily, on that occasion, the water did not rise more than a few inches inside our home, leaving me to clean up. But it was only after years of practice and endurance that I felt comfortable doing this. We knew severe weather could happen yearly, and we were prepared. To me, at that time, yearly floods were my paradigmatic crisis event, and I had drilled, trained, and exercised for it. But what about events I was not yet prepared for? How could I teach others to do what I did?

This is where the potential of video games can come into the picture. Video games uniquely present events in a way that the player is not only a passive witness to a story. Instead, they are participants in it; their actions and decision hinge on them quickly picking up skills, witnessing the repercussion of behaviors, and internalizing the attitudes towards not only the event but the context, actors, and causes of the event itself (Keller, 2008). Events become stories, and play becomes learning.

The context for any story is essential, as it sets the stage for the story, skills, and behaviors that the teller wishes to convey. This can be from such a general level as the geographical region where such a story happens; this regional setting affects not only the attitude towards people and countries but towards ethnicities and cultures (André, 2012). These stories also lead the player to confront their attitude toward such crises as climate change and everything surrounding it, from growing ocean levels to economic impacts. Of course, presenting players with the elements of reality also presents them with the hazards of misinformation that leads not only to violence and societal instability but to more material dangers to the well-being of themselves and those around them. And the mention of this confrontation of the context and information culminates in what can be a lofty goal: ensuring that people can see the truth of the matter and trust those working diligently to uncover it.

With this in mind, the central goal of this dissertation is to present a comprehensive and adaptable model that can be followed to produce games that can genuinely represent the context and stories behind Paradigmatic Real-World Events (PRWE). The grand objective is for this model to be helpful when creating games that have as an objective the dissemination of skills, attitudes, and behaviors that people make use of in case of crisis, a

Gamified Crisis Framework (GCF) to apply to any PRWE and to be adaptable for developers and storytellers alike.

To focus on this objective from a single standpoint for experimentation and research purposes, the research will be on hurricanes. Hurricanes, in particular, represent one of those PRWEs that affect society at several levels, and a PRWE that represents them at its most devastating is the 2017 Hurricane Maria in Puerto Rico. This hurricane affected the population in a vast but isolated region (Puerto Rico as a Caribbean Island) and was cut off from resources for extended periods. It happened during a time when society had become dependent on information technologies that, during the emergency and months after its pass, collapsed and took a long period of time to recover.

In my life, Hurricanes have an intimate meaning and implications. Maybe growing up, I did not understand that the yearly flooding of my home was caused by hurricanes or tropical storms, but as I grew up and now, in the hindsight of scientific curiosity, I can look back and comprehend that the effects that I grew up so accustomed to were in fact, the impact of several hurricanes in my region. I am no stranger to seeing communities cut off by landslides, roads overtaken by flood waters, or bridges uprooted by currents.

I grew up knowing that supplies can run short, livelihood is at risk, and that life is not as stable when you live in the path of tropical storms.

Field research on the Island of Puerto Rico led to interactions with the survivors of Hurricane Maria. During this research, I was part of a team leading to their participation with eighteen focus groups, over 200 participants of varied demographics, plus a dozen or more in-depth interviews (Chavez, et.al., 2019). Talking to these people, listening to their stories, and conversing about their experiences made it clear that what they experienced was an exacerbated version of all my young experiences. Furthermore, the motivation for undertaking this line of research is deeply rooted in personal experience and professional experience. Living in a region of the world that is prone not only to severe weather events like hurricanes, but also tectonic and societal strife led to a sense of kinship with the people of Puerto Rico, and even more, my own academic curiosity and ideals as a human being led me to the motivation to do something about it. Ever since that experience, efforts have been focused on this research theme and have made previous strides towards presenting the fruits of these efforts cohesively to put into evidence the vulnerabilities of the population.

The vulnerabilities that the population of Puerto Rico displayed during the 2017 Hurricane Maria are a result of both our modern way of living, the effect that social media has on the population compounded by the perception of trust in government translates into actual confidence in the information (Takahashi, et.al., 2020). From the reliability of modern social media and cellular networks for communication to a sense of overconfidence over past hurricanes, the way Puerto Rico suffered from hurricane Maria was not just an immediate effect of the storm but the consequences that a widespread blackout that lasted for months had on the people's health and well-being. The way the survivors of hurricane Maria speak about their experiences is enough to understand that the event was not just a bad storm; it marked a before and after in their history.

These vulnerabilities added to a unique societal standing of the country they belong to (USA) but with a lot of partisan and political incongruencies made for a case with all the (tragic) elements to demonstrate and learn from. Rules and regulations that generally enable the mainland states of the USA did not help the island in need. Despite the population in Puerto Rico being US citizens, the way that the government acted during the crisis left them to fend for themselves in many cases, making the community the primary source of support for one another, while the local government tried its best to aid and secure provisions. The impacts on their power grid, supply

chain, roads, and telecommunications were worse inland and in the most vulnerable communities. These impacts left Puerto Rico with an estimated excess of 4,000 fatalities, thousands of injuries (Kishore, et.al., 2018), and material impacts calculated at $132 Billion. (GAO, 2020).

It dawned on me that what these people needed at the time went beyond having empty oil drums to salvage their possession or a board to deflect water hazards. It dawned on me that further skills and knowledge were needed and a great medium to help foment this knowledge and skills in video games. Especially when the game is treated as a reflection of a PRWE, it has the means to not only give that knowledge and skills to those who need it but also exercise the need for empathy for those who do not. This means that while games can be a tool for those at risk of going through a PRWE like hurricane Maria, those who are (currently) safe from such disasters can also have a chance to experience and understand what these people are going through.

And while the game proposed further in this dissertation deals with a worst-case scenario that we hope will not repeat itself, it is the ultimate hope that the skills and knowledge that a fully developed experience has would provide the account and illustration of the events. After all, when

dealing with natural disasters, it is better to prepare for the worst-case scenario than to be underprepared.

II.- Literature review, past models

In this chapter, I will go through the literature that the Gamified Crisis Framework (GCF) will build upon. This includes theories about society and its actors, including how society is conformed, how people learn through society, and the connection between actors. There will be a review of crisis preparedness and communications models, the best practices and ways that trust in messages is built, and the identification of risk. Complemented by notions of gamification and the potential for games that make the medium a vehicle for learning and transportation.

Developing a model to aid in creating crisis games to help populations at risk and inform developers on the specific needs of said populations requires a multidisciplinary approach. The model will be nurtured by previous theories and models about society, crisis communication, and serious games. According to the complexity that PRWEs represent, this unique combination of disciplines is events that are not just a matter of presenting the disaster and its immediate effects but also the context and actors affected and involved with the preparation, amelioration, and recovery.

Individual, society, behavior

Starting with societal theories, the most basic ones start with Giddens' "Constitution of Society" (1984). It is widely known as structuration theory, where the practices and traditions of society reflect historical accumulation, adaptation, and integration into a structure that gives way to society as we know it. Within Structuration theory, the actions and practices of the actors enter a loop of duality, where the structure is created from the traditions and customs while at the same time the structure gives way to customs and practices. There is a constant need to maintain the interaction between the structures representing the external forces, institutions and norms, and actors' agency bound by their internal motivations and desires (Giddens, 1984). In a way, structuration theory focuses on the role of the individual but is always affected by what society has already accepted as the norm and set conduct.

This simple start to how society is an interaction between the individual and the societal environment will be important when developing the protagonists in stories, so the focus is not lost that this is an actor in a structure that has been built around them and how those social structures create norms and thus behaviors. Furthermore, it is within those behaviors

and structures that the actors that the players will interact with will convey the nature of the society however, as situations become more complicated and interconnected, Giddens alone cannot fully grasp the scope of the modern world (Genov, 2019) instead there is a need to complement this approach with more ways of understanding society.

The Social Cognitive Theory (SCT), introduced by Albert Bandura (1986), is a widely recognized, widely used theory for understanding knowledge acquisition. SCT proposes that learning is a social phenomenon that can only happen when the actors are present in a context where observation of others is present and allows for the acquisition of knowledge and, to a degree, a continuation of the values and proficiencies carried through the duration of not only society but order. SCT proposes a reciprocal determinism concerned more with the interaction between actors and the environment. While considering the environment, the context that is compromised by society and the values that have been deposited in it, which becomes even more evident and rich by combining it with the structuration theory, where that structure is determined by the customs and actions of the individual actors, making it a self-informing process (Giddens, 1984).

By doing this, society becomes a series of repetition and reaffirmation of behaviors that can be attributed to a set of expectations, not only those determined by the structures of power but also those reinforced by peers and authorities. And the means how an actor can learn these is through Self-efficacy and Behavioral capability. These two elements are needed for actors to participate in society. Behavioral capacity deals with the basic requirements for the actor to perform, and self-efficacy is the sense that the actor has on themselves to partake in the required, expected, and reinforced behaviors. (Bandura 1986).

SCT is built on the principle that observing situations play out leads to the acquisition of behaviors and practices. And that principle follows a specific component that explains the process. Starting with self-efficacy, this component of SCT is one of the critical factors that enable learning: the belief that the actor is able to perform the behavior that is presented, that being the action depicted. Behavior capability is closely followed, where if self-efficacy is the belief that an actor can perform, behavior capability is the necessary acknowledgment that the actor processes the abilities and skills required to perform this. These two elements are in a balance, where if we wish to impart the knowledge, we must make it so that a person can believe they have the skill and the means to perform an action, even if such performance has just been acquired. These, however, have to be regulated

by a sense of self-control, meaning that there is a limit to what behaviors need to be considered doable in which situations. Following up with these essential elements of SCT, expectations and expectancies are tied with the result of the behavior and actions with the value of diverging from previously held behaviors. That means the advantage of performing in the way proposed, even allowing for the addition of reinforcement of behavior with encouragement (Bandura 1986, 2009).

SCT is useful when it is used to understand why the representation of certain elements of society are put in media and helps the consumers of said media to process what they are seen (Bandura, 2009). SCT has its limits, primarily when quantifying the effects is concerned, as measuring the internal cognitive processes of the observed actors in society is difficult. Still, for the study and explanation of behavior from a qualitative manner, it offers a great way to understand how people learn within their context and how we can help others learn about the situation that is not familiar to them (Nabi & Clark, 2008). Furthermore, it is well documented that the principles of SCT are relevant to games and learning, taking advantage of the affordance and self-efficacy that SCT is built upon (Homer, Raffaele & Henderson, 2020). In particular, there is support for games helping with behavioral change when paired with well-designed stimuli, but so far, this has focused on health and hard skills (Kim, et.al., 2020; Muhamad & Kim, 2020).

Societal theories can only carry us so far, but to understand the individual or actor involved in the stories to be told, they are a good start, and keeping the references clean and well organized with basic but essential theories is necessary. SCT and Structuration Theory carry with them the building blocks that we can use to support the Gamified Crisis Framework (GCF), at least from the angle of actor, society, and understanding how gamification of a disaster situation can help with the learning of best practices and behaviors during a time of peril. However, we need a different approach that can only be seen in disaster literature and crisis communication regarding perception and behaviors before, during, and after a paradigmatic real-world event (PRWE) or crisis events in general.

Disasters and emergencies

When dealing with how people prepare for a disaster, specific mechanisms take place in their minds. These processes usually involve key factors like information and trust, which will come into play as the models are adapted to provide for the GCF. People need to take in the information being provided; whether this is from the news media, their social circle, their traditional uses, customs, or simple personal intuition, people respond to emergencies they can understand. But how we understand how people react

and internalize these episodes of peril is where the literature about disasters comes into play.

As mentioned earlier, a crisis may cause a disaster. For crisis communication scholars, a crisis is the event, traumatic, sudden, often unexpected situation that comes and disrupts the normalcy that the population often hopes for, and what follows with the disrupted normality is the disaster, where the institution and people must do their utmost best to recover (Sellnow, 2021; Peek, et.al, 2021). These two states are in tandem, which prompts the need to be prepared to face both, each having some difference in their approach, causes, and consequences, but closely related and inseparable from one another.

Crises can largely be seen as the result of not heeding the warnings of risk assessments and caution, in a way, seeing that the disaster is the risk that has come to function and affects those who had been put in their wake (Sellnow, 2021). A crisis, in a way, is a breakdown of all the safety nets and precautions that the institutions and individuals put into keeping themselves and their communities safe. Some of these breakages might be more obvious than others; for example, living in an area that is prone to hurricanes might be inevitable for some, whether because of personal,

societal, or economic restrictions, mobility is not always possible for everyone, and displacing entire population out of these areas might be simply not feasible. Building structures to withstand the force of the storms might be an answer, you are still at risk, but the risk is minimized by having something to combat it. However, for several reasons, you might be unable to build with the best material. And so, this is the cycle of risk into a crisis that leads to a disaster (Sellnow, 2021).

So, once all the means by which people try to ameliorate risk within their capacity break when a crisis happens, the crisis is a moment, an event, the flash in the sky as the space shuttle disintegrated and the debris came catering down to earth, the moments as an earthquake rage, or the day and night that a hurricane traverses a region (Sellnow, 2021), the crisis passes. The status quo changes, normalcy is interrupted, and the state of disaster begins. The state of disaster or catastrophe (Sometimes interchangeable, sometimes indicating that a catastrophe is larger than a disaster) reveals the weaknesses and breakages of society, institutions, and government but also reveals the morality, preparedness, and goodwill of the same (Peek, et.al, 2021). Id the crisis is risk realized; the disaster is its reevaluation. While the state of disaster is where the behavior of the population comes to shine, and where their motives and connection to their peers are revealed, and while we could hope to expect that everyone comes together to help in some

capacity, it is also true that some are unable to react due to trauma, those who shut off to protect their own and even those who seek to have selfish gains during those times of strife (Peek, et.al., 2021)

Proposed as a way to explain the perception of risk, the Mileti Model divides perception into forces that are moderated by the characteristics of the information and the characteristic of the receivers; in this case, the actors or players (Mileti & Fitzpatrick, 1992). This is fundamental when conveying information during a PRWE. This is the public perception of risk information coming from diverse sources and the necessity to discern which are reliable and which are not. This assessment is not devoid of nuance; the public perception of risk information is equated to the sender's characteristics, which could be the official sources, casual acquaintances, social circles, or personal beliefs, but they always have key elements that add to the information's credibility.

The characteristics of the information in accordance with Mileti & Fitzpatrick include the following: specificity, consistency, accuracy, clarity, a relevant channel, adequate frequency, trusted origin, and a solid process of distribution and ratification (Mileti & Fitzpatrick, 1992). When it comes to defining a message for what it needs to convey, these are excellent starting

points that can lead to the understanding and acceptance of the information and lead to the preparedness and amelioration of crises situations (Guo, et.al., 2022).

The Mileti model also is concerned with the nature of the public's characteristics. In this case, it is the nature of the receiver, such as the network that surrounds the receiver, the resources available, their demographics, their main activities, existing knowledge, cognition characteristics (how these groups usually react to emergencies), experience, and proximity to the disaster (Mileti & Fitzpatrick, 1992). In a situation of emergency, the model and these information characteristics explain how the information is valued and makes it so it becomes understandable, trusted, and becomes something that relates directly to the person. As mediators, the public perception of risk and the public's characteristics give way to the public's risk perception, enabling the actors' understanding, belief, and personalization. This leads to public behavior; if the message manages to get its core objective through would result in the preparedness for emergency and mitigation of the aftermath.

During the 2017 hurricane Maria, several elements brought up by the Mileti model were brought to light, though in the worst possible way. The

message, disseminated to mitigate the impact of the weather event, was broken up before, during, and after the disaster. Hurricane Maria was preceded by hurricane Irma in just the space of fewer than 20 days. However, what the survivors of the hurricane told visiting scholars was that hurricane Irma was publicized as a powerful storm in the media and official message, and while Irma's impacts were substantial, the damages were less noticeable (Takahashi, et.al., 2020).

With a public characteristic where the population is already in a strenuous relationship with the government, by the time Hurricane Maria was due to make landfall, some people brushed aside the warning as another over-hyped event or as a storm that would be diverted as many others before did. In accordance with the Mileti model, the public perception of risk information had lost some of its characteristics, certainty, and accuracy and was now in doubt. However, an element that needs to be explored is how and why people react the way they do.

Where the Mileti model explores the characteristics of message reception and message nature and sees it lead to behavioral responses (Pidgeon, et.al., 2003), the Protective Action Decision Model (PADM) goes into further detail about how something is considered dangerous and how

situational facilitators and impediments can affect the way people react, meaning their decision to act during an emergency (Lindell & Perry, 2012). The PADM shares some of the same concerns as the Mileti model, particularly regarding the nature of the message and the receiver. However, the behaviors also consider how the environment and society cues might interfere with the decisions those affected might make. This immediately affects the exposure, attention, and comprehension that the message gets, affecting the behavioral responses.

Ideally, the PADM expects the population's behaviors to lead them to search for accurate and correct information, to take actions that will protect their well-being, and find proper ways to emotionally cope with the situation. However, the PADM acknowledges that some situational impediments and facilitators make those behaviors possible (Lindell & Perry, 2012). Facilitators can include a reliable infrastructure, solid emergency response institutions, and their own populations' socioeconomic status, while things like remote access to supplies, inadequate infrastructure, and fractured response protocols could lead to impediments for the population to have positive behaviors.

In this case, the PADM's concern with these situational elements in real-world applications is obvious: It is a way to account for aspects of social disparity, endemic disadvantages, and situational factors in cases of disasters. These elements are essential when creating relationships between the context, actor, and information, as they relate directly to those components. This is particularly a critical element when creating messages, especially when the technology in place is elemental for the well-being of those at risk. Both in the imminent threat of a disaster or to prevent the worse of a recurrent situation (Sutton & Wood, 2022). In Puerto Rico, the failures of facilitators resulted in the zones closer to the capital and the developed urban housing complexes having access to more resources than those that suffered from the impediments of being located in distant settlements or those without access to the technology and messages that could have helped the population to better cope with the situation.

However, thus far, we have only considered messages from trusted sources and official institutions. Whether or not these are the most reliable or if the institution itself is faithful to the population, there still needs to be a reckoning with the rise of false information.

The rise of fake news, distrust, and negative behaviors impact the efforts to disseminate life-saving messages. The "Social Amplification of Risk Framework" (SARF) is a model that will help explain and understand the process (Kasperson, et.al., 1988). SARF has the particularity to focus on the value that actors put on the sources, through how close to them the ideologies of the structure bringing information is, whether or not they historically trust it. This makes the SARF consider an impact that happens at the personal level but has societal repercussions. The dangers of misinformation and badly relayed information, as well as the consequences of bad decisions by using the wrong sources, are some elements derived from utilizing the SARF.

The SARF also acknowledges a ripple effect that is centered on the individual, and while this is something that mainly was designed to deal with corporate risk assessment, it is also an indicator of how the decision taken at a personal level has consequences that directly affect those around the person (Kasperson, Et.al, 1988). This is because SARF, both on its inception and more contemporary revisions, puts in evidence the process of how information is created. The primary source for an actor is another actor, but that actor's information is synthesized from another source, and that source gets the information from a specific structure and organization (Kasperson, et.al., 1988). The message becomes a product of competence, objectivity,

fairness, consistency, and good faith, thus giving it credibility and confidence. But how the individual assigns those values to the message can be easily subverted by the presence of bad actors, their own ideologies, and behavior (Pidgeon, et.al., 2003).

Thus, by implementing messages that had a variety of impacts and consequences, as seen in the Maria disaster in Puerto Rico, it is possible to show the players the consequences of investing trust in sources that are not adequate and the danger that this might have not only on their personal safety and well-being but that of their community (Pidgeon, et.al., 2003). Furthermore, the way information flows in the case of emergency are seen as the mediation as to how people will acknowledge or disregard the necessity for evacuations, depending on how their proximity to safe areas might impact such movement (Jaiswal, 2021). And this is true not only for the direct impact of an emergency but also for the consequences of the main event, both because of actions and behaviors before the emergency and those taken during the emergency (West, et.al, 2021).

Gamification

Messages, context, actors, and society have so far been well established, and it is essential to mention that if we were trying to only explain how these elements interact with one another, it would be sufficient to build up to this moment. However, when the objective of the GCF is to gamify crises, it is necessary to understand the means through how games can be that medium to enable people to better grasp messages. But even more important is how to build a certain empathy for those affected to raise awareness and see the bigger picture of PRWEs, like hurricanes, that are potentially getting worse due to climate change, plus the role that society, government, and accountability of government has (Olivier, et.al., 2019).

Transportation is an effect that can be observed in different media where the affective power of narrative creates in the viewer a feeling of personification and relation (Mahood & Hanus, 2017). This is important for the GCF, especially when trying to reach actors not immediately affected by the impacts of ever-worsening weather.

The essential element of transportation is taking elements from reality (Mahood & Hanus, 2017). And the GCF focuses on the context and research

on the aspects surrounding the PRWEs. Identifying and relating to the people involved in PRWEs is vital when the objective is for the actors far away from the center of the crisis to have a link and a concern for the well-being of peers (Cohen, 2001). Furthermore, games that have people make choices and interact with the situation of others tend to build up empathy and compassion for those who are afflicted by these situations (Farber & Schrier, 2021), especially when we adopt a model where the player has the agency to make decisions and see the actions play out and developing empathy towards those in the situations as mentioned earlier (Wang, Singhal, 2009).

With the models and theories in place and knowing that games have the potential to help people experience empathy and compassion for others, we now also turn to the element of knowledge and skill, which games have support for their potential as tools to impart them (Ypsilanti, Vivas, Räisänen, Viitala, Ijäs, & Ropes, 2014). For this, an effort to gamify an experience needs to be undertaken. Finding the correct PRWEs and unraveling them from enough perspectives to make it evident that the role of the individual has a more significant impact on their well-being, then putting that into a format that can help them experience the situation and learn from it to improve the future of their response to emergencies. Gamification is made with the hopes that portraying some aspects into an

organized experience where the player is in control can come out with better understanding and knowledge. In particular, gamified experiences tend to have a positive outcome regarding quantifiable performance tests for skills, while there is emergent support for social skills where players might better understand soft skills (Majuri, et.al, 2018). Even cursory exposure to these experiences can make a difference; even more, exposure serves as a viable way of learning (Boyle et al, 2016).

In order to do this, gamification relies on several mechanisms for guidance, but that is ultimately in the hands of developers and creators of games. Some of the elements that traditional gamification offers is a way to track progress; in some simple interactions, this can be achieved by awarding achievements or keeping rankings. Social factors can be introduced with roles for other players, while different motivations to stay on task can be used in environments like organizational performance (Cassone, 2016). However, when it pertains to the gamification of a PRWE, immersion elements should come first, where the player is more concerned with seeing their character's outcomes, the skills they exercise working or failing, and the decisions having consequences in the story (Majuri, et.al., 2018). And, of course, having these scenarios of life-threatening situations play out where the player is safe and can actually see the consequences of their action reinforces the experience (Breuer & Bente, 2010).

So far, the games and research that have been made in an effort to bring crisis management to the forefront have found themselves limited by the scope and necessity of immediate analysis. Creating games that are more focused on skills and knowledge rather than the whole context of culture, society, and politics are even rarer. But those games trying to bring forth the issue of disasters and their consequences have found themselves well received; if urgently needed, a different approach and more research to further solidify the feasibility and reach (Solinska-Nowak, et al., 2018). And the reach of games is not limited to the consumer, youth, or general population level. Instead, games were created with the specific objective of bolstering resilience and preparing first responders for situations that are not seen every day (Massive casualties), where behaviors and attitudes during can mean the difference between life and death (Tomaszewski et al., 2020). And they are well documented as effective training tools in diverse industrial environments and limited scoped events where the extent of an emergency is concentrated (Bruzzone, et.al., 2018).

Games about disasters are limited, but research shows interest in adopting them more from a basic education standpoint. In some subjects, games about disasters can help students understand the connection between environment and population (Gampell, et.al., 2020). However, so far, the focus is on the educators and pupils, learning mechanical skills and some

basic knowledge, but missing the emotional and empathy aspect required in an interconnected world (Gampell, et.al., 2017). Though there are various efforts to implement traditional, in-person games that can benefit youth to acquire practical skills to be used in times of emergency, recontextualizing certain behaviors that can help them better understand emergencies, starting with how to discern when something is an emergency (Nur & Wijaya, 2021).

Further literature about formal research into serious games for crisis and disasters is limited, as the field is emerging. Efforts to show how gamification benefits work and education are emerging regarding serious games and corporate interests. But these components are yet to transcend to the subject of the crisis in a comprehensive manner, and even less when the objective of the research is to reach out to game creators and to make sure that the context, actors, events, and situations are portrayed in such a way the experience is not only a tool for learning but also a tool for promoting empathy.

Which makes this a particularly auspicious moment to introduce the Gamified Crisis Framework. Some efforts have been made by official agencies: FEMA helped create the "Cyber Ready Community Game," a board

and card game that focuses on backing up personal data and some preparedness, the Red Cross has some activity books, and the app "Monster Guard" with some instructional potential, but so far those efforts leave by the wayside deeper elements of society and personalization that make them more akin to instructions rather than experiences.

In this chapter, I presented the previous work in which the GCF builds its principle, bringing the different elements that help inform each of the aspects that will be appropriately explained in chapter IV.

III.- Methodology and procedures

This chapter discusses the methodology to be used, which includes selecting the ample, the participant recruiting strategies, and the questionnaire. The study focuses on how people perceive a game created with the specific objective of informing, training, and confronting the reality of natural disasters. In addition, I will delineate how I will be conducting the coding of the data and its analysis.

Overview

The Gamified Crisis Framework (GCF), in its inception, has the objective of being a set of guidelines that both scholars and developers can use to create games that focus on Paradigmatic Real-World Events (PRWEs) and not lose the focus form the context and how it informs and guides towards the desirable outcomes that the experience created had.

To help understand how the model works in a real-world scenario and make use of the extensive knowledge that the researcher has about the 2017 hurricane Maria in Puerto Rico, it has concluded that in its current

iteration, the present study will be a qualitative analysis that comprises three phases: a gameplay phase that will have the participants through the game Storm line. A semi-structured interview phase will be applied to three selected participants whose answers will help refine the question for the questionnaire. A phase of semi-structured questionnaires to be applied to 28 participants, and an analytical phase will focus on coding, double coding, and detailed analysis of the categories and themes identified. Because this is a qualitative study, the interview, questionnaire, and analysis will focus on the participant's existing knowledge and how it might be transformed by playing a game inspired by the PRWE of Hurricane Maria and created following the guidelines that the GCF lays down.

The qualitative study, combined with a game created specifically for the case of the 2017 Hurricane Maria, offers a unique combination of methodologies. The qualitative analysis will be rigorous and the conclusions rich in information and perspectives, while the games are a creation fueled by my mediatic research and firsthand experience of the event. Not only that, but the iteration of this creation is also solely dedicated to this study, making it a guiding narrative that will reflect the interest of the study while giving the participants agency to make decisions.

In section V of this work, the details and nuances of Storm Line will be elaborated on, as well as how its creation was fully supported by the guidelines in the GCF (detailed in chapter IV). To briefly summarize and to have an idea of what the gameplay phase of this study will be, Storm Line is a Twine prototype. Twine prototypes are helpful in game development as they represent a convenient way to illustrate a narrative flow and can even use multiple choices and narrative lines that change as the player goes through it. Twine prototypes also allow for some embellishments that are easy to manage and do not detract from the experience. Adding illustrations and formatting text can be effective in keeping the attention of the player, though this is also because the gameplay experience is designed to be brief and concise, with game sessions that should not take more than 30 minutes for someone who has an average grasp of the English Language and has some experience with games. Having the participants play the game and take an in-depth questionnaire no more than 24 hours later should help the researcher answer the research questions previously discussed.

Research Questions

Because the study and this dissertation must be of an explorative nature, research questions are the most valuable guides. These questions

are at the heart of the interview design, in which queries regarding awareness, empathy, competency, and behaviors are formulated based on the brief gameplay the participants undertook. As a central question, I propose this.

RQ: What elements of serious games can help people who are at risk to better face a crisis situation?

With this central question in place, we can identify which of the elements of Empathy, Competency, Actionable behaviors, and Awareness are considered the most important by participants. The interviews and study analysis will bring a unique perspective on the matter, contrasting and comparing the value of each of the outcomes. Therefore, I am proposing the following additional research questions:

RQ1: How might serious games about hurricanes help populations at risk improve their risk perceptions when faced with a hurricane crisis?

Queries regarding awareness will help answer this RQ. Awareness will include the event itself, why it was so severe, and the role of climate

change. By linking this to the awareness of action and consequences by diverse groups in society, it will be better understood, and an answer can be better articulated (Kasperson, et.al., 1988). Awareness needs to be focused on the function of the category of PRWE that hurricanes are, in this, case, hurricanes, and even more in particular, the 2017 Puerto Rico's Hurricane Maria.

RQ2: How does playing serious games regarding Hurricanes change the perception of vulnerable populations?

Queries regarding empathy will help answer this RQ by considering how the participants' opinion regarding the people that are at risk is expressed (Wang, Singhal, 2009). This can be whether in the function of they being adjacent to the population at risk, members of that population, or distant, but hopefully aware and empathetic towards that population. Not only that, but it will also be richly understood by seeing how the participants relate to the other's experiences from a perspective of their own. Either by finding homologs or through the new experience itself, especially if the relationship to the key population that the game is evoking, the survivors of Hurricane Maria, is underlined (Olivier, Et.Al., 2019).

RQ3: How does playing serious games about hurricanes change the skills that populations at risk have when facing a hurricane crisis?

Competency questions will help answer this RQ, including their competencies in finding information, listening to trusted sources, and disregarding fearmongering and unverified sources. Not only will the experience with the interactive media give them some basic pointers about how to better deal with hurricanes, but it should also provide them with a few new skills that might not have been considered before, and even if the interaction with the medium is brief, it should be noticeable (Boyle et al, 2016). This question will also address the participants' existing knowledge, and even if the current iteration of the game is brief on those skills, it might point or reinforce existing skills.

Not only that, but the experience should also serve as a safe space to demonstrate the consequences of the actions taken, further reinforcing the skills needed to prevent bodily harm in others or even the potential for ham on oneself (Breuer & Bente, 2010).

RQ4: How does playing serious games about hurricanes change the behaviors that populations at risk have when faced with a hurricane crisis?

Focusing on the Behavior aspects, it is essential to discern what elements of behaviors we are reaching with the framework's guidance. Questions about Actionable behaviors will help answer this question. Behaviors need to be linked to skills to a certain degree, but as a standalone, these are more related to the capacity to act and react when faced with a situation where life is in danger and the venues of information that are not always evident (Lindell & Perry, 2012). Like skills and competencies, it is essential to also have shown the consequences of the actions, but instead of showing the outcome of skills, it would be the outcome of decisions that can include the focus of the situation or social support of immediately available sources (Breuer & Bente, 2010).

Sampling

For this study, 31 participants will be asked to play through the prototype of Storm Line. Out of these 31 participants, 3 were interviewed in-depth face to face for the objective of assessing and refining the

questionnaire. 28 will fill out in-depth questionnaires no more than 24 hours after their gameplay phase, so the experience is fresh in their minds but long enough that they have time to meditate and reflect on the game. The participants for this study will be recruited mainly from regions where hurricanes are commonplace. A particular push will be made for participants in more vulnerable regions like Puerto Rico, Mexico, Central America, the Southern USA (in particular the gulf area), and the Caribbean. Recruitment will start from publicly available gaming communities on Twitter, Facebook, and Twitter and will snowball from administrators to users.

Relying on gaming communities is multifold: gamers, even those in Spanish-speaking countries, are more likely to have some degree of English proficiency and game literacy that will enable the application of the game and subsequent Zoom interview to go without further complications. Ideally, interviews will be conducted in English, so this existing population of people with some language proficiency helps immensely. Though if the interviewee requests it, the interview will be conducted in Spanish, the game will always be in English.

Participants will be compensated for their time to incentivize participation, and an offer of thirty dollars per participant will be publicly

announced. Some of the scouted groups include "Puerto Rico Video Gamers" (Puerto Rico), "Puerto Rico Board Gamers Association" (Puerto Rico), "Florida Gamers" on Facebook, which are promising to create snowballing, as well as reaching out to video game content creators on Twitter.

Interviews and Questionnaires

When conducting qualitative research, particularly qualitative research that seeks to answer questions like the ones portrayed in this study, interviews are, without a doubt, one of the most revealing tools available to a researcher. Conducting a limited number of exploratory interviews with well-selected participants can enable research to streamline data collection into an in-depth questionnaire (Lindlof & Taylor, 2017). Especially when the research project involves a single researcher and when the answers sought need to be detailed and from an intimate perspective, interviews and in-depth questionnaires serve as a means to let the participants let their words flow and for their ideas and opinions inform the answers.

The richness of interview answers comes from the rapport and personal attention the researcher creates while interacting with the participant. In the case of the present study, the interviewer will also make

use of the advantage that they are also someone who has experienced hardships regarding hurricanes and other severe weather events, as well as a personal interest in video games, and if required, even sharing on the native language of the participants (Hesse-Biber & Leavy, 2011).

The questionnaire follows in this wake to improve the questions and structure it in such a way that the answers are akin to those conducted in the interview, if more direct and punctual (Hesse-Biber & Leavy, 2011). Of course, special care has to be taken where the rapport of the interviewer might backfire, the data obtained might be biased if the conversation isn't kept professional and focused or if the interviewee isn't on the level of maintaining answers within an acceptable level of formality (Brinkmann, 2017), a problem that will not be carried over once the participants start filling up in-depth questionnaires. This does not mean that participants will be required to speak or write academically, but a proper balance needs to be achieved.

The interview will not last more than 1 hour, and as mentioned before, it follows a period of gameplay. The interview is meant to be semi-structured; the questions at the end of this chapter are the guidelines for the conversation and are used to focus and re-center the interviewee. The

questionnaire will be structured around the interview questions, summarizing, or expanding as needed to attain answers that aid in understanding the participants. In addition to initial queries and instructions, the guiding questions are divided into five categories, 4 of which are directly related to our research questions regarding Awareness, Empathy, Knowledge & Skills, and Active Behaviors.

Participants will sign up for the study through the researcher's email; in turn, the participant will fill up a simple form with some basic demographic information and be given a link to the game. This form will include a copy of the consent form, the terms of participation explained, and further details for contact instructed. Participants should contact the researcher after the gameplay phase of the study to schedule their interview slot, and their compensation will be delivered via PayPal once the interview is complete; voice confirmation will be given during the interview. Exploratory interviews with three selected participants will aid in the refinement of the questionnaire. This sign-up and process of consent for the questionnaire are the same as the interview, allowing the participants time to play and write their answers, under the knowledge that answers need to be developed and be considered valid.

Data Analysis

Once responses are completed and compiled with the demographic data acquired from the sign-up form, the data analysis will begin. Having some demographics will help us understand better the participants and where they stand in their Interviews will be transcribed and, if necessary, translated to have all data in a uniform format.

For data analysis, coding and double coding is the best way to go. Grounded theory tends to be the go-to for this kind of study and allows what the participants have shared with us really guides the answers to the research questions in their own words (Hesse-Biber & Leavy, 2011). A series of codes will enable and facilitate the researcher to uncover what is essential to the participants and how it links to their experience playing the game. By allowing the answers to reveal the critical themes that the participant focused on and acknowledging the dynamism of individual opinions, and finding the consensus and agreement, the researchers will be able to classify the salient information regarding Awareness, Empathy, Knowledge, and behavior which will give the insight to answer the research questions (Charmaz, et.al., 2018). Following are the questions to be operationalized during the interviews:

Individual Interview questions

I.- Awareness Questions:

1.1 Before Playing this game, did you know about the 2017 Puerto Rico's Hurricane Maria?

1.2. Did you identify the game setting is based around Hurricane Maria?

What is your experience with severe weather events? Hurricanes?

1.3. Do you think Hurricanes are changing?

1.4. Have you been affected by any hurricanes?

II.- Empathy questions:

2.1. Who are the most vulnerable to hurricanes in your area?

2.2. Thinking about hurricane Maria and after learning the game scenario is inspired by it, do you see similarities with your own experiences?

2.3. Does it put your experiences in a social community context?

2.4. In game, did you share any information with one of the npcs? Why and what type of information?

2.5. In that same interaction you are given the chance to help someone not a member of your family, what did you do? Why? What was the consequence?

III.- Knowledge & Skills questions:

3.1. You are from ****** and you tell me this region is in ******.

3.2. You are currently living at ****.

3.3. Do you have a plan to protect yourself and your family, and others in case of emergencies?

3.4. What emergencies are you prepared for?

3.5. How are you prepared for emergencies?

3.6. In the game, at the very beginning, you are given the chance to make sure everything is safe before calling out the rest of your family.

3.7. Did you Check for any potential dangers?

3.8. What is your plan regarding evacuation during a severe weather event?

3.8. Do you have a preparedness kit?

3.9. If you were in a situation where evacuation was not an option what would you do?

3.10. Do you think the family in the game did the right thing?

IV.- Active behavior questions:

4.1. When a severe weather event or Hurricane is projected to impact you, where do you find information?

4.2. What do you focus on?

4.3. What are your sources, do you think they are reliable?

4.4. How do you keep in touch with other members of your family/social circle?

4.5. What would you do if you no longer have access to your usual means of communication?

V.- Follow up questions:

5.1 Any personal experience or comments you would like to share?

5.2. Do you think the game presented something you had not considered?

5.3. Of all our questions today, which one do you think was the most important?

The interviews conducted in the early phase of the study helped condense and prepare the following questionnaire questions.

Final Questionnaire

A.- Awareness questions:

1.a. What is your experience with severe weather events?

2.a. Ever had experience with Hurricanes?

3.a. Do you think Hurricanes are changing?

4.a. To what extend have you been personally affected by hurricanes?

5.a. Before Playing this game, did you know about the 2017 Puerto Rico's Hurricane Maria? What did you know or what do you think the event was?

6.a. Did you identify the game setting is based around Hurricane Maria? What Clue you in or how do you think the game represents Hurricane Maria

B.- Empathy Questions:

1.b. Who are the most vulnerable to hurricanes or severe weather in your area?

2.b. Thinking about hurricane Maria and after learning the game scenario is inspired by it, do you see similarities with your own experiences?

3.b. After playing the game, how do you see yourself as part of a society or community with people who are vulnerable to hurricane/severe weather events?

4.b. Does it put your experiences in a social community context? Why did you or why you wouldn't share information?

5.b. During the game you have the option to help a character that is not part of your family. Did you help them? did you Share information? What where the consequences?

C.- Knowledge & Skills questions:

1.c. Do you have a plan to protect yourself and your family, and others in case of emergencies?

2.c. What does it cover (as in what kind of emergencies) and how?

3.c. In the game, at the beginning, you are given the chance to make sure everything is safe before calling out the rest of your family from the bathroom. Did you Check for any potential dangers? Are the two potential hazards presented in the game something you were aware of/knew to check for?

4.c. What is your plan regarding evacuation during an emergency? do you have emergency supplies or emergency kits?

5.c. Do you think the family prepared well for their emergency? Why?

D.- Active Behavior questions:

1.d. When a severe weather event or Hurricane is projected to impact you, where do you find information?

2.d. What kind of information do you usually focus on?

3.d. How do you know that the information you are getting is reliable?

4.d. How do you keep in touch with other members of your family/social circle?

5.d. What would you do if you no longer have access to your usual means of communication?

E.- Follow up:

1.e. Any personal experience or comments you would like to share?

2.e. Do you think the game presented something you had not considered before? what was it, and why?

3.e. Which of the previous questions do you think was the most important and why?

In this chapter, I detailed the methodology for a study aimed at assessing the most critical elements of Awareness, Empathy, Knowledge &

Skills, and Active Behaviors that the GCF, through the game Storm Line, aims to impart. The analysis was also laid out, focusing on coding to discern what the participants point the answers to in an effort to better understand the position of actual players.

IV.- Gamified Crisis Framework: Detailing and guidelines

In this chapter, I will detail every element that compromises the Gamified Crisis Framework (GCF), its connection to Paradigmatic Real-World Events (PRWEs), and how the game is nurtured by each of the elements, preparing for a gamification process that ideally will bring the outcomes of Awareness, Empathy, Knowledge & Skills (Competence), and Active Behaviors.

The Gamified Crisis Framework (GCF) is the effort to create a simple guideline that developers and researchers can lean on to develop games that accurately represent Paradigmatic Real-World Events (PRWEs). As discussed earlier, PRWEs can be any number of events that represent a before and after, an event that becomes the representation of how grave a situation can be, and how people, government, and institutions should or should not act during these events. It is important to remark that PRWEs are not limited to natural phenomena; instead, the objective of the GCF is to be workable within the real world for any kind of event. For example, when studying an event like the 1968 Mexico Student demonstrations, the model can guide creators on how to approach their research to deduce what the motivations of both demonstrators and government, the motivations behind talking

points, and the importance of the geographical location and the society at the time.

The model is divided into three levels, each representing a level of abstraction derived from the Real World, Interactive media, and the personal outcomes at the player level. In these three levels, there is a progression of creation and an expectation of results that creators and researchers alike will find intuitive and rich. The model is a guideline, a pattern that can be adjusted and made as vast or compact as possible. As long as the proposed elements are included, the richness of the original PRWE will be successfully implemented as a game. The model is meant to be simple to accommodate but substantial in how it can be potentially populated by the elements leading from one step to the other.

Paradigmatic Real-World Events (PRWEs)

The real-world level is determined by the PRWEs, and these are the subject matter that the game will be focusing on. At this level, developers and researchers can find the real-world inspiration and elements that games require to convey the message they aim to convey. It is essential to properly define these elements, as their composition and imputed data will determine

how the game elements will behave. The information gathered from PRWEs, and the subsequent document created is meant to be flexible in its details and scope. Some PRWEs results can be simplified but well-informed and meaningful; others can be extensive and detailed. In the end, the PRWE report is only as comprehensive as the interactive media requires it and is informed by as much information as deemed necessary.

As to how to obtain the information that needs to be entered into the model, it is as flexible as the model itself. In the researcher's opinion, qualitative, firsthand accounts can perfectly complement archival and statical data, as well as proper literature created by trusted sources like government agencies, voluntary corps, and expert manuals. In historical contexts, of events far in the past, historical records can aid in the population of the PRWE portion of the model.

Socio-Economic Elements

This is the way the setting of the game works from governance and economic standpoint. The ideology system of the region is understood by the structures of society that compose the reality of the setting and the interaction between actors and these structures (Giddens, 1984). This

represents, to a certain degree, the potential level of infrastructure integrity available to the region and its wealth in economic and environmental diversity. Government is included here as a force that needs to be considered in particular when talking about PRWEs that involve societal struggles and institutional responses, including, but not limited to, their power of peacekeeping, crisis response, and executive decisions in times of emergencies.

This element of the model is better suited to be populated by general information from textbooks if dealing with settings in the past. Or current available governmental reports as well as contemporary studies regarding the state of a region in the function of infrastructure and governance. As for the economic level, this is a way to understand how money and wealth are characterized in the region. While most of the world now subscribes to a capitalistic method, some holdovers around the globe might still hold in high regard trading and bartering for goods and services, or, in the case of a prolonged crisis where the value of money falters, and the existing economic structures are toppled or interrupted, how the change affects the community. In these cases, a researcher or creator will be encouraged to consult with either historical or living accounts on how these alternate methods of the economic drive may have been received by the people, as it would represent a rich element for the narrative.

Cultural Elements

These are the customs and practices of the actors within society. These represent both personal and physical elements of the people and places of the narrative within the game. From religious practices to architectural design, this element gives the setting the vibrance of its people and the region's flavor. Details like traditional foods, ways of acquiring supplies, and housing structures are included here (Emerson, Et.Al., 2011).

This element might be seen as superfluous for many researchers, but if the objective is to properly represent the world where a PRWE takes place, understanding people will provide answers as to why some things are prioritized over others. Good sources of information for this element can be as direct as field research and participant observation to historical accounts and anthropological studies. The mention of architecture is essential as a reference for visuals and narratives and is especially salient for PRWEs where the threat of infrastructure damage is present. That means that the loss of critical infrastructure impacts how the institutions and private sectors respond, how the general population is affected, which level of vulnerability they may incur, etc.

Societal Structural Elements

This is the way society interacts within itself, and the behaviors learned within society as an acceptable and proper matter (Bandura 1986). Any culturally lead societal norm is included here, including common family house structures, age of maturity (When an adult is considered an adult), levels of separation between individuals, family structures, and society. This also includes any notes of resistance towards messages put by trusted sources, counterculture, and dissent (Emerson, Et.Al., 2011).

A creator or researcher will make good use of analysis of both popular media and anthropological studies when populating this field. Again, direct interaction with the population would serve as the best information venue, but historical accounts and narratives can be used to patch up and populate with the necessary richness. It is important to remark that this is an excellent place to include political ideologies and tensions if the PRWE requires it, especially if the government plays a central role in societal struggles, whether by inactivity or direct confrontation, or tension.

Preparation, Amelioration, Recovery

These are the standard preparation practices that the population is exposed to, both in general and in particular. For example, evacuation drills are common in earthquake-prone areas, and in all modern institutions, fire drills are a commonality in general. This is where campaigns for preparation will be included as well as the content that the government makes available. The elements of the Public Perception of Risk Information are helpful here, in particular, remembering that information perception hinges on specificity, consistency, accuracy, clarity, channels, frequency, sources, and process (Mileti & Fitzpatrick, 1992).

In particular, this element focuses on the type and content of the messages that are sent to the population and whether or not those messages include skills, behavior, and attitudes on top of whether or not they contain veracity or not. This is also where institutionalized practices come into play as a way to facilitate and improve behaviors or impediments if the influence is negative (Lindell & Perry, 2012). A dive into institutionalized literature, school curriculum, and social campaigns will be helpful for a creator, of course, if the PRWE is contemporary. For an historical PRWE archival research and historical data would be a suitable

venue for the creators to pursue, particularly if they have access to printed media.

It cannot be stressed how valuable access to mass media can be in this area, as usually, social campaigns would have printed guidelines in newspapers, spots on television and radio, and banners or websites online. Of course, the further back in history, the fewer these elements are available, but proper research provides several venues to get the idea of what sort of information was being propagated.

Of course, as with many of these elements, direct confirmation of the population makes for a compelling source of information and understanding, as it gives the creators a way to understand how well the population was taking in this information. And whether this information was helpful, valid and/or trustworthy is essential to include. The fact that incorrect and facetious information was disseminated at the moment was regrettable, but that is not a reason to exclude it from the final product; excluding it and not pointing out the inaccuracies would be a disservice. Making it clear that messages detrimental to the population were circulated by who, why, and when makes for an essential element of learning and literacy in identifying good information.

Information diffusion

This element is where developers would find and input how the previous preparation, amelioration, and recovery elements are conveyed to the population. This is a critical step for the GCF, as it is where the research can find if the issues with the crisis came from a lack of channels of communication or effectiveness in communication or even both. At this level, the SARF (Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson & Natick, 1988) becomes a valuable source of discernment. At this level, the sources of information need to be weighed. The way official channels convey their information is included here, as well as how good the government's standing is to the population.

Special consideration must be made about counter proposals and dissent in the information. Of course, this can end up being positive or negative depending on whether or not the official information is/was considered accurate and correct at the moment. As mentioned in the previous step, "Preparation, Amelioration, Recovery," the information propagated that served as a detriment to the actors involved in the PRWE is as essential as the information that served to help them, and in his elements

of the GCF, the focus should be on the channels in which the messages were spread.

Generational and Historical Memory

This is where the events of the past feed the response that the population took regarding the PRWE. It is also responsible for determining common sense in the region and whether or not the event was a common occurrence that was paradigmatic or a first-time catastrophic event (Schuman & Corning, 2017).

Personal Standing Elements

Elements of what a regular citizen is in the setting and context come into play here. This should also match the target demographic to a degree, as connecting to your demographic might serve as a way to help relate to the situation even deeper. This can include their affluence, physical traits, societal standing, and other pertinent elements (Emerson, Et.Al., 2011). My proposal for this research includes this self-designed concept, and as such, it is open for reinterpretation, but it is highly recommended that creators and

researchers consider this as the first element that will serve as a template for the main character.

Statistical data and popular culture can serve as sources when direct interaction and field research are not an option, and accounting for whether or not the region in which the PRWE takes place is rural or urban also serves the creation well to make a distinction. Even within a small region, uses and costumes may change.

Family Structure

This context element is also personal and feeds more into the project setting, making it close to the "personal standing" but setting up for the direct interpersonal relationships of the target demographic. This is where determining how families usually work in the targeted region is included (Gouviera & Castrén, 2021). This is important, especially if the narrative is focused on a single person, as it feeds into the motivations and objectives of a character.

Interactive Media

The elements of the PRWE need to be defined before moving to the next level. That feeds the elements of the Interactive media. On this level, what is composed is the general concepts and context of the PRWE, a blueprint of an event. At this level, changes can be made to fit the project that the developers and researchers want to make. Also, at this level is where factualization of a real-world event can happen for narrative purposes.

Environmental setting

In the gamification, this element determines the game's look regarding the setting. This component is nurtured by the Socio-Economic and Cultural elements found on the PRWE level. This means that the way the levels would look (Or be described) are influenced by the real-world setting and any details about the governance and economic system (Harper, 2017).

Storytelling Setting

This element is nurtured by several components from the PRWE. Socio-economic Elements once more tell of how the world will work in the sense of governance, while Cultural elements will tell of people's relationship with the environment and their practices. Societal Structure Elements will tell how people relate to one another, while the information Diffusion marks how the warning signs and post-emergency information is distributed. Generational and historical Memory also sets up how the game environment feels regarding what society knows and reacts to (Harper, 2017).

Information flow setting

This is, for the purposes of crisis research, one of the cornerstones of gameplay. Understanding how to discern good and accurate information from the information that is not. And how that information becomes trustworthy or not depends on several elements. The most basic comes from the Preparation, Amelioration, and Recovery Element of the PRWE, where the type of information is defined and established, which is the trustworthy source (Mileti & Fitzpatrick, 1992). Following that logic, the Information

Diffusion for the channels of information distribution comes into play, characterized by the actors distributing and countering information.

Family Structure comes into play here; whether the setting calls for a character that is solitary and does not have a family that can sway their information consumption, or if the character is in a family structure that does have sway on their information acquisition, this element needs to be brought up for the Interactive media level (Lindell & Perry, 2012). And finally, for this element, the way Personal Standing affects their setting is elemental, as it marks whether or not the character(s) have the means to have awareness, interest to be prepared or if they are going to be one of those members of counterculture and negative information flow in the function of preparing for a PRWE.

Main Character(s)

It is hard to determine what element from the PRWE does NOT influence the constitution of the Main Character(s). Cultural and Societal Structure elements are basics; the way the main character identifies (or not) with their culture and the people in it is essential to build a character. Preparation, amelioration, Recovery, and Information Diffusion serve as a

way to set how and in what spectrum of the reliability of their own information and knowledge about PRWE they fall into, considering, of course, if they are even capable of acquiring the necessary information to better cope with the event. Finally, Generational and Historical Memory, Family Structure, and Personal Standing help figure out how they relate to the people closest to them, whether or not they have historical knowledge of the events about to transpire and how well situated they are to affront them (Gouviera & Castrén, 2021).

Supporting Cast

From secondary characters to transient presences, secondary characters populate the world and bring further context and motivations. Much like the main character's relationship with the Preparation, Amelioration, Recovery, and Information Diffusion, the supporting cast have their own relationship with information and sources that influence the views of the main character(s). While Generational and Historical Memory, Family Structure, and Personal standing mark the direct relationship with the main character and the way they see the PRWE (Gouviera & Castrén, 2021; Harper, 2017).

In-Game Mechanics

Somewhat disconnected from the PRWEs, these elements represent the game's core game mechanics and user interface that developers would inject the narrative into. All gamification aspects work together to nurture and inform this element but also delimit how much is needed. If a game is a simple text-based adventure, some visuals and structural richness might not be as required.

Outcomes

The GCF proposes these cardinal elements for any project aiming to create Games set in PWREs. However, something that the framework does not constrain is the type of gamification. The final product genre and mechanics are up to the developer and/or researchers, who will work with their own capacities and proficiencies to bring out the ideal outcomes that the GCF is after.

Empathy

The PRWEs affect a wide variety of populations, but some are more likely to be affected by others. By bringing together the elements from the real world into interactive media, it is expected that the player who experiences the product will have a better outlook on the "other" that is affected by the PRWE (Wang, Singhal, 2009) while also bridging one's firsthand experiences to others through the experiences of the characters they are following (Olivier, Sterkenburg & Esmé, 2019).

Competency

It is generally accepted that serious games can help develop skills and competencies, facilitate the acquisition of new knowledge, and reinforce existing ones (Boyle et al, 2016). For the objectives of this framework, exposing players to the experiences is a way to convey these competencies, with proper demonstration and feedback of consequences and experiences (Breuer & Bente, 2010). This also includes competency in information curation, finding proper channels, and trustworthy sources.

Actionable behaviors

These are the attitudes and behaviors in times of disasters that the PADM (Lindell & Perry, 2012) proposes, but with a new facilitator that the interactive media has provided to create awareness of how to acquire information, adequately protect themselves, and those around them. Including the emotional mechanisms through how to cope with the stress of the situation that PRWE can bring.

Awareness

As a stand-alone outcome, awareness needs to be considered as the general awareness of situations on the impact of PRWEs in regions unaffected directly, but that might be affected indirectly. General awareness can be a good first step; as outcomes go, it might be one of the most elemental but can enable further changes in the future. Understanding awareness, in general, makes for a solid basic but satisfactory outcome, especially concerning how some actions affect the outcomes of others (Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson & Natick, 1988).

In Appendix A, a visual representation of the GCF can be found. The illustration of the visual model shows the different levels at which the model works and its connection between the PRWE and the interactive media elements, drawing attention to how interconnected the components are to one another.

In this chapter, I went into detail about how the Gamified Crisis Framework captures the Paradigmatic Real-World Events to inform the Interactive media level to create gamification that will ideally bring outcomes of Awareness, Empathy, Knowledge & Skills (Competence), and Active Behaviors. This chapter also explains the interconnectivity between PRWEs y and interactive media, which is the framework's goal.

V.- Designing and Creating a Crisis Game: Storm Line

This chapter will go into the process of using the Gamified Crisis Framework to create a crisis game titled Storm Line. This chapter will go phase by phase, describing the source of information and how it was integrated into the game and narrative.

The concept

In 2017 Puerto Rico was hit by one of the most devastating storms in the history of the island. Hurricane Maria assailed the island and cut off communications, crippled infrastructure, and forced people to confront their own sense of preparedness regarding natural hazards. This is, in turn, exacerbated by the fact that just a week prior, Puerto Rico was hit by Hurricane Irma; while not as powerful as Maria, it weakened the infrastructure enough to leave sectors vulnerable.

Add to this a weakened trust in official messages and the creation of a certain skepticism amongst the population regarding the actual severity of storms. And all of this was because the official reports were forecasting Irma

as a storm that would be extremely dangerous, but in the end, it diverged from the predicted paths, and its effects were not as harmful as the media and government touted (Takahashi, Zhang, & Chavez, 2019). Maria fully embodies the concept conceived in this work, the Paradigmatic Real-World Events (PRWE). Maria marks for the island of Puerto Rico and its people before and after, an experience that has marked them for years to come.

This is where the inspiration for a game that can convey this scenario comes from, from a drive to create an interactive experience that helps change behavior and attitudinal change in the recipients of this message, so when the alerts come, people act upon them to have the best possible reaction. We know that games have the potential to promote behavioral change and skill acquisition (Boyle, Hainey, Connolly, Earp, Et.Al. 2016) and that one of the major troubles during emergencies is that people are so ingrained in their own biases that they will choose to ameliorate or outright dispute the official reports, creating apathy and overconfidence when faced with information that contradicts their beliefs (Allahverdyan & Galstyan, 2014).

And for those not directly involved in situations like these, it can build up empathy and relatability for those suffering the effects of storms that are

becoming more powerful and more frequent. But there are elements in game creation that are worth revisiting and adjusting, and this is where having a solid framework to help develop an experience is of utmost use for researchers and developers.

Storm Line refers to two things: One, the fact that sometimes populations only had communications through landlines, and two, from the way Hurricanes line up in the Atlantic, forming a line of storms that usually is clearly heading for the Caribbean and Gulf of Mexico Region. Storm Line is inspired by the accounts of the People of Puerto Rico and their experiences before, during, and after Hurricane Maria. The author was part of a team of field researchers that conducted panels and in-depth interviews with the people of Puerto Rico, from urban areas to rural communities.

The game is inspired by classic point-and-click adventures like "This War of Mine" (11 Bit studio, 2014.) and the "Monkey Island" series (1990-2010, Disney Interactive, current owner), which are good examples of commercial games that enjoy success while also having both learning potential and can convey a poignant story. In its final iteration, the hope is that the game will be a valuable tool for change and for having people be better prepared for the messages they will need.

Background

Storm Line is heavily inspired by the events in 2017 in Puerto Rico. The scenario depicted in the game is a direct translation of the firsthand accounts of survivors that a team of researchers from Michigan State University collected over panel studies (Chavez, Graciano & Takahashi, 2019). The researchers used qualitative research methods during these panels, mainly focusing on panel studies and in-depth interviews. Panel studies are effective thanks to how they help the researchers gain knowledge about how the population experienced a disaster like Maria (Hesse-Biber and Leavy, 2010). This is true both as a group and as individuals, as everyone, at the moment and given an opportunity to express themselves, open up to the researchers and relate their experiences.

This is where we get the concepts we will employ in Storm Line, the messages, the experiences, and the regrets over several occurrences and moments. Not only that, but by nurturing our game with information gained through panel studies, we also gain a certain level of understanding as to the consensus of several pivotal moments during the event (Lindlof and Taylor, 2017). That is saying that we can hear where people agree and disagrees on certain things brought up during the panel, like how much the

government helped them, what was their general feelings and how they managed to gain communication, and central to our objective, how much not believing the forecasts put out by the government ended up affecting them. And by gathering all this information and using the Gamified Crisis Framework (GCF), the experience produced is work that reflects the PRWE effectively and makes an effort to give voice to those most vulnerable.

As mentioned in the chapter focused on the GCF, many of the elements of information in a game are directly influenced by the way the crisis communication models address the subject. The Mileti model is an excellent way to look at how the ideal message is transmitted and what characteristics it should have, like specificity, consistency, certainty, accuracy, clarity, proper channels, frequency, reliable sources, and proper processes. As well as considering how it is received by the public depending on their network, resources, demographics, activity, knowledge, cognition, experience, and distance to the emergency (Mileti & Fitzpatrick, 1992). As for the ideal way for people to act during a crisis situation, we can turn to the PADM or "Protective action decision model," where the ideal decisions made during an emergency can be described best (Lindell & Perry, 2012).

These elements are essential, as they will represent the official messages that the game tries to convey, eroding biases against them while allowing for flexibility and sound decision-making. We hope that by taking these steps, we are bringing an experience that is not only beneficial and oriented towards an ideal outcome but also creates an emotionally engaging environment that explores dilemmas and faces the player with the reality of a situation that is becoming increasingly relevant as time goes by. (Isbister, Flanagan & Hash, 2010, April).

Storm Line's narrative

Storm Line begins as many of the Puerto Rican stories we were told on the island begin: In the bathroom. For many that were unwilling or unable to get to shelter, the bathroom always represented a safe spot in the house. Usually, the bathroom has sturdier walls than the rest of the construction or is situated behind several layers that offer better protection than other rooms. For storm line, we want to show a small nuclear family with a member absent, a dynamic that is also directly inspired by the accounts of Puerto Rico, which, as a Commonwealth of the USA, sees a lot of mobility amongst the family, having some members living in the "Mainland" for work and returning periodically to spend time with their family. Immediately we

throw the player into the midst of a hurricane, and the narration and, subsequently, visual cues will emulate the experiences we know were experienced through an event like that. In particular, the firsthand accounts commented on two things: the noise and the aftermath of seeing foliage simply ripped from the trees, which would be something we wish to focus on.

As the game progresses, the family needs to start moving; one of the members, the eldest child, is the Player character, the one that the player will usually control. The exploration in the game's early stages will be more intimate and natural, but the decisions the player must make hinge on many recommendations that are usually made during an emergency. For example, the game cues the player that there is a lot of debris and that a section of the house is particularly damaged. When the player inspects that area, they will know there is glass everywhere, so making sure their family wears shoes is now an option. Another bit that can be explored is the danger of gas leaks and how easy it is to have an accident without previous preparation. These are common sense decisions that are usually conveyed by official messages, making sure your environment is safe and checking for risk factors, helping the player see that taking a moment to investigate before getting all clear is essential.

But that represents just one element of the game; the second element is that of the family member away and communication. In Puerto Rico, people shared that cell phones were knocked out for several months. Their usual means of communication were no longer available, and two elements came into the foreground. One was Radio, and we plan to explore that element in future iterations; the other was landlines.

Some phone landlines remained working even in some remote parts of the island, so families sometimes could get their first bits of information not from the local media but from the family they called on the mainland that would give them reports on how things were developing. We are integrating this into the gameplay, where the player briefly takes control of the father. The father character is watching news broadcasts and chooses the themes they wish to focus on so they can convey information back to their family on the island. The game mechanics will constrain the amount of information they can convey, so the primary gameplay utilizes this element as a starting point to get the narrative going, thus nurturing each other, and creating a challenging experience.

The flow of the prototype is simple but effective. Make decisions, see consequences; the consequences might be binary at this point (Inform your

family to wear shoes, prevent injury, neglect to check the gas lines, the mother character will be injured.) And these starting decisions will shape the tone of the narrative and the urgency of the main character's actions. Once this interaction with the parent that is away from the island, the main character must return home and convey this information.

But as they return and meditate about what they learn, they are approached by one of their neighbors. Another element ever present in the Puerto Rico account of hurricane Maria is how in these times of hardship, most of the community members came together and helped each other. Even neighbors that did not interact priorly come to each other's aid to help with physical injury, material damages, or simply to share information. So, the main character is given a chance to help another person who, while present in their vicinity (they are their neighbor), might not be a close acquaintance.

This interaction offers a few elements considered in-game, which is that sharing information about a limited resource might hinder the main character's intention. However, helping also opens other possibilities, namely, in the iteration's case, transportation and access to a battery-operated radio with which the neighbor plans to help the main character gain

some additional information. The current iteration ends with the player returning home to recon with their previous actions and to communicate what they learned from their parent on the mainland. The game expresses the options gained thanks to the information and proposes ways of acting, but the game ends here, in a moment of uncertainty and with looming dread.

Agency and choices

Storm Line, as rudimentary an experience it might be in this iteration, has some flair in its game design and intent. The player has a limited set of choices; however, there will usually be a way to skip, cut corners and just get the narrative going quickly. For the study intention, the experience must be placed multiple times, so players have an opportunity to experience these shortcuts and their consequences. But these situations of playing the game quickly will usually lead to the same outcome: hasty decisions without care will lead to harm.

While this might seem constraining, the game's objective is to illustrate the best practices in a way that is not melodramatic or unreal. As the following steps in creating Storm Line through the GCF will show, the

characters' actions are informed by real-life occurrences and the good outcomes of taking these decisions.

GCF created experience

In this iteration Storm Line is a simple but effective experience aimed to be a narrative focus and fully informed by the GCF's conceptualization of content. That means that while creating and adapting the events and narrative hooks in the story, the elements from Paradigmatic Real-World Events, the Interactive Media translation, and the expected outcomes were implemented.

Storm Line and the Paradigmatic Real-World Event

As mentioned earlier, Storm Line is a fictionalization fully inspired by the experiences, accounts, documentation, and data from the aftermath of 2017 Hurricane Maria. This is not only from readily available information from public NOAA archives and the National Weather Service but also from documentation found in newspapers, news clips, and of course, the firsthand experience of the researcher as part of the field team researching the impact

of the hurricane on the population. Thus, any data and the itemization of the GFC come from this field research.

Socio-economic elements

Storm Line takes direct inspiration from the average Puerto Rican family for this element, from field research, and from a lengthy visit to the island (Chavez, Graciano & Takahashi, 2019). In this case, the details that Storm Line borrows from the setting are to establish that the island is somewhat disparaged, with a disconnected government whose response was slow and not as widespread as expected. It is also important to underline that the world's reality at that time was that the population depended more on themselves than on the societal structures to break through the crisis (Giddens, 1984) and that people would need to accept or reject helping each other as situations arise.

Cultural Elements

Moving more onto the cultural elements, we have to make a note here. Because of the nature of the prototype being only slightly aided by still

images, the representation of this element is limited when it comes to flair and vivid richness. However, within the experience's limits, Storm Line mentions a few key things that will make sense to those in the know.

Using the bathroom, usually in a typical Puerto Rican house, the most robust room in the house, as a shelter, was a shared experience that the survivors of maria shared with the researchers, thus why the game opens with the characters huddled down in the bathroom. Cultural elements that can also be included here are the structure of towns with few urban areas of apartments and tall buildings and instead focus on single-family homes in neighborhoods and smaller food outlets and the figure of the town plaza as a center of activity (Emerson, Et.Al., 2011).

Societal structural elements

Puerto Rico, being a commonwealth of the United States of America, has a somewhat fraught history with the country it is related to, and that translates to economic uncertainty and limited opportunities. And this in families of average socio-economic standard means that often one of the parents will travel to the main continental states for work for extended periods of time. The game brings several elements to this concept that help

identify and inform the characters. In this case, a big deal is focused on the family structure, especially with the nuance of diaspora, immigration, and roles within the family (Emerson, Et. Al, 2011).

It is expected that the oldest sibling in a nuclear family will be the one responsible in the absence of a parent working away for extended periods of time, making it common that youths are expected to perform tasks for their families. These factors informed the decision to make the character male, to have a younger sibling, and to take charge. And while it is true that switching gender roles should have no significant impact on the story and events, for this iteration, implementing any character-building elements is better left for the future.

Preparation, Amelioration, Recovery

In this element, the game lifts directly from the population's accounts and what the media at the time was putting out regarding preparing for hurricanes. Some of the most popular newspapers on the island, like "El Nuevo Día" would dedicate full spreads to preparation checkmarks, recommendations to secure dwellings, and constant information about where to go in case of evacuations.

This is in line with how the crisis literature recommends information regarding emergencies in-game the simple decision to check surroundings, get information, and secure delicate infrastructure comes into play for this element (Mileti & Fitzpatrick, 1992), making it so the character in-game takes decisions that are properly informed.

Information diffusion

This was a challenging element to include in the scenario of the game. From firsthand testimonies, many of the population of Puerto Rico, after the events of Maria, were left literally and figuratively in the dark. In many cases, the population depended on web-based sources of information, some of them inaccurate, sensationalized, or dismissive. In the game, there is an effort to express that the main characters are cut off save for a single line. And again, this is from firsthand accounts of the precarious state of the survivors (Chavez, Et. Al, 2019). However, something that was true was that the use of portable radios to listen to broadcasts was a significant factor in bringing information and that the news media that was putting out reports were not necessarily informing the people on the island; they were informing the people on the mainland (Takahashi, Et.Al., 2019).

Generational and Historical Element

Historically, Puerto Rico is not a territory unfamiliar with severe storms. Their people are well aware of their peril and hazards, and there are basic preparations that all people take in case of emergency. In this regard, the population in the game represents a level of affinity with what to do by taking necessary action, thanks to past experience (Schuman & Corning, 2017). Even more, the element of the elderly neighbor is informed by how the older generations remembered past storms and their proclivity to consume media that is not as common amongst the player character's main demographic.

Personal Standing Elements

An element that, because of the length of the experience, is not delved into too deeply. This comes back to the point that most families in Puerto Rico are nuclear and that when a parent is not present, the eldest sibling is the one taking charge of the house. This is more common when the parent not present is the father, and the oldest sibling is male; Puerto Rico has a traditional structure, and while outliners and more diverse families exist, we want to represent the average. In this case, the game draws from the PRWE

the fact that a sector of the population affected were young adults that had not had experiences with major hurricanes but had some experiences with other storms.

Family Structure

From a more specific standpoint, the main character of Storm Line is the oldest son of a four-member family. A currently married couple, male and female, the father working somewhere on the mainland and the mother as a homemaker for the family administrating the income that the father sends from the mainland. The eldest son is a young adult of undisclosed education but can be assumed to be well learned and responsible for the family. The younger sibling is a tween, male and vivacious. This description of the family that is portrayed and their dynamic goes into more detail than the other elements where family is included, so the dynamic can be differentiated. Also, this kind of family dynamic was common in Puerto Rico at the time of Maria and could represent an average family during the crisis.

Interactive Media

Now that the baseline for the game has been established, we can translate these into what the game's narrative will portray. As explained in the main chapter for the GCF, this is where game design comes into play, but also where the people responsible for putting together the experience can inject the resources and proficiency, they may have. As this is a solo project with a person with limited experience in programming, the game is a Twine prototype, a text adventure with some visual aid; thus, the potential for interpretation of the PRWEs is limited. However, to enrich this section, there will be special consideration as to how more proficient and sophisticated game creators would use the research made for the PRWE level to create a more immersive and mimetic experience.

Environmental setting

Nurtured by the Socio-Economic and Cultural elements found at the PRWE level. Storm line, in this case, describes those houses as humble, that there is a central hub of activity in town and that the player character lives in a single-family home. There is also a sense of lack of governance presence, with their absence exacerbating the effects of the hurricane that

had just passed and the dread of the hurricane about to come. Some of the descriptions about foliage being ripped out and destruction were also informed by the firsthand accounts of survivors, and the way people interact with each other is also part of the results of this first information collected.

In an enhanced version of the experience, this element would also feed into the look of the houses, with most of them possessing tin roofs, with the specific foliage of the island being represented. Aspects like the contents of the pantry and decorations in the house would also be depicted in accordance with the common uses of Puerto Ricans Families. Small details like iron wrought bars over windows and corner stores would also be represented, making the environment feel more like the place we aim to represent.

Storytelling Setting

The setting for Storm Line, being a twine experience, is simple. The story makes it clear that it takes place in a socio-economic area where people are humble but well situated, in accordance with the average Puerto Rican population as denoted by their location and the sense that their area is not the priority for the government response. Some semblances of cultural

elements can come through with the way other characters react to the main character, as well as the regard that the characters need to take charge in accordance with the societal structure elements that were discerned from the research. As for information diffusion and generational and historical memory, the game imposes the challenge that the main character is not readily able to get new information and needs to make do with what they might already know and what they are being fed by others with more experience or access to alternate media form what they usually would use.

As expected, with better resources and expansion, the storytelling setting can make use of many elements, but in all regards, they would mainly stay the same, only better represented.

Information flow setting

Because of the game's theme, preparation, amelioration, and recovery are essential. The game counts on the player to make decisions that will keep their family safe and will inform the player and show the consequences of not taking necessary steps. In particular, securing the dwelling after a storm and ensuring that delicate infrastructure is not damaged is critical. Simple and direct things that people can do to stay protected. Information

diffusion is purposely limited, as it is part of the game that the character must search for information, and while we lean on reliable information for this iteration, other sources of unreliable information can also come to the foreground. Family Structure and personal standing are guiding factors. Elders who know where the landlines might still be available and older generations using alternative, analog means of information will help with the flow and give the player a sense of variety and richness.

In the Twine iteration, there is a limit to how much can be conveyed. In an expanded setting, this element can do much more to help people learn, from finding newspapers with information to hearing outlandish news from neighbors. This could really make for an immersive and formative element.

Main Character

The main character is the eldest son of a family of four, and as such, based on the Cultural and Societal Structure elements, they adopt a sense of responsibility readily as it is expected of them. The player is urged to take this role, as your family counts on you. Preparation, amelioration, Recovery, and Information Diffusion come in the form of the decisions they take during

their first moments of gameplay; from checking the surroundings to acquiring good information and deciding what to do with it, the player must make sure their family and themselves are safe. Generational and Historical memory, Family Structure, and Personal Standing feed more into this, with the absent parent serving as another source of reliable information, their elders as sources of alternative media to inform decisions, and the mother and younger siblings as motivators to do all they can to perform.

With more sophisticated mediums, there can be a skill curve that can be learned; the player could practice skills or see them play out or can acquire documentation and guides to better help their family. In the twine iteration, the options are limited, but more dynamic interactions and more emotional attachment to a player character that the players could customize could potentially help to better make a case for the population represented.

Supporting Cast

The supporting cast in the twine iteration is limited to the core family of four and a neighbor (as well as a cursory mention of other people that are there more as a setting element than directly relevant actors). Preparation, amelioration, recovery, and information diffusion elements play into this

secondary cast as they serve both as sources of information and as the incarnation of the consequences of the main character's decisions. The emotional attachment to the core family makes it, so the main character has a direct connection to the consequences. While generational and historical memory, family structure, and Personal standing make it so their relationship is more intimate.

Naturally, in the extended potential of an enhanced experience, this would enable the player to feel more immersed in the world and their character's place in it. Other people expect respect for their seniority, and others potentially see them as targets for their youth. This is something that is expanded to an enhanced experience and could really help players think about their own place during crisis situations, especially younger players.

In-Game Mechanics

In this aspect and as mentioned in more detail in the GCF chapter, in-game mechanics are somewhat separated from the rest of the gamified elements and are more akin to what the creators are capable of doing. In the case of Storm Line this is a Twine experience with some elements of choice and immediate feedback to the consequences of said choices. In this

sense, the experience is more akin to text adventures or a storybook where the reader chooses what page to go next depending on what they want to do.

In expanded experiences, these can potentially be grand, but this is one realm of speculation that can be inspired by other games where the thematic is human interaction and skills.

Outcomes

The following elements may function as the ideal of what the interviews will reveal after the gameplay, and they will be revisited in the results chapter in more detail, but as a baseline, some ideals could be observed.

Empathy: from what Storm Line presents, it is hopeful that those who play it will have a degree of understanding and empathy towards people whose safety net is not as solid as they could have. In this case, empathy for the family, especially if they are hurt, is expected, and a sense of pride for helping the elderly neighbor.

Competency: the initial scene where the older son comes out of the bathroom and surveys the house is one of the competencies that are expected to be salient. Being careful with how the phenomenon affects their homes.

Actionable behaviors: the proactivity of finding reliable information, helping others, and securing your immediate environment should be mentioned in the interviews.

Awareness: Once informed about the event in Puerto Rico with Maria and explaining the situation in the setting should leave the interviewee after playing Storm Line with a better sense of what hurricanes can do to people and how helping others can be beneficial in the long run.

In this chapter, I presented how the GCF is applied to the creation of a simple Twine experience, deeply informed by a multitude of sources. These sources come from statistics and firsthand accounts, as well as personal experience.

VI.- Findings and analysis

This chapter will go into the findings and analysis of the respondents' answers to the questionnaire. There will be an overview of the recruitment results and some demographic data. The analysis structure will explain the categories and coding, intermingling some quotations directly from the respondents. Make note that the quotes are inserted verbatim and subject to grammatical and spelling errors. All names have been changed to preserve participant anonymity.

The study was conducted in summer of 2022 and attracted 31 participants, out of which three were interviewed, and 28 filled out the questionnaire. All of these participants came directly from either the initial postings on the social media groups or were referred by other participants that shared the study. In all, snowballing was considered successful. 3 were selected for the in-depth interview, aiming to choose at least 2 from Puerto Rico and another person from the continental United States. Video interviews were conducted with these participants, lasting between 25 to 60 minutes, attaining in-depth answers, and helping refine the questions for the questionnaire. These participants were compensated for their time as the

rest of the pool (financial support was provided by the Michigan State University Completion Grant, summer, 2022).

The rest of the interested participants received a link to the game (https://bit.ly/3dvCom9), allowing 24 hours to play Storm Line. 28 participants completed the questionnaire with insightful and adequate answers, meaning that there were minimal monosyllabic answers, and most responses were two or more sentences long.

For demographic purposes, 12 out of 28 participants identified as Female, 11 out of 28 identified as Male, and 5 out of 28 identified as non-binary. Their locations were varied, with the majority coming from the South of the United States, 13 out of 28, followed by non-disclosed locations in the USA, 5 out of 28, Broad Central and South America 4 out of 28, with some representation from Puerto Rico and the North Atlantic regions each with 2 out of 28 and cursory representation from Australia and the West Coast of the USA with 1 each. Successfully, all the participants were from areas with a propensity for severe weather events.

Participants' age was in their majority in the 25 to 34 year-old bracket, with 19 out of 28 participants falling into this category. 6 out of 28

participants were in the 18 to 24 age range, while 2 reported being 35 to 44, and 1 participant was 55+. Education wise, the participant pool also seemed to be well educated; 8 participants reported holding graduate level degrees, another 8 reported having a college degree, while 7 out of 28 reported having some college under their belts, and 2 out of 28 had done some graduate schoolwork. The 2 of the remaining participants reported having a high school level education, and 1 reported having a trade school degree. For consideration, out of the 28 participants, only 8 lived alone, while the rest lived in some sort of communal unit, be it with their spouse (9), their family (7), or roommates (4). Self-identified ethnicity showed a majority of 18 identifying as white, 5 as Hispanic or latine, 2 as native American, and 3 as other.

Each item in the questionnaire was already assigned a category to answer the research question. As expected per the first coding, each set of answers gave way to themes that were identified and that, when contrasted with one another, bring us a plethora of understanding of how the participants took in the game, appreciated the scenario, and contextualized their own experience with crisis events (Hesse-Biber & Leavy, 2011).

Awareness

Awareness and perception of weather, situations of crisis regarding weather, and general knowledge about hurricanes and, in particular, Hurricane maria. This is important to determine how the participant perceives the extent to which a situation involves them, the context in which it happens, and the potential ramifications of being involved in the events, in this case, severe weather (Breakwell and Barnett, 2003). The items for this category were worded to emphasize the focus on hurricanes but still gave enough space for participants to talk about other categories of severe weather events. Particular attention was driven to the case of hurricane Maria as the setting for Storm Line and the subject of the game. Severe weather experience: What is your experience with severe weather events? Ever had experience with Hurricanes?

This first item, intended as an initial probe into the participants' previous experiences, revealed that most have a close relationship with extreme weather, particularly hurricanes (Mileti & Fitzpatrick, 1992). If we look at the demographics, it is a point that makes sense and is easily explained by their geographical location. What was not as expected is the account of just how close to these events the respondents would be, opening

the study to a baseline of participants that not only are aware of the dangers of severe weather and hurricanes, but the majority have also lived through them. Out of the participants, 7 out of the 28 participants only had cursory or basic ideas of what a hurricane or some other extreme weather events entitles. That means that throughout their life, they have never experienced such a crisis, or the crisis happened so far enough that they were not affected directly, and any first-hand knowledge comes from media and secondhand information.

For the rest participants, 16 out of the 28 participants recounted their experience with severe weather in what was categorized as "intimate," meaning that their livelihoods and person had been present in events that could be considered dangerous, but that thankfully did not put their lives or property at extreme risk.

> Hurricane Isabel knocked out a lot of Virginia power and connectivity in 2003. I remember being stuck in the dark for a while and not having to go to school. We were given a gas generator by a neighbor to get through things until the state could repair the multiple power lines that had been knocked over and snapped during the storm. It lasted about a week. - Monique.

These kinds of answers are consistent among the respondents that we classified as "intimate," people who have experienced extreme weather, but because of their socio-economic standing, location, or safety net, were not as widely affected as the rest of the responders in the study, which can be classified as "Extreme."

> I personally lost a car to a hurricane that was forecasted as "this storm won't be that bad," but alas. I drove straight into an area with too much water, and the car started floating before flooding. Ended up having to wade home in the storm which took about an hour and a half fighting against the high water and wind and rain. - M.

These extreme accounts are shared by 5 respondents; these are participants who have had their livelihoods, property, and well-being compromised and even permanently changed by extreme weather (Mileti & Fitzpatrick, 1992). This makes this set of participants highly aware of what extreme weather can do, which will be particularly important moving forward. However, as the analysis moves forward, the attention of the questions begins to focus on hurricanes.

The next item is about hurricane experience: To what extent have you been personally affected by hurricanes? Between this item and the "Severe Weather experience," we refine the participants' relationship with hurricanes. Needless to say, the accounts that the participants report in both items are intertwined. With only 3 of the participants never actually experienced a hurricane themselves. There is a spread of experiences ranging from close contact, which encompasses 3 participants living near an area where hurricanes happen, to 8 participants out of 28 that have been impacted by hurricanes but have not experienced major adverse effects.

The rest of the participants are in two camps: those with severe experiences with hurricanes and those with deadly experiences. These 8 respondents that have experienced this severe impact are keenly aware of what hurricanes are particularly capable of. Those with severe experiences and experienced situations where while their lives have not been at immediate risk, they have to deal with the emotional and financial burden of seeing their property damaged and their neighborhoods impacted (Lindell & Perry, 2012).

> Many of my family members have lost their roofs and belongings during severe hurricanes. On a more personal level, the effect has been mainly psychological. Especially after Maria, if there's any threat of a hurricane heading our way, I have a lot of anxiety and fear around the possibility of another event similar to that one. - Gallia.

The other 8 out of 28 respondents are in the furthest range of awareness of what hurricanes are capable of; these are individuals that have had brushes with death because of hurricanes, and some even seemed to reevaluate their experience from the "Severe Weather" item, and in perspective recount their experience more vividly in this query.

> Hurricane has affected I and my family personal life. it has caused a lot of havoc to my family that I find it hard to forget. The physical range and trauma bit made my family go through was enough to affect me psychologically. The environmental destruction had really changed my perception about nature and its beauty. - Devin.

These findings were to a degree expected, but not to this degree. Maybe finding a few participants intimately involved in crisis events were expected but having subjects that had been through very severe storms and

even the study's PRWE was welcomed. These questions revealed that the participants in this pool were well aware of the severity of extreme weather, and even those not near areas at risk for hurricanes displayed, for the most part, an above-average awareness of what hurricanes could do (Sellnow, 2021).

To round up the participants' general awareness of hurricanes, the questionnaire included an item focused on the severity of hurricanes over time. The question was simple, "Do you think Hurricanes are changing?" and the answers were consistent. Because of the already established awareness that the pool of participants has demonstrated, it was expected that the grand majority (25 out of 28) would, in one way or another, comment that hurricanes are worsening, becoming more frequent and more powerful. The remaining 3 participants considered hurricanes to be the same as always but did mention the caveat that they were also more exposed to the media and thus were also better disseminated (Pidgeon, et.al., 2003).

Regarding the study's focus on the 2017 hurricane Maria in Puerto Rico, the participants continued to show their awareness of the case. The query presented was specific "Before Playing this game, did you know about the 2017 Puerto Rico's Hurricane Maria? What did you know, or what do you

think the event was? ". 20 participants were aware of the crisis and the following disaster, some even going into detail about the case and its ramifications (Pidgeon, et.al., 2003).

> I understand that it destroyed a large portion of Puerto Rico's infrastructure and that the US was not very helpful in providing support to those in need. I just understood it to be a more severe than normal hurricane. – Reba.

Out of the participants, 3 were particularly vocal about living through Maria, people who not only know about but had first-hand experience with the PRWE.

> Yes. I was living on the island when it passed. The hurricane itself was bad, but the agonizing aftermath, lack of access to basic needs, and the seemingly never-ending crisis was the main source of my bad memories around Maria. – Gallia.

The rest of the participants (5 out of 28) did not know about the event; however, it is interesting to note that none of the responders that

declared to have no experience with hurricanes were unaware of Maria and its ramifications and that in the case of those unaware of what maria entitled, all of the participants had have been affected by hurricanes in the past.

The final question related to awareness revolves around: Did you identify the game setting is based around Hurricane Maria? What Clue you in, or how do you think the game represents Hurricane Maria? In this query, the participants made an assessment about the location of the game, while a portion of the participants, 4 out of 28, did not find connections between Maria and the game created through the use of the GCF, even if most of those that did not identify the setting had previous knowledge about Maria. The rest of the participants, however, partially identified the setting. 13 of the responders mentioned that the setting had to be a Latin American nation because of the language used and the descriptions in the game cluing them in.

> I did not, I assumed it was based on other hurricanes that hit small island communities, but not Maria. I did notice the people's names and choice of words were related to Spanish speaking people. - Serge.

The rest of the participants, 11, noticed the location readily, making mention of more specifics, including the situation of having 2 storms back-to-back, the use of names, and mention of the bathroom as a shelter where giveaways that made them really pinpoint if not the whole location, the reasoning of why it was inspired and modeled after the event.

> Initially I didn't know the game was based on Hurricane Maria. However, certain dialectal clues (such as use of "mijo") and seeing the images of the streets that were used for the game made me think that this may be related to Hurricane Maria. - Allen.

Empathy

Moving on to this category of questions, it is interesting to come up with the findings of the previous section about how the pool of participants that answered the questionnaire is, in its majority, people who are strongly aware and knowledgeable about the crisis, hurricane Maria and the consequences and effects of severe weather. In this category, the focus is on the community and how the participant is part of it (Giddens, 1984), especially in identifying the vulnerable elements and their role in the community at large (Pidgeon, et.al., 2003).

The first query of this category regards Identifying who is vulnerable. Once more, the participants presented answers that are consistent with this pool's level of awareness regarding disasters, plus demonstrating knowledge and relating to what makes a vulnerable person vulnerable. In the minority, 6 out of the 28 participants only had a vague idea of who is vulnerable in uncertain terms but made an effort to identify and mention it. On the other hand, 8 of the respondents could articulate some of the categories of vulnerable people.

> Poor people, elderly people, and people living in very rural areas are the most vulnerable. - June.

The rest of the participants, 14, displayed a nuanced grasp of what makes people vulnerable, articulating nuances of what makes those sectors of the population be in such a state aware of the risks that they are in.

> The economically vulnerable population is also the group most at risk as they have fewer resources to pull up a lifeline. Small scale farmers and families living in areas at risk of landslides, such as hillsides. On nearby regions, some valleys are at risk of mining operation dams disasters, when such dams break due to excessive

rainfall, poor maintenance or corruption-driven design flaws. - Naevern.

These findings make the following question all the more interesting: "Thinking about hurricane Maria and after learning the game scenario is inspired by it, do you see similarities with your own experiences?" This question is simple, but it prompted responses from the participants that revealed much about them.

A fraction of the pool, 3 respondents, did not find a link between the game scenario and themselves, mainly because of either being far from the areas where hurricanes happen or because, in their experience, they have not found themselves in a dire situation as the one depicted in "Storm Line." The rest of the responders, however, had plenty to say about the situation. 8 respondents found certain similarities with their experiences, these might not be directly lifted from the game, but they could see the elements and connections.

Not particularly mine, but I've heard a lot of similar stories from friends and close relatives. I do remember during some of the worst hurricanes that hit the country we would lose light and would spend

time huddled up together by a flashlight or candle just talking between ourselves. - Ben.

They acknowledge that even in their case, the situation is not as dire; they can relate to the woes of someone in a situation that is extreme. On the other hand, 5 respondents take it a step further and actually see some of their own actions in the game scenario, seeing parallels even if they have never been directly affected by a hurricane.

I have definitely drawn parallels between myself and this game. I have been blessed my whole life where a broken window or two was all we had to deal with after a hurricane. - Rodrigo.

However, for 7 of the participants in this pool, their experience with the game went even more profound. This portion of the respondents personified in the actions of the game their own experience, directly acknowledging the feelings of desperation and dire, as well as the strategies for the amelioration of risk and dangers (Pidgeon, et.al., 2003).

> Yes, absolutely. The parts that were most similar to my experiences were the desperation to get information when the communication infrastructure was so damaged. I also related to listening to that one AM station maybe for the first time in my life since it was the only way to get any news. Finally, that fear of not knowing if your loved ones were ok after the hurricane brought me back to those days just after Maria had passed. - Gallia.

This is important for the GCF as it is a direct connection to how it can properly connect the player to the scenario, and the fact that participants draw from the specific circumstances from Storm Line is a boon to the model. But as necessary as this portion of the players was, it is equally important to mention the 5 remaining participants.

> I have yet to really experience a hurricane, but, It does make me want to be more prepared and careful in the future. - Chad.

These stirring portions of the participants hint at the potential for Storm Line to potentially provoke a change in the attitudes towards a disaster and what they get out of a game created under the GCF.

The rest of the items in this category serve as a way to help the participants contextualize themselves as part of a community that includes members at risk. This is from a perspective of their own position of risk, their capacity to share information, and their capacity to help others. These self-contextualized roles are essential, as they help them see how connected they are to their community and what is the role they have (Peek, et.al, 2021) while aiding the GCF to see how effective the actions of the main characters whereas representing the action that can be beneficial for the players.

To help the players see themselves as part of the community, the questionnaire prompted them: "After playing the game, how do you see yourself as part of a society or community with people who are vulnerable to hurricane/severe weather events?" From this question, three categories emerged. The smaller fraction of participants, 5, saw themselves separated from the community at risk. This attitude, however, is not necessarily for selfish reasons, instead coming from a place of critique, separation from the affected zones, or for duty just to family groups rather than community.

> America is sadly not much of a country that's full of community and bringing together to overcome natural disasters. It's more of a place where everybody fends for themselves. - Chad.

The most significant fraction of respondents to this query, 12, declared being aid providers. Either by a change of heart thanks to the game experience or existing values, the participants see themselves in a position where their efforts are better employed towards helping others and assisting as much as possible.

> I have a tendency to stick with my family and fend for myself, but the game helped me see the value in reaching out to other neighbors. Not only can I help them, but they can help me and we are stronger together. - Jules.

The remaining 11 respondents are participants who see themselves as members of the vulnerable ranks, and either have an attitude towards learning and improving their situation or simply acknowledge and try to cope with it.

> Yes I feel I am part of a larger community affected by such . This is so as I see the same losses and injuries I have experienced from my part are similar to what others in areas hit by equal tragedies have too. - Emma.

The follow-up question of this category has them reaffirm their position, and in this query, the focus is on information sharing: "Does it put your experiences in a social community context? Why did you or why wouldn't you share information?" In this inquiry, the participants provided insight and affirmation of their position as community members.

A small subsection, 2 out of 28, were unsure about their role, though this might be caused by their own position as part of the vulnerable population in which they contextualize themselves. For the rest, the majority, 11 participants, see sharing information as a means to unite their community (Peek, et.al, 2021).

> Sharing information is necessary for survival. One person doesn't have much of a voice, but when information is shared ideas can also be bounced around to increase Chances of survival. - Celly.

The uniters see information as a link, a means to keep the community strong. In The meantime, another portion, 7, do it for the simple reason of informing others and preventing panic and misinformation but does not hold higher objectives like those seeking to unite.

> It reaffirmed that I prioritize equity in my community. I shared information because the distribution of information may not be accessible to certain folks and because the accessibility of information is akin to the accessibility of resources during severe weather events. Sharing information also (largely) prevents miscommunication and panic. – Allen.

The final portion of responders in this query, 8 out of 28 participants, would share information because it can benefit others. These altruistic functions make no mention of uniting or merely informing but hold the idea of doing it because it is right.

> By my personal code, I feel like I would always want to share information. It just seems like the right thing to do in a community situation like that, to help other people as much as possible and hope they will do the same for me. – Erin.

And by knowing their self-contextualization and their motivation to act regarding others, the final query in this section is related to their motivation in the game to lend assistance to a non-family member: "During the game, you have the option to help a character that is not part of your family. Did you help them? Did you share information? What were the consequences?"

To 2 of the respondents, the interaction with the non-family member in games was relatively inconsequential, or it simply did not represent an important enough moment to remember. Meanwhile, 3 reported having more concern for the main character and their in-game family, making the non-interaction with the character somewhat justifiable for themselves.

> I believe in helping my self and my family first since I consider them as priority. I was in a state of confusion about what to do and what not to do. I felt I was vulnerable too and needed assistance and trying to be a savior to anyone. - Charlie.

A more significant portion of respondents, on the other hand, 16 out of 28 respondents, kept a relatively sober answer, simply stating how they helped the character of the "Don" and the outcome of such help. These answers were sufficient, meaning that at least as a game mechanic and

storytelling moment, it does have some staying power. However, to 7 participants, this interaction represented an opportunity for self-emulation, having the character react the way they would have themselves. This attitude marks an opportunity for a future iteration of Storm Line to better represent these secondary characters.

> I did help the character and share information, as that is what I would do in real life and how I hope people would act toward me. This leads to a better result for everyone involved. - Adam.

This is an encouraging confirmation of the potential to help players see the positive outcomes of helping others and should be something that can be capitalized on along with the criticism or lukewarm reaction obtained by this question.

Knowledge & Skills

The following category of questions is closely related to the competencies and skills that the participants have regarding reacting to crisis events and disasters. This section is closely related to how people

should conduct themselves during a crisis and the following disaster, leading to an amelioration of the consequences of the phenomena (Lindell & Perry, 2012).

After analyzing the first two sections of the data set, there is an expectation for this pool of participants to be relatively well prepared. The first item in this section is about emergency plans and what the respondent feels they are prepared for: "Do you have a plan to protect yourself and your family, and others in case of emergencies? What does it cover (as in what kind of emergencies) and how?"

A fraction of the respondents, 3 out of 28, are planless: they have no plan, do not seem to have plans, do not go deep into details, or simply state that they "do what they need." On the other hand, an equal portion of 3 declared their interest in implementing emergency plans and better preparing for severe weather. These respondents are another vein of support for the GCF potential. Even if small, it gives the game some pointers to improve.

I don't, but I need to get myself a kit to prepare better! I know important things like water, a flashlight, nonperishable foods, and a first aid kit are a must. - Chad.

The rest of the responses to this item are divided into two. The majority of respondents, 14 out of the 28 participants, declare having some sort of plan. It might not be thorough or account for everything, but it is functional and denotes the participant's already established knowledge and awareness of severe weather and hurricanes.

Yes I do have a plan to protect them. Mainly ways to get to safety in the event such tragedies occur and knowledge on rescue centers if things escalate from bad to worse. This would be in emergencies such as hurricanes, tornados, and other severe weather conditions. - Emma.

The final 8 respondents have thoroughly planned strategies for dealing with emergencies; they go into detail about their approach and the reasoning behind their choices.

> If there is an evacuation ordered and my family does not leave, I will not leave them. If they decide to leave, I will leave with them. My mother-in-law leaves if its anything over a category one for medical reasons. I will stock up on several weeks supply of food that is non perishable. Any perishables I will pile and insulate either in the freezer or fridge until power runs out and then i have a plan to keep perishables cold in coolers for several days. Outdoor cookers with charcoal, fire starter and wood for fires if temps drop at nighttime. Tarps, nails, and tools ready to patch roof holes. I will stock up on dog food and have a first aid kit and medicines for my animal. Take precautions to prevent any damage I can control around the house. - Carla.

In a subsequent item aimed to affirm and recontextualize this item, we asked respondents for more details about their plans, especially in case of evacuations: "What is your plan regarding evacuation during an emergency? Do you have emergency supplies or emergency kits?" This item revealed a few adjustments from the previous item, though for 4 of the respondents, no change of stance happened between the previous question and this, as either they still have no plans or their plans already account for evacuations. However, a portion of respondents, 3 out of 28, have their stance stirred

into action, as the chance to express themselves about these themes has enabled them to take action.

> Unfortunately, I will say that me and my housemates are relatively unprepared in regards to this. I do know the general things that should be kept in mind, such as first aid, medications, pets, and water- It is something that I should probably put more thought and effort into compiling so that it is available should the need arise. - Monique.

Out of the rest of the respondents, 10 went into further details about their plans, even reconsidered their position, and expressed what they would do if they had to evacuate or faced an emergency. The remaining 11 out of 28 respondents focus solely on their evacuation plans, making a distinction between staying put and the process of leaving their dwelling behind.

> Arrange your evacuation ahead of time. Don't wait until the last minute to plan your evacuation.Plan what to take. Many families choose to have a go bag ready with some of these critical items. - Sonya.

The sample continues to demonstrate their competency regarding the study's subject matter; the following item in the section is related to identifying hazards and how and why they prioritize them: "In the game, at the beginning, you are given the chance to make sure everything is safe before calling out the rest of your family from the bathroom. Did you check for any potential dangers? Are the two potential hazards presented in the game something you were aware of/knew to check for?" A fraction of the participants, 6 out of 28, responded with a simple explanation of an in-game mechanic, an appropriate answer but did not provide much in the function of analysis other than the memorability of the scene.

For the rest of the respondents, half of the 28 participants (14) declared they looked for the specific hazards because they are dangers they would find in real life. In their responses, there was a similarity between their real-life experience and what they saw in the game. They knew that debris and/or gas lines were hazards that they should look out for, as they are also present in the emergency cases that they had faced in the past. Thus, they were satisfied with their inclusion in Storm Line.

> Of course I did. Gas lines (if you have them) are always important to look out for, though in this house I'd be checking the

electricals first. Hurricane or tornado, the roof and windows are always a thing to watch out for. - Sarai.

The remaining 8 responders declared not having considered one or both hazards. These participants expressed surprise that some seemingly innocuous elements of life can quickly turn into a situation where harm can come to a person.

I knew of broken glass and sharp debris, but the gas leak was something I didn't think of at first. I opted to have my mum check it for me the first time because I assumed the main character wasn't an adult and an adult should handle a gas leak. The second time I checked it myself because the game seemed to hint I should do it, and I was interested in seeing if it did anything differently. - Ellie.

The last item of this section was about how the players perceived the family's preparedness in the game: "Do you think the family prepared well for their emergency? Why?" This question serves as an evaluation of the narrative and a review of the player's own crisis preparedness. In general, none of the participants seemed to ignore or sideline this element of the game. The efforts of the GCF were in full display as 13 out of 28 participants

had positive things to say about the family and could pinpoint the steps that this particular story wanted to underline about how some of the survivors of Hurricane Maria weathered the storm.

> As well as they could be, considering they did not evacuate (and this is not as feasible an option on an island nation). They had the concrete/cinder block bathroom as a storm shelter, and that's a lot more than some can say. It really protected them. - Jules.

Conversely, 3 of the respondents saw this question as an opportunity to relate to their situation in somewhat uncertain terms but made it clear that they would do the same things. However, the remaining 12 out of 28 respondents were a welcomed criticism of the family and their shortcomings. The game intentionally put a fault on the family plans: their emergency food supply, hinting that the cans of stash had gone bad, as well as not preemptively securing all windows and cutting off the gas.

> I think they were well prepared for the crisis. They had a safe place to stay in and water and food, although some of the canned food had gone bad so maybe the best thing to have done is check before the hurricane hit land, when they were warned in the news. - Ben.

This reinforces the already notable position of this pool of participants and the fact they are locating these subtle but evident shortcomings as designed spaces that the GCF portrays as believable scenarios tailored for the experience.

Active Behavior

In this last formal section of the questionnaire, participants were questioned about their behavior when searching for information and their means of communication choice. This section is pivotal as to how the participants gather and share information and identify reliable sources (Lindell & Perry, 2012). Likewise, there is an effort to understand how they communicate with their social circle and family and their actions when the normalcy and reliability of their usual means break (Kasperson, et.al., 1988).

First, we ask the participants about their primary source of information: "When a severe weather event or Hurricane is projected to impact you, where do you find information?" A marginal single respondent out of the pool was unsure about this question, arguing that information came after saving their own life in case of emergency. 5 participants

declared that they mainly looked for information online but did not give details about the venue, while 6 of the respondents made a point to cite and refer to official sources like NOAA or meteorologists online.

Of the remaining participants, 8 out of 28 declared their predilection for classic media like newspapers, tv, and radio. The final 8, however, were a more interesting case. This group tried to explain why they sought the sources they used, underlining a need to find the most reliable, most valid information available depending on availability and access. That means that if one of the usual channels was feeding untrustworthy information or was unavailable, they would swap that source for another one.

> I find information through reliable, peer-reviewed sources. These include trustworthy news sites and government weather reports. I supplement these with the relevant hashtags on Twitter to see how local neighbourhoods are fairing. - Allen.

After this query, the follow-up focused on the type of information they searched: "What kind of information do you usually focus on?" The majority, 16 out of 28, would primarily focus on the nature of the phenomena: its location, intensity, and trajectory. This is a very reasonable approach, as it

would open up possibilities for action. 3 out of 28 participants, on the other hand, primarily would focus on the procedures and official instructions like evacuation orders, shelters, and aid centers. The remaining 9 out of 28, however, had a more comprehensive approach, focusing on both the nature of the storm and the official message from authorities and agencies.

> Where food banks and evacuation centers are located. Emergency contacts, routes to hospitals, and police stations. Location of relatives and close friends. Areas where things may be donated like clothes, food, medical supplies, etc. Danger zones for landslides and flooding are also really vital. – Ben.

To follow up on these questions, we put the participants' perception of their information validity in question with a simple question: "How do you know that the information you are getting is reliable?" The results from this query were revealing, as it was not a straightforward set of answers on whether or not they trust their sources. A minority of 3 were pessimistic about their information, not outright dismissive, but they did not seem to have any recourse in case their information was invalid. It is interesting to underline that all pessimistic outlooks come from respondents relying mainly on traditional media.

> I mean I've seen them report correct info as far as I know thus far, I guess if they wanted to lie I'd just be screwed. If I can't trust the locals than who CAN I trust? - Anya.

However, a fraction of the participants had a naiver yet justifiable stance; 7 out of 28 declared that they simply trusted their sources because of their familiarity with them, how reliable they had been in the past, and the prestige they might have.

> By making sure the source of the information is reliable. When it comes to this, I almost always go to websites and sources that have experts in weather, such as newspapers and weather people (like Ada Monzon). - Gallia.

The remaining respondents fell into a dichotomy; 9 declared that they rely on the information they get because it comes from official media like NOAA and other institutions. The other 9, however, had a more nuanced answer, saying that they compare and contrast the sources of information with one another to make the best-informed decision possible.

I guess I don't. I try to look at different sources and compare them, and if most sources agree, I feel the info is reliable. - Lea

To follow up on information gathering, we continue with communication. These last two questions in this section are aimed at helping the participants consider their own practices when contacting others. The first question is simple "How do you keep in touch with other members of your family/social circle?" A minority of 2 rely solely on online platforms; however, the rest of the respondents are an even split between relying on mobile devices (13) and a mix of face-to-face, mobile, and social media, with just a couple mentioning landlines (13) these revelations are in accordance to how times are changing and society's reliability on mobile networks.

This is why the follow-up question is so important: "What would you do if you no longer have access to your usual means of communication?" This simple query was enough to ignite in the participants a scramble for options. Except for a singular respondent that declared to have nontraditional means of communication like radios, the rest fell into different categories of opinions.

2 of the participants declared that they would try to use any of the varied mediums available but were uncertain how to go about it or if it would even work. On the other hand, 12 out of 28 respondents realized that they had little to no options known to them when it came to a communications breakdown. Some start to formulate options, like setting up rallying areas or backup plans, but most seem to understand that this is an element of their life that can easily be disrupted.

> It would be devastating as no access to such means sort of paralyzes my access to information. It would be devastating. - Dale.

For the remaining 13, the Storm Line lesson resonated with them and mentioned finding areas where communication was reliable or at least more likely to remain. They make mention of government buildings, enterprises, and other places where ground lines are more likely to be available. To these users, the possibility of losing their usual means of communication is a threat, but they have formulated a plan to try and counter it.

> I would try to seek an alternative method of communication. I know local libraries typically open after an emergency and have computers there. - Rodrigo.

In all, the responses from the participants provided insight as to how a game created by the GCF can help them recontextualize and reevaluate their stance regarding communications and information.

Extra information, personal stories, and salience.

The final queries of the questionnaire were optional questions where the participants were given the opportunity to share their own stories, how the game presented them with something they had not considered before, and what were the most critical questions in the questionnaire.

Personal experiences fell into four categories: Frustration (6), Relief for not having direct experiences like the ones depicted (3), and unity messages (3). The rest chose not to answer or had answers that were not related to the study. Frustration stories share common themes of disappointment towards their own actions in times of emergency, or the actions of others, whether they be institutions or the general population.

> Having personally been very affected by hurricanes in the past, one of the things that upsets me the most is having people take them

lightly. The hurricane I almost drowned in the floods of was treated as "not a big deal" by my local community before it hit and as such it took us all by surprise at how devastating it was. I think awareness of how dangerous they can be is extremely important. I think the research you are doing is extremely important, thank you. - Adam.

Unity stories hinged on how the group could better get through an emergency and made calls on how their experience reflects this.

Working through a hurricane is different than living through one. Working was good because it kept me busy, but I also had to ensure that people were calm and were being helped with leaks and everything. - Lea.

Stories where the participant expressed their separation from extreme danger, fell into stories of relief, acknowledging their position as privileged and thankful for not having the experiences that the characters in the game had.

> My hometown was struck by a "500 year flood" in 2012. I live on a hill and we avoided damage to our home as a result, but many of the kids I went to school with were permanently displaced due to entire homes being washed away. Kids were unable to go to school for the rest of the school year, adults weren't able to go to work or get food for their families. Watching my friends go through that affected me deeply, even though I wasn't affected personally. - June.

This variety of experiences helps visualize what this diverse but unified group of severe weather-aware participants find essential. The GCF and Storm Line did provide them with his sense of representation of their own stories, which we can see in the following question of the roundup: "Do you think the game presented something you had not considered before? what was it, and why?" Responses were revealing and varied, but the answers were grouped into a few categories. To a singular respondent, the game was merely a chance to experience something new. However, the rest of the responders found a deeper meaning to Storm Line.

To some, it was a sense of familiarity; 5 out of 28 reported recalling their own experiences and putting the aftermath in perspective, helping them realize weaknesses in their plans and reevaluations their strategies.

> This game allowed me a perspective I have not had in years. It is easy to forget how devastating it can be to be separated from loved ones with no way to contact them. - Chad.

To another portion, 9, it was an opportunity to reconsider their position in society, their relationship with the vulnerable, and their community, seeing that beliefs they had held before can be different and that alternatives exist.

> The biggest element was the positivity. I tend to have a pessimistic view of the situation, but it is nice to think of persons being able to work together and get through the hardships. - Linn.

In others, their most significant takeaway was the necessity to have a plan in case of crisis and disasters. 12 out of 28 participants reevaluated their stance in the face of phenomena, both known and those that they did not think were possible.

> I think I've considered it in a hypothetical way (anxiety!) but not in a step-by-step "what would I do?" kind of way. I would not have

considered trying to find a pay phone or means of communication like that. - Ellie

As a final question, the questionnaire left them with the prompt of what question was most important to them. A singular respondent made a plea for all of them, a sentiment that was appreciated but did not help fully grasp the question's importance. Equal portions of 3 out of 28 participants decided that "Awareness" and "Empathy" were the most important categories. In this camp, respondents seemed to care about contextualizing their own experience in the function of severe weather and the community at large.

A more significant portion of 7 opted for giving their most important status to "Active Behaviors," mainly regarding how to identify reliable information and sources, with some interest regarding the communications and means to contact others.

The rest of the participants and 14 out of 28, leaned towards "Knowledge and skills," arguing that this category was the one that connected more directly to their survivability by having emergency plans and identifying the kinds of crises that they could go through.

In this chapter, I presented the results from the questionnaire participants filled out to find the themes around Awareness, Empathy, Knowledge & Skills, and Active Behaviors. These results gave me insight into the most essential elements that can help players.

VII.- Conclusions

In this final chapter, I will lay down the conclusions that can be unraveled from the study's results and analysis. I will also go into the future of research using the Gamified Crisis Framework (GCF).

This study represents both the culmination and continuation of four years of constant and ongoing research toward understanding how to better prepare people to face major natural disasters. This is an objective shared with other peers and colleagues that can attest to how much a single moment in time can forever change the livelihood and perspectives of a human being. That is the main reason why I coined the concept of a "Paradigmatic Real-World Event" (PRWE), to represent just how transcendental some of those crisis events can be. In the introduction, I went into detail about which events could be considered paradigmatic, and for this work, I focused on the event that has occupied the bulk of my attention: the 2017 hurricane Maria.

The analysis of the participant's contributions has shed light on the ways the Gamified Crisis Framework (GCF) could help people understand just how severe and life-changing a PRWE can be, highlighting the nature of

disasters and including society and people as critical factors in these events. It can also help them empathize with the people who have suffered from the impacts of such PRWES and, after analyzing the respondent's answers, what is most important, to identify and prepare for crises and disasters events that they are vulnerable to themselves. Going into this study, I had a big question to answer and 4 smaller but not less essential sub-questions to support it. Before answering the big question, I will go into the 4 sub-questions and build up towards the big answer.

Regarding the first research question, "How might serious games about hurricanes help populations at risk improve their risk perceptions when faced with a hurricane crisis?" awareness is one of those outcomes that can be somewhat hard to properly grasp. Still, as I analyzed and considered the respondent's questions, more and more evidence came about the perception and awareness of the risk that comes with the individual's experience.

It is evident that people who have not been exposed to situations of risk do not have a grasp of the importance of having a basic understanding of their environment and its volatility, along with the dangers that they

might imply, as is seen in the models for crisis communication, in particular the Mileti model and its perception of risk (Mileti & Fitzpatrick, 1992).

The participant pool for this study was highly aware of the risk and well versed in the potential for danger, but not all of them had firsthand experience on just how destructive a hurricane could be and the dangers they could represent. Thanks to the sampling, most had at least cursory experience with hurricanes, and most were aware of the ramifications of hurricane Maria. But not all could say that the phenomena had scarred or changed their lives. So, when the game presented them with a dread scenario, they commented on how much worse the situation was, and those who had actually been through similar events commented on how much it was like what they had lived through.

Through the game Storm Line, the GCF made use of its inclusion of real-world elements and was nurtured through real accounts of survivors, helping recontextualize and reevaluate the participants' perceptions of risk and can potentially do the same for a wider audience.

Regarding the perception of vulnerable people and the level of empathy towards them, there are a couple of venues that participants

expressed during the study. The second research question: How does playing serious games regarding Hurricanes change the perception of vulnerable populations? Aimed to understand this. All the participants had at the very least a vague notion of what made a person vulnerable to crisis, and half of them even identified some of the systemic issues that put them in such a state of vulnerability. A minority seemed to see themselves separated from the vulnerable population. Still, for the rest, an exciting trend emerged that had them either in the position of someone who is a member of a vulnerable population or someone who could help the vulnerable population, taking the opportunity to exercise this position and see their actions positively help others, building their empathy (Wang, Singhal, 2009).

The scenario presented the participants with an opportunity to help someone else during the game. By design, it made it look like the person was vulnerable but not in direct danger. Some participants opted not to lend aid, but not for selfish reasons. Instead, they acknowledged that their own situation was worse, and they needed to take care of their own, while a portion saw this as an opportunity to simply complete an objective, appreciating the positive outcomes that potentially come from helping others. The rest were moved by their own experiences. Players could see similarities between their own experiences of risk and crisis to those of the

characters in the Storm Line; some could relate to them to a lesser degree. Still, others could even personify the tragedies and dread of the situation, seeing how others are being affected and seeing how all the context surrounding the situation (Olivier, Et.Al., 2019).

The GCF, through Storm Line, had the players experience a situation at different levels of personalization, helping them see the hardships of others, and directly exposing them to the consequences of vulnerabilities, particularly on populations at risk. The majority of participants felt a kinship for them and wanted to be prepared to aid or lessen the strife of the vulnerable, in some cases, including themselves. As a Model, the GCF has the potential to stir players into reevaluating their own vulnerabilities and those of others, but to improve on them should include several scenarios and more evident consequences than those presented in Storm Line.

As I moved forward, the theme changed toward the knowledge and skills needed for times of crisis and the question: How does playing serious games about hurricanes change the skills that populations at risk have when facing a hurricane crisis? Was the main venue to understand it. Participants, in general, were well versed in the implementation of emergency plans and evacuation, only a few had no plans, and after playing the game, even those

felt motivated to improve their preparation and gain new skills, according to the assumptions that even cursory experience can enact change (Boyle et al, 2016). But even for those with solid skills and planification, the game was able to present them with new considerations in the opening scenes where the player has to assess the danger in the immediate vicinity of their family's location.

To the players, this subject was the most important. Players appreciated the fact that they could experience this in the game. They made not that from that point onwards, checking for glass and gas leaks would be part of their routine, confirming the GCF's objective of providing safe environments to see hazards happen and the abilities that can prevent harm, providing the player with the safe environment that I hoped would be provided and taken advantage of (Breuer & Bente, 2010). Not only that, but when it came to finding ways to communicate with others, a few appreciated the idea of landlines being reliable as something new to add to their repertoire of survival tactics.

The GCF, through Storm Line, presented to the player an opportunity to experience skills that can potentially benefit their own survivability and safety during a crisis event and the disaster that follows it. By presenting

real-world scenarios from the accounts of real survivors and in the context of the location of the PRWE, the GCF presented them with situations that were all the more believable and thus stayed with the participants more. Even if briefly, the skills presented in the game were present in the player's answers, adopted by the participants, and present in their answers, this is encouraging, as it denotes the way skills are presented through the GCF can be conveyed successfully.

The final of the sub-questions is aimed at the active behaviors and the query: How does playing serious games about hurricanes change the behaviors that populations at risk have when faced with a hurricane crisis? Participants, in general, seemed to have the drive to act on their skills when presented with a crisis event; not only did they have a good awareness of the situation, but between the revelation of new possibilities and the GCF's presentation through Storm Line for better practices and their benefits, they seemed to have a solid grasp as to what to do as the Protective Action Decision Model depicts (Lindell & Perry, 2012).

However, there is a split between the ability to know what to do and the ability to do it, as sometimes the consequences of the action can stop a person from acting even in a game setting (Breuer & Bente, 2010). The

participant's answers provided insight, mainly when it came to how to look for information and how to communicate with others. The section on the ways participants looked for information and how they corroborated their validity where a glance at how executing a skill does not always mean doing it right. The questions regarding communication denoted how the participant would react to breakage of their regular use of mediums, having access suddenly impeded. Additional to this, the evaluation of skills also provided the opportunity to have the respondents share their own ways of reacting to emergencies, not only comment on the preparations they had laid down or considered laying down after playing Storm Line.

In general, and inspired by the game events, people seemed to realize seeking new mediums is a reasonable action to take, while others came to the realization that when communications break down, most of their actions are interrupted, and without a plan or awareness of where to mobilize and get what they need, they are not in a good position.

The GCF, through Storm Line, had the participants reevaluate their behaviors and capacity to react faced with a crisis event. Some denoted a capacity to adapt and find new venues, but a considerable number of participants denoted realization of their loss means and had to meditate on

what to do. In general, the GCF has given the participants who played Storm Line a space where they could see their behaviors reflected and some options to adapt. In wider audiences, the GCF has the elements necessary to display similar scenarios that can benefit the players.

Given the above, my findings lead me to answer the central research question proposed for this dissertation: What elements of serious games can help people who are at risk to better face a crisis situation?

To the players, the most salient element of Storm Line was the opportunity to perform actions that they deemed necessary to improve their wellbeing during a crisis event. This is consistent with the idea that when a player adopts a game and can perform actions safely, they are more likely to adopt skills and even explore different outcomes, safe spaces to experiment and see things play out and even retread on failures (Breuer & Bente, 2010). Furthermore, the GCF presented them with a fictionalization of a PRWE that was deeply built from the experiences of the survivors of Hurricane Maria, and such, the participants connected to the characters and connected the game set to the real-world setting; to the point that some even saw echoes of their real life in the game, personalizing and connecting with the societal reality around them (Olivier, Et.Al., 2019).

In the end, the participants and analysis make an argument that the GCF, through the game Storm Line, should underline the skills and behaviors that represent the best course of action in a situation of crisis. The experience is reinforced by the location and sincere realism of the event, and that familiar realism, portraying characters and locations that can be identified or related to in the real world, provides a venue to make that skill and behavior affirmation even more impactful and staying.

The GCF has all the elements to make this happen; its guided structure allows to plug in as much and as complex information as needed, but the results of this study and from the participant's perspective, the more they can do in the game and the more feedback they get, the better.

Final thoughts and future research

The Gamified Crisis Framework, from its rudimentary inception, was always aimed at trying to help represent the context and narrative surrounding the strife and resilience of communities that were trusted into situations that, for many, are unimaginable, both because of the severity of the event and the level of loss that they can bring. However, this assertion is, in fact, a lie. Anyone can find themselves in the midst of a PRWE,

anywhere in the world, at any moment in time that could change everything in an instant.

People need to be prepared, and they need to be aware of the best practices and the attitude necessary to face the risk-turned reality and the worst-case scenarios. We have seen examples of the consequences when people are not prepared, when agencies, businesses, and governments are not prepared when people are so sure about their status quo that when a breakage comes, they are helpless. In this study, I focused on the 2017 hurricane maria, and I did so through a very simple and rudimentary Twine prototype. Players praised the narrative but were left with a need for more, and some were even excited about the possibility of seeing better gameplay and different situations.

To progress, the effort to prepare people for the worse games cannot stay in the realm of instruction manuals or fictionalized scenarios. The GCF provides the framework, and the developing team that includes research fills them. In the case of Storm Line, a team of one did this much. A team of experts and veterans would do so much more. Perhaps the full fictionalization of Storm Line was one of its weaknesses. A participant pointed out, "I thought the location was Culebra!" a small island that was

the actual first part of Puerto Rico to be impacted by Hurricane Maria, and that from the interviews, the MSU research team that I was a part of recognizes, both as a reference and as a firsthand account.

But as it stands, and as short and simple as it is, Storm Line served as proof of concept, and future work should focus on including more interactive game mechanics accurately representing necessary skills and more interactions that present the player with the outcomes of their actions.

For now, Storm Line should be like the scenario that is presented in its words, a small event that passed and triggered action that needs to be followed by a much bigger event that can change everyone's life, but unlike the hurricanes in the game, destructive and frightening, let these game be agents of change for good, and means to prepare our future generations to face this world as it convinces and changes.

APPENDICES

Appendix A: Visual representation of the GCF

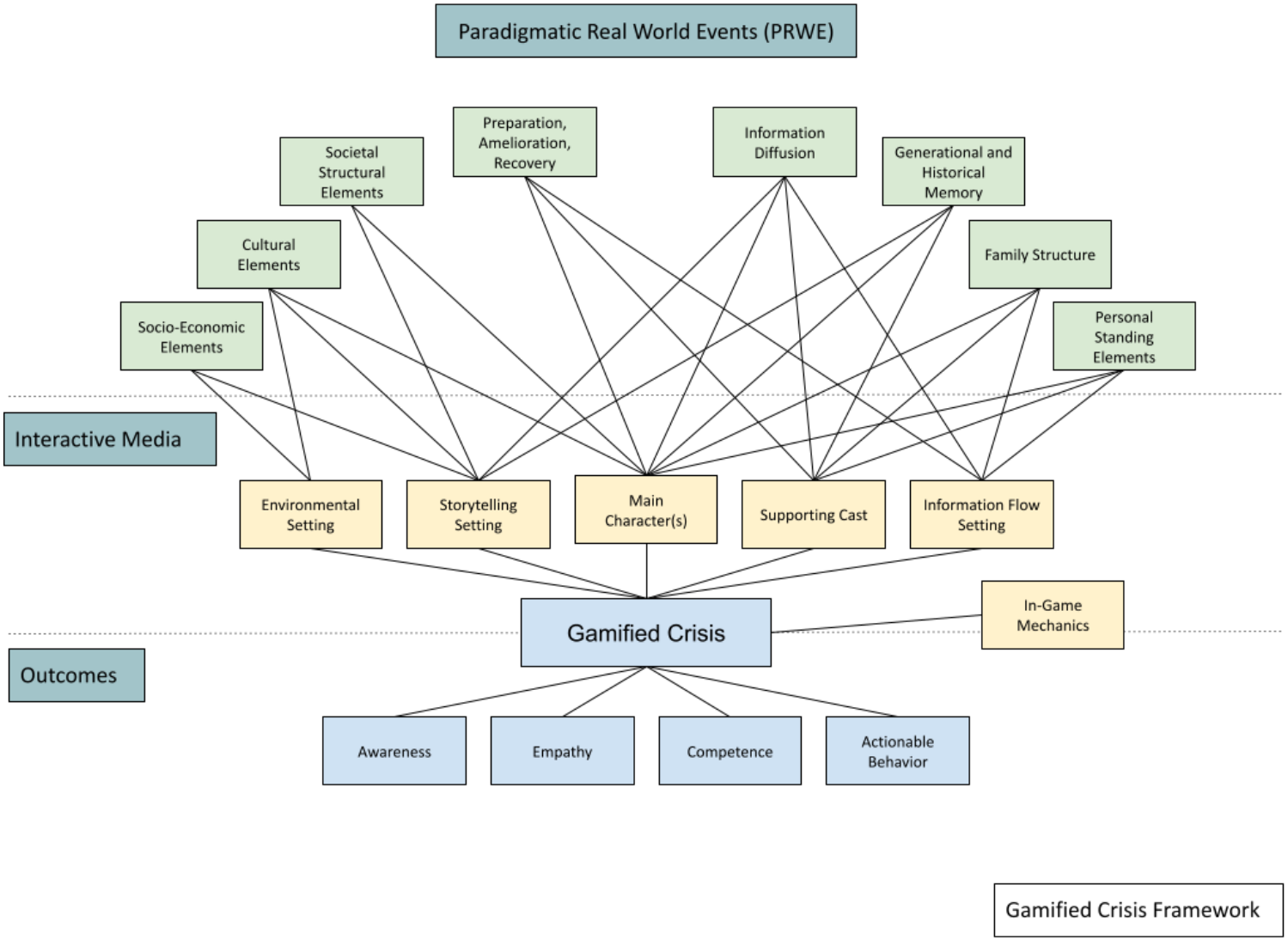


Figure 1: the GCF

Appendix B: Game captures.

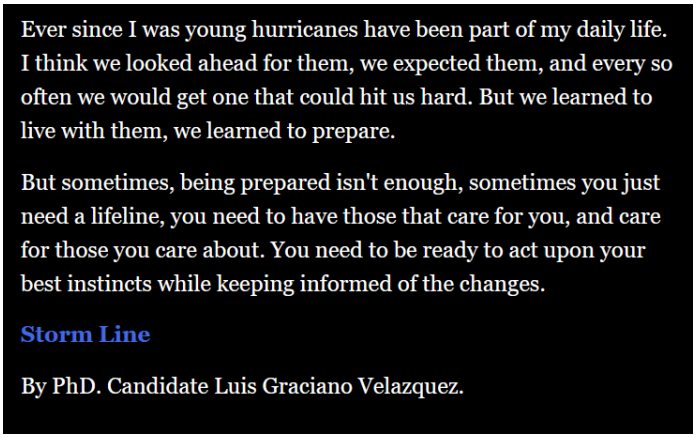


Figure A.1: Opening lines of Storm Line

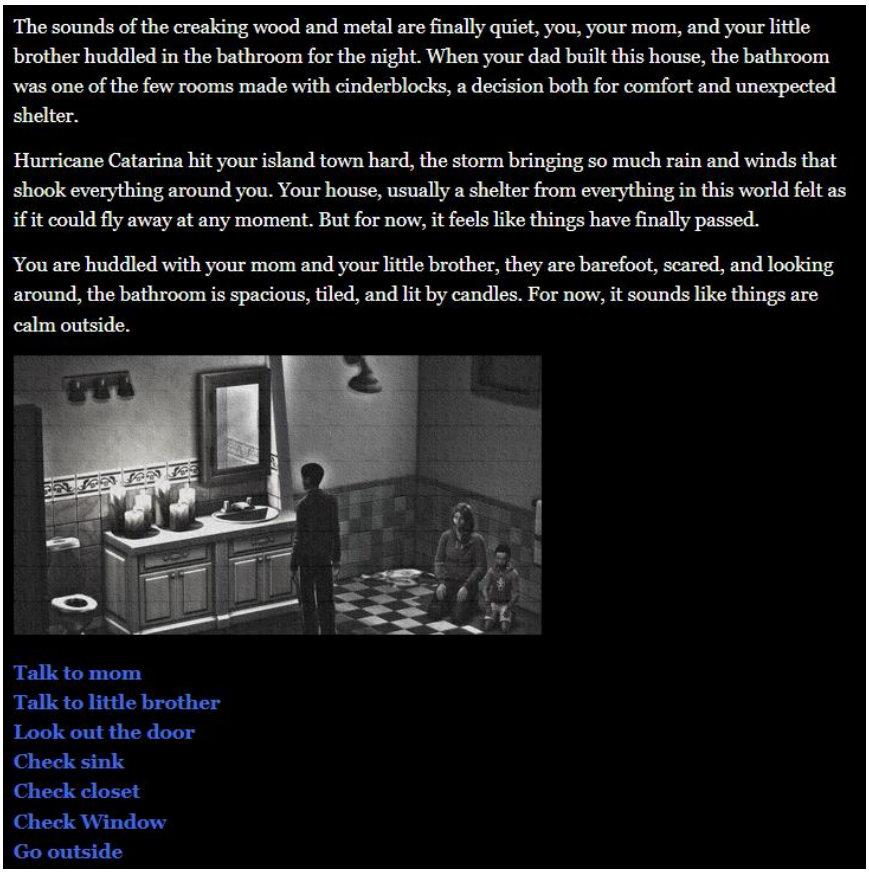


Figure A.2: Taking shelter in the bathroom

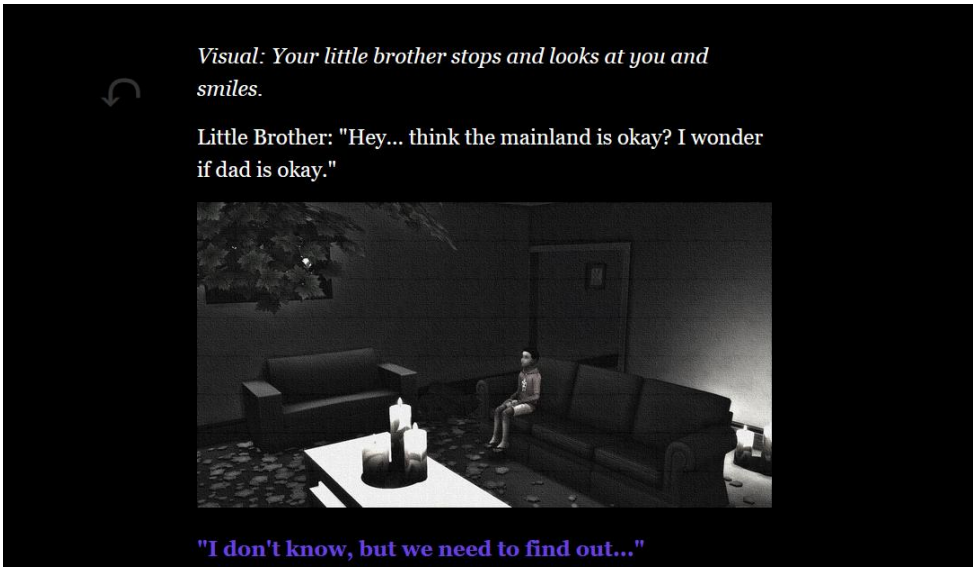


Figure A.3: Little brother admiring the damage

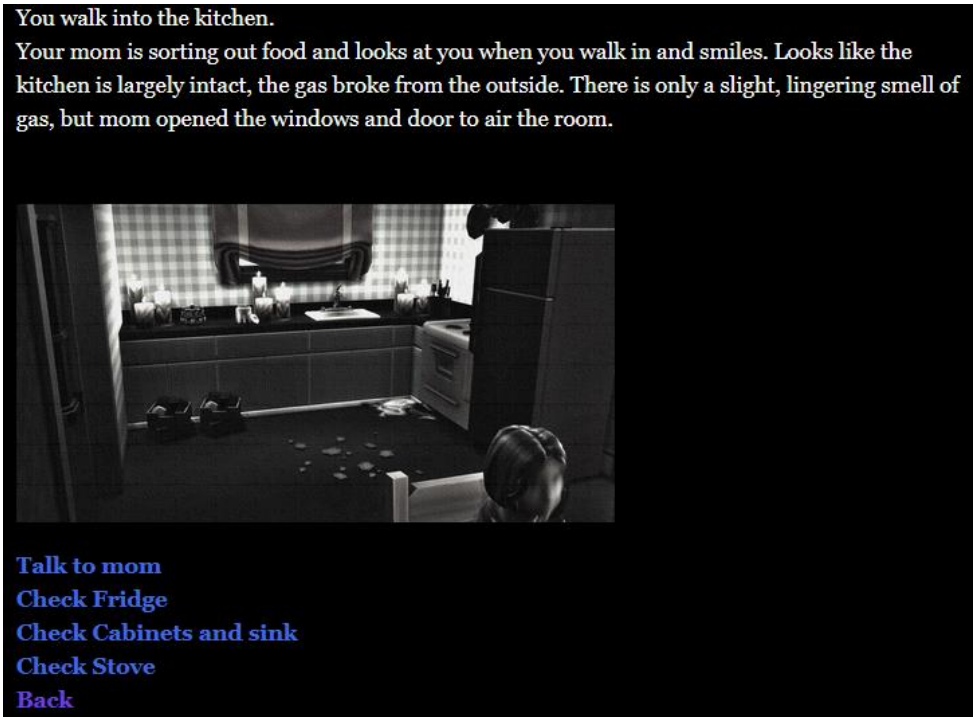


Figure A.4: The kitchen, talking to mom

As you talk with your dad you start to notice that other folks around the plaza are taking notice of you using the old phonebooth, and it looks like they are milling about. A lady even knocks on the glass, looking impatient.

You: "Okay papá! Other people want to use the phone... I think this old booth is the only one that works... I'll try to call you again tomorrow... maybe... keep us informed?"

Father: "Si hijo, of course... just... I will try to get there, but there is just no way right now..."

You: "Dad...I think you are helping us more from there... there is just no news..."

Father: "I know... still you know what to do... okay?"

Love you dad!

Figure A.5: Calling dad

You hang up and get out of the booth, immediately the lady rushes in, but she is pulled out by another woman, there are shouts and some people are starting to get rude. You purse your lips and walk faster away.

You: So... They are giving relief at that fancy hotel and at the market! We are in luck... the tarp will patch that hole on the roof, plus more water and food is good. Yet, This isn't over... we need to prepare! It feels like a string of bad luck! But, I can't lower my guard, I can't be complacent... this is bad, and we don't know how bad it will get... I can't panic...

I better get back home

Figure A.6: The way home

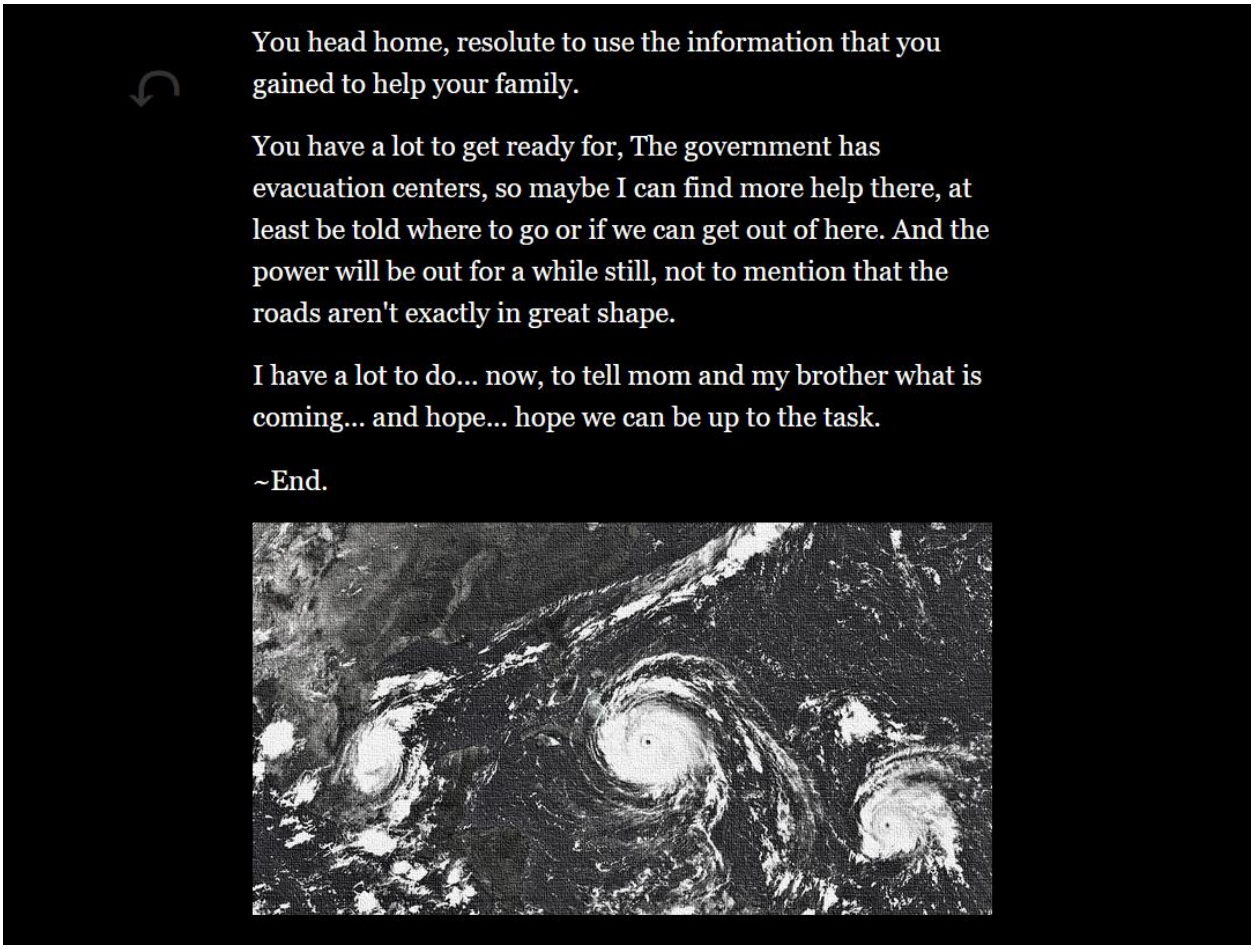


Figure A.7: Closing Screen

Appendix C: Game design postpartum and archive.

A few casual words to follow up the design of Storm Line using the Gamified Crisis Framework. The game offers a simple straightforward experience, but also offers a few nuances that few players commented on. There is a moment in the game where the player has the option to help the mother of their player character by either shutting off the gas, telling her the gas is leaking or ignoring the situation and letting her get hurt. In game the repercussions of letting mom get hurt are obvious, she will snap at you, be hostile and will even be compounded if you let the character's brother get hurt.

These subtle changes where an attempt to make the game feel more alive and to try and make the players feel like the interactions had meaning. However, players did not comment on this, was it because they where too subtle? Or because players paid more attention to the gameplay, they did the "right way." A few comments di point out that the game was very positive, that all came out okay even with he negatives, this is where I wish I had made this longer. Your brother gets an infection from his cuts, your mom is getting more and more sour, the Don shuts in and withholds help and at one time where every bad decision made culminates on the player's

house collapsing, the Don would not help. This game is set in between two hurricanes, inspired by Maria and Irma, so a lot of drama, some intrigue and disinformation would take place as the player prepares for a bigger, deadlier event. The main character's father, serving as a source of reliable information, but needing to complement with the locals to get the true details about where to go for help. Did the players notice the difference between the father checking the current weather and the future weather? Current discards one of the relief stations, future lets them know more problems are coming.

But for this iteration it concludes with a cliffhanger that people wanted more of, more complexity, more story, more consequences and not only markers and simple outcomes. I must revisit this game, acquire better tools, a team, funding, there is interest, and it can potentially save lives.

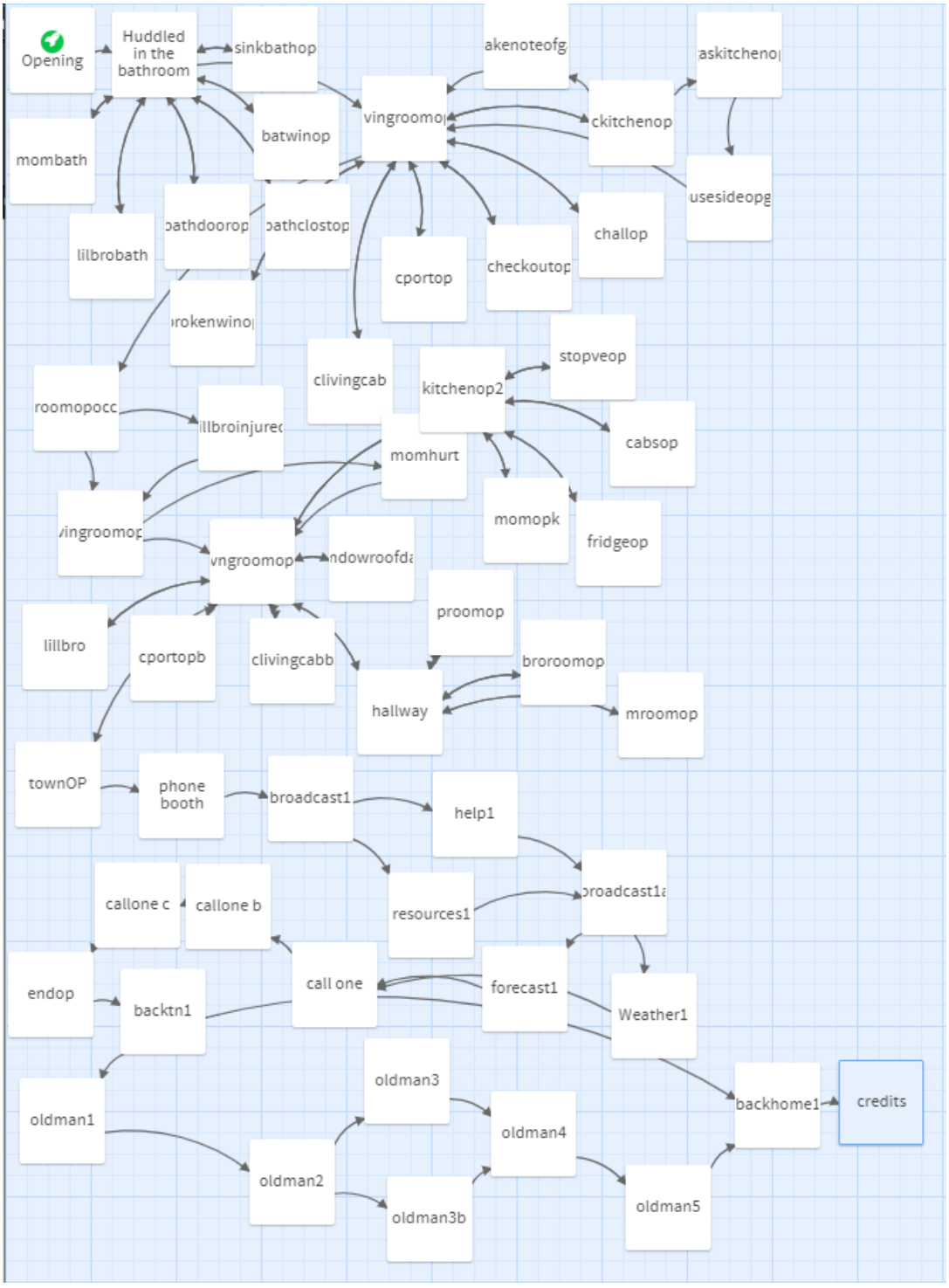


Figure B.1: Storm Line's branching

```
You head home, resolute to use the information that you gained to help your
family(if: $oldmanfriend is 1) [ and the Don].

You have a lot to get ready for, (if: $help1 is 2) [The government has
evacuation centers, so maybe I can find more help there, at least be told
where to go or if we can get out of here.  (if: $oldmanfriend is 1)
[Luckily, the Don is willing to give me a ride, good, because that would
have been quite a walk]](if: $res1 is 2) [ The government is distributing
aid, so I need to get whatever I can for my family. (if: $oldmanfriend is
1) [Luickily, the Don is willing to give me a ride, good, because that
would have been quite a walk.]] (if: $forecast1 is 2) [And we really need
that help, especially with another hurricane coming our way... wonder if
it's going to be stronger than the one we just have... I shudder just at
the notion. (if: $oldmanfriend is 1) [The Don is all alone here... so if
worse comes to worst, we can weather it together... especially because his
house is sturdier.]] (if: $current1 is 2)[And the power will be out for a
while still, not to mention that the roads aren't exactly in great shape.
(if: $oldmanfriend is 1) [We already know there are some places we can't go
to, but the Don thinks we can get a power generator, bet he will be willing
to share it with us.]]

I have a lot to do... now, to tell mom and my brother what is coming... and
hope... hope we can be up to the task.

~End.



<img
src="https://ia902503.us.archive.org/25/items/bathroomSL/stormlinesSL.jpg"
width="640px" height="339px">

[[ Credits ->credits]]
```

Figure B.2: The final story screens markers and different outcomes

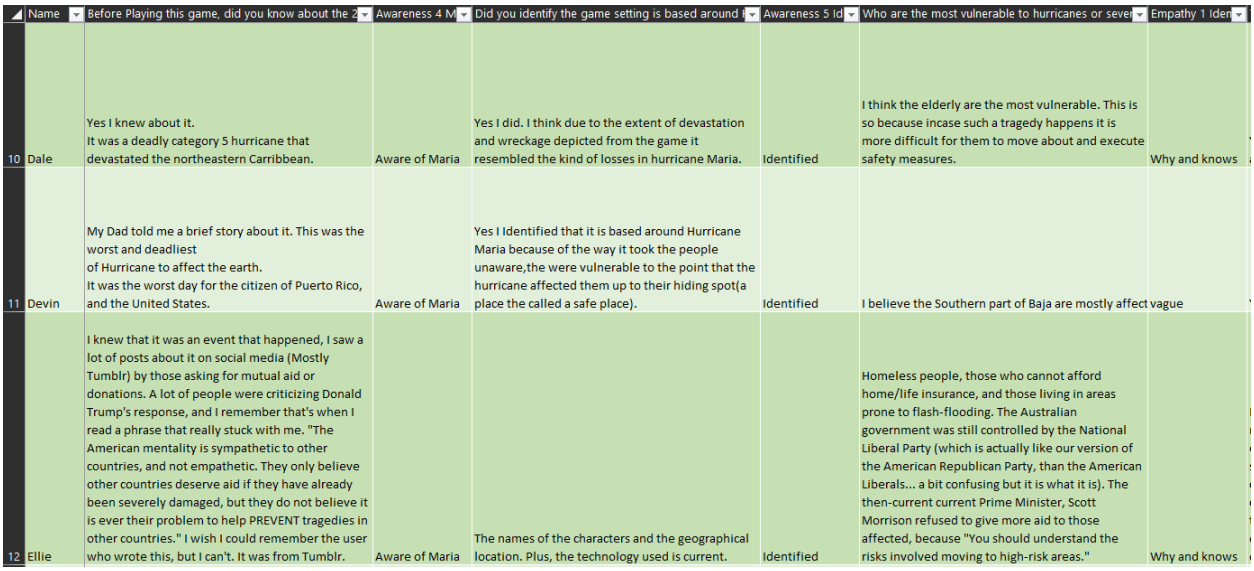
As for archiving this work, the game now also lives in the Internet archive. While the link in the body of the text should live as long as I do, and that one will work in mobile devices, this downloadable file should serve as a backup for both the game and the images used.

https://archive.org/editxml/storm-line-ia-version

Appendix D: Sample of data set spread sheet and coding.

	A	M	N	O	P	Q	R
1	Name	What is your experience with severe weather events? Ever had experience with Hurricanes?	Awareness 1 previous experience	Do you think Hurricanes are changing?	Awareness 2 Hurricane knowledge	To what extend have you been personally affected by hurricanes?	Awareness 3 Hurricane experience
2	Adam	I almost drowned in a flood in Virginia during Hurricane Matthew in VA in 2016. My boss forced me to stay late at work despite warnings from coworkers that people needed to leave to get home safely and it caused me to get caught in flooding.	Extreme	I don't think the hurricanes themselves are changin	Standard	As I stated before, I nearly drowned in hurricane flooding. My partner's car stalled out when the waters got too high on our way home from work and we had to walk the last two miles home in floodwater that ranged from knee to chest high. I got knocked over a few times and had trouble righting myself, we both got very sick afterwards, and my partner's car was beyond saving. We also lost our jobs as a result of losing our transportation due to the flooding.	Deadly
3	Allen	I have experienced severe weather events in Nova Scotia, mostly extreme rain- and windstorms. However, we have had hurricanes. In 2019 we experienced Hurricane Dorian and in 2021 we experienced much of the effects of Hurricane Henri.	Intimate	Hurricanes seem to be increasing in frequency. While I acknowledge that there is an Atlantic hurricane season, the number of hurricanes or tropical storms occurring along the Atlantic each season seems to be increasing.	Worsening	During Hurricane Dorian, the wind and rain had resulted in days of power outages and water outages, meaning that I had to rely on non-electrical sources of power and light. Significant damage occurred to infrastructure as a result of overblown trees and powerlines, which made commuting to and from work almost impossible for me.	Severe
4	Anya	I'm not sure I've experienced a storm bad enough to	Cursory	I do. I remember hurricane Katrina hitting New Orle	Worsening	I personally haven't experienced hurricanes very m	None

Figure C.1: Answers and codification (1)



	Name	Before Playing this game, did you know about the 2	Awareness 4 M	Did you identify the game setting is based around H	Awareness 5 Id	Who are the most vulnerable to hurricanes or sever	Empathy 1 Iden
10	Dale	Yes I knew about it. It was a deadly category 5 hurricane that devastated the northeastern Carribbean.	Aware of Maria	Yes I did. I think due to the extent of devastation and wreckage depicted from the game it resembled the kind of losses in hurricane Maria.	Identified	I think the elderly are the most vulnerable. This is so because incase such a tragedy happens it is more difficult for them to move about and execute safety measures.	Why and knows
11	Devin	My Dad told me a brief story about it. This was the worst and deadliest of Hurricane to affect the earth. It was the worst day for the citizen of Puerto Rico, and the United States.	Aware of Maria	Yes I Identified that it is based around Hurricane Maria because of the way it took the people unaware,the were vulnerable to the point that the hurricane affected them up to their hiding spot(a place the called a safe place).	Identified	I believe the Southern part of Baja are mostly affect	vague
12	Ellie	I knew that it was an event that happened, I saw a lot of posts about it on social media (Mostly Tumblr) by those asking for mutual aid or donations. A lot of people were criticizing Donald Trump's response, and I remember that's when I read a phrase that really stuck with me. "The American mentality is sympathetic to other countries, and not empathetic. They only believe other countries deserve aid if they have already been severely damaged, but they do not believe it is ever their problem to help PREVENT tragedies in other countries." I wish I could remember the user who wrote this, but I can't. It was from Tumblr.	Aware of Maria	The names of the characters and the geographical location. Plus, the technology used is current.	Identified	Homeless people, those who cannot afford home/life insurance, and those living in areas prone to flash-flooding. The Australian government was still controlled by the National Liberal Party (which is actually like our version of the American Republican Party, than the American Liberals... a bit confusing but it is what it is). The then-current current Prime Minister, Scott Morrison refused to give more aid to those affected, because "You should understand the risks involved moving to high-risk areas."	Why and knows

Figure C.2: answers and codification (2)

	Name	In the game, at the beginning, you are given the ch	Competency 2	What is your plan regarding evacuation during an e	Competency 1b	Do you think the family prepared well for their eme	Competency 3
10	Dale	Yes I did. I guess I was aware of them. The gas leak and broken window is something I have experienced.	Emulated	Incase of an emergency I have s clear direction of rescue centers where I can seek refuge and also navigation means to go through effects of the tragedy. Yes I have emergency supplies and kits .	detailed	I think their had emergency supplies such as canned food. Their building was also well fortified hence not as much diverse effects as compared to their neighbours. I'd say they were well prepared.	positive
11	Devin	I only check if there's any obstacle that has been ca	No meditation	My dad has a boat and life jacket which everyone makes use of.	detailed	I believe the prepared well to the best of their abili	positive
12	Ellie	I knew of broken glass and sharp debris, but the gas leak was something I didn't think of at first. I opted to have my mum check it for me the first time, because I assumed the main character wasn't an adult and an adult should handle a gas leak. The second time I checked it myself because the game seemed to hint I should do it, and I was interested in seeing if it did anything differently.	revealed	We don't, really. We've never had to evacuate our h	affirmed	Sort of? There was tinned food and supplies in the closet, which was good, and the mum seemed to be able to quickly make food afterwards just fine. But they did need to find a tarp elsewhere to cover the hole in the roof, so maybe could have been more prepared for that. Not than I can judge, I suppose.	critcism

Figure C.3: Answers and codification (3)

	Name	What would you do if you no longer have access to	Behavior 5 com	Any personal experience or comments you would li	Personal story	Do you think the game presented something you ha	Game Instigatic
10	Dale	It would be devastating as no access to such means sort of paralyses my access of information. It would be devastating.	realization	I think I have experienced great loss but got to realise others have too. It has been an enlightening encounter.	Frustration	No. Everything it presented was something I've either experienced, witnessed, or considered.	Familiarity
11	Devin	I will look for and alternative means to send a mess	relay	No,I have shared that already.	none	It gave me some insight into how another family in a different living situation might experience such a storm and handle the moments in the time right after.	Introspection.
12	Ellie	Seek out a phone booth.	Hardline	Most of them have been given in other responses, I	none	I think I've considered it in a hypothetical way (anxiety!) but not in a step-by-step "what would I do?" kind of way. I would not have considered trying to find a pay phone or means of communication like that.	Preparedness

Figure C.4: Answers and codification (4)

BIBLIOGRAPHY

BIBLIOGRAPHY

Allahverdyan, A. E., & Galstyan, A. (2014). Opinion dynamics with confirmation bias. PloS one, 9(7), e99557.

André, G. (2012). Natural hazard mapping across the world. A comparative study between a social approach and an economic approach to vulnerability. Cybergeo: European Journal of Geography.

Anthony Giddens. (1984). The constitution of society: Outline of the theory of structuration. Univ of California Press.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory Prentice-Hall, Inc, Englewood Cliffs.

Bandura, A. (2009). Social cognitive theory of mass communication. In Media effects (pp. 110-140). Routledge.

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., ... & Pereira, J. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. Computers & Education, 94, 178-192.

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., ... & Pereira, J. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. Computers & Education, 94, 178-192.

Breakwell, G, and Barnett, J. (2003). Social amplification of risk and the layering method. In N. Pidgeon, et.al (Eds.). The social amplification of risk. (pp. 80-101) Cambridge University Press.

Breuer, J., & Bente, G. (2010). Why so serious? On the relation of SGs and learning. Journal for Computer Game Culture, 4, 7-24.

Breuer, J., & Bente, G. (2010). Why so serious? On the relation of SGs and learning. Journal for Computer Game Culture, 4, 7-24.

Brinkmann S. “The Interview” in The Sage Handbook of Qualitative Research, 5th ed., edited by N. K. Denzin and Y. E. Lincoln. Thousand Oaks, CA: Sage.

Brinkmann, S. (2017). Philosophies of qualitative research. Oxford University Press.

Bruzzone, A. G., Massei, M., & Di Matteo, R. (2018). Modeling, interoperable Simulation and Serious Games (MS2G) for healthcare and first responders in disasters within industrial plants. In Proceedings of the 50th Computer Simulation Conference (pp. 1-11).

Charmaz, K., Thornberg R., and Keane E. 2018. "Evolving Grounded Theory and Social Justice Inquiry." in The Sage Handbook of Qualitative Research, 5th ed., edited by N. K. Denzin and Y. E. Lincoln. Thousand Oaks, CA: Sage.

Chavez, M., Graciano, L., & Takahashi, B. (2019). Natural Disasters and Community Uses of Media and Information: How Hurricane Maria Impacted Puerto Ricans. Unpublished Manuscript submitted for publication. MSU.

Cohen, J. (2001). Defining identification: A theoretical look at the identification of audiences with media characters. Mass communication & society, 4(3), 245-264.

Emerson, R. M., Fretz, R. I., & Shaw, L. L. (2011). Writing ethnographic fieldnotes. University of Chicago press.

Farber, M., & Schrier, K. (2021). Beyond Winning: A Situational Analysis of Two Digital Autobiographical Games. Game Studies, 21(4).

Gampell, A. V., Gaillard, J. C., Parsons, M., & Fisher, K. (2017). Beyond stop disasters 2.0: An agenda for exploring the contribution of video games to learning about disasters. Environmental Hazards, 16(2), 180-191.

Gampell, A., Gaillard, J. C., Parsons, M., & Le Dé, L. (2020). 'Serious' disaster video games: An innovative approach to teaching and learning about disasters and disaster risk reduction. Journal of geography, 119(5), 159-170.

GAO, United States Government Accountability Office (2020). Puerto Rico Disaster Recovery. Report to congressional Request.

Genov N. (2019) Multi-paradigmatic sociology: debates present and perennial. Zhurnal sotsiologii i sotsialnoy antropologii [The Journal of Sociology and Social Anthropology], 22(1): 24–46.

Gouveia, R., & Castrén, A. M. (2021). Redefining the Boundaries of Family and Personal Relationships. In The Palgrave Handbook of Family Sociology in Europe (pp. 259-277). Palgrave Macmillan, Cham.

Guo, Y., An, S., & Comes, T. (2022). From warning messages to preparedness behavior: The role of risk perception and information interaction in the Covid-19 pandemic. International Journal of Disaster Risk Reduction, 73, 102871.

Harper, D. (2017). People and places. Approaches to ethnography, 95À128.

Hesse-Biber, S. N., and Leavy, P. (2010). The practice of qualitative research. Sage publications.

Homer, B. D., Raffaele, C., & Henderson, H. (2020). Games as Playful Learning: Implications of Developmental Theory for Game-Based Learning. Handbook of Game-Based Learning, edited by Jan L. Plass, Richard E. Mayer, and Bruce D. Homer, 25-52.

Idone Cassone, V. (2016). Lude et labora. notes on gamification at work. Performance Research, 21(4), 101-107.

Isbister, K., Flanagan, M., & Hash, C. (2010, April). Designing games for learning: insights from conversations with designers. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2041-2044). ACM.

Jaiswal, M. (2021). Determinants of Residents' Shadow Evacuation Intention During a Hurricane in the Rio Grande Valley, Texas.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. & Ratick, S. (1988). The social amplification of risk: A conceptual framework. Risk analysis, 8(2), 177-187.

Kim, J., Song, H., Merrill Jr, K., Jung, Y., & Kwon, R. J. (2020). Using serious games for antismoking health campaigns: Experimental study. JMIR Serious Games, 8(4), e18528.

Kishore, N., Marqués, D., Mahmud, A., Kiang, M. V., Rodriguez, I., Fuller, A., ... & Buckee, C. O. (2018). Mortality in Puerto Rico after hurricane maria. New England journal of medicine, 379(2), 162-170.

Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: Theoretical modifications and additional evidence. Risk Analysis, 32(4), 616-632.

Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: Theoretical modifications and additional evidence. Risk Analysis, 32(4), 616-632.

Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: Theoretical modifications and additional evidence. Risk Analysis, 32(4), 616-632.

Lindlof, T. R., and Taylor, B. C. (2017). Qualitative communication research methods. Sage publications.

Mahood, C., & Hanus, M. (2017). Role-playing video games and emotion: How transportation into the narrative mediates the relationship between immoral actions and feelings of guilt. Psychology of Popular Media Culture, 6(1), 61.

Majuri, J., Koivisto, J., & Hamari, J. (2018). Gamification of education and learning: A review of empirical literature. In Proceedings of the 2nd international GamiFIN conference, GamiFIN 2018. CEUR-WS.

Mileti, D. S., & Fitzpatrick, C. (1992). The causal sequence of risk communication in the Parkfield earthquake prediction experiment. Risk Analysis, 12(3), 393-400.

Mileti, D. S., & Fitzpatrick, C. (1992). The causal sequence of risk communication in the Parkfield earthquake prediction experiment. Risk Analysis, 12(3), 393-400

Muhamad, J. W., & Kim, S. (2020). Serious Games as Communicative Tools for Attitudinal and Behavioral Change. The Handbook of Applied Communication Research, 141-162.

Nabi, R. L., & Clark, S. (2008). Exploring the limits of social cognitive theory: Why negatively reinforced behaviors on TV may be modeled anyway. Journal of Communication, 58(3), 407-427.

Nur, M. H. A., & Wijaya, P. W. (2021). Revitalization of Traditional Games as a Tool for Contextual Education on Disasters (Case Study: Mount Krakatau).

In IOP Conference Series: Earth and Environmental Science (Vol. 830, No. 1, p. 012033). IOP Publishing.

Olivier, L., Sterkenburg, P., & Esmé, v. R. (2019). The effect of a serious game on empathy and prejudice of psychology students towards persons with disabilities. African Journal of Disability, 8

Peek, L., Wachtendorf, T., & Meyer, M. A. (2021). Sociology of disasters. In Handbook of Environmental Sociology (pp. 219-241). Springer, Cham.

Pidgeon, N., Kasperson, R. E., & Slovic, P. (Eds.). (2003). The social amplification of risk. Cambridge University Press.

Ritterfeld, U., Cody, M., & Vorderer, P. (Eds.). (2009). Serious games: Mechanisms and effects. Routledge.

Schuman, H., & Corning, A. (2017). The conversion of generational effects into collective memories. International Journal of Public Opinion Research, 29(3), 520-532.

Sellnow, T. L., & Seeger, M. W. (2021). Theorizing crisis communication (pp. 4-10). John Wiley & Sons.

Solinska-Nowak, A., Magnuszewski, P., Curl, M., French, A., Keating, A., Mochizuki, J., ... & Jarzabek, L. (2018). An overview of serious games for disaster risk management–Prospects and limitations for informing actions to arrest increasing risk. International journal of disaster risk reduction, 31, 1013-1029.

Sutton, J., & Wood, M. M. (2022). Emergency Alerts and Warnings. In Routledge Handbook of Environmental Hazards and Society (pp. 319-333). Routledge.

Takahashi, B., Zhang, Q., & Chavez, M. (2019). Preparing for the Worst: Lessons for News Media After Hurricane Maria in Puerto Rico. Journalism Practice, 1-19.

Takahashi, B., Zhang, Q., & Chavez, M. (2020). Preparing for the Worst: Lessons for News Media After Hurricane Maria in Puerto Rico. Journalism Practice, 14(9), 1106-1124.

Tomaszewski, B., Walker, A., Gawlik, E., Lane, C., Williams, S., Orieta, D., . . . Schwartz, D. (2020). Supporting disaster resilience spatial thinking with

serious GeoGames: Project lily pad. ISPRS International Journal of Geo-Information, 9(6), 405.

Wang, H., & Singhal, A. (2009). Entertainment-education through digital games. In Serious games (pp. 293-314). Routledge.

WCPO Cincinnati. (2021, December 14). How the 'Quad States' tornado happened. https://www.wcpo.com/news/state/state-kentucky/why-the-quad-states-tornado-happened

West, J., Davis, L., Bendezú, R. L., Gandía, Y. D. Á., Hughes, K. S., Godt, J., & Peek, L. (2021). Principles for collaborative risk communication: Reducing landslide losses in Puerto Rico. Journal of Emergency Management, 19(8), 41-61.

Ypsilanti, A., Vivas, A. B., Räisänen, T., Viitala, M., Ijäs, T., & Ropes, D. (2014). Are serious video games something more than a game? A review on the effectiveness of SGs to facilitate intergenerational learning. Education and Information Technologies, 19(3), 515-529.