Developing an Executive Education Simulation Using Game Design Methodologies

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ABSTRACT

Given the disproportionate impact of rising sea levels and recurrent flooding on coastal areas, it is crucial to develop awareness regarding the consequences of natural disasters on both communities and the environments they live in. Heightened awareness of the effect of resilience-focused policies on the communities and the environment encourages policy makers to optimize the allocation of funds to mitigate the impact of flooding and other natural disasters. The Hampton Roads' Building Resilient Communities (BRC) Flood Game is a simulation role-playing game designed to allow players to learn about the impact of community response to sea level rise and recurrent flooding. This simulation role-playing game guides players through four phases: Introduction/Projection, Plan, Commit, and Simulate/Analyze. Players will learn the tradeoffs of resiliency investments, the impact policies can incur on the population, and the time required for return on investment. Designed using research-based game design principles, the BRC game aims to positively influence the user experience and enhance the overall gaming environment. This paper will present the application of the embedded design model which leverages design elements in various ways to support learning. Subsequently, the application of the model to the BRC game will be shown to demonstrate overall results.

ABOUT THE AUTHORS

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Joshua Behr, Ph.D., is the Associated Vice-President of Research Initiatives and Research Full Professor at the Virginia Modeling, Analysis and Simulation Center at Old Dominion University. Dr. Behr conducts studies, performs modeling, and publishes insights related to resilience, catastrophic events, recovery, and supply chain material & labor convergence. Much of this involves connecting both modeling and data from several systems to produce actionable, policy-relevant knowledge and forecasts. This entails leveraging natural systems data to model storms and flooding, built environment data to characterize the physical structures in our communities, and social-behavioral data related

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Hampton Roads' Building Resilient Communities Flood Game

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INTRODUCTION

The Hampton Roads' Building Resilient Communities (BRC) Flood Game is an interactive, role-playing game designed for participation from a wide range of stakeholders including individual citizens, community and neighborhood leaders, non-profits and advocacy groups, business and industry, policy officials, elected representatives, and leaders from government departments and agencies. The participants are divided into several teams in which they collaborate with other participants while bringing their unique perspectives attempt to make resilient policy decisions that will lead to high environmental impact. The purpose of Hampton Roads' BRC Flood Game is to provide players with an initial scenario and then participants collaboratively decide how to identify, prioritize, budget, and implement policies throughout the game. The game reinforces policy decision-making and collaboration skills as well as awareness of the impact policies can have on a region and the people living there.

By playing the game, participants will develop an understanding of the:

1) Economic, health, environmental, and homeland security tradeoffs stemming from resiliency investments,
2) Disparate impacts that policies may have upon traditionally underserved populations,
3) Need to build consensus in resiliency decisions,
4) Budgetary constraints relative to many potential projects,
5) Synergistic nature of coordinated efforts in producing more resilient communities,
6) Co-benefits of actions relative to the health of the environment, public health, and recreation,
7) Lag times between investments and the realization of benefits.

Recently, game-based learning and in turn the development of serious games, i.e. educational games, to encourage learning and reinforce concepts have become increasingly popular (Tsekleves et al., 2016). Game-based learning is the process of utilizing games to teach or further reinforce a concept (Pandeliev & Baecker, 2010) while serious games are games developed and designed to encourage game-based learning. Previously, games were mainly used for entertainment purposes (Zanin, 2017). However, recent developments have proven that serious games can be an effective tool to facilitate learning and reinforce concepts and skills while providing players an opportunity to explore the outcomes of their decisions (Pivec et al., 2003).

Serious games have previously been used to facilitate the learning of policy making and political impacts on a community. A study conducted by Smith et al. for the Globalization and Health Journal discusses the use of serious games to help policymakers and global health organizations learn to respond to global health failures (Smith et al., 2020), specifically in the realm of infectious disease outbreaks. The study discusses the lack of resources provided to global health organizations and policy makers to prepare and respond to global health crisis. While the goal of this matrix game was to promote education and advancement beyond current methodologies when faced with a global health crisis, the commonality of teaching decision-making skills makes the findings relevant to the current study. Through survey responses and participant reflection, this study found that the use of serious games has the potential to impact global health responses. It was emphasized in survey responses that the game was reflective of real-world decision making and the impacts were realistic. To ensure the HRBRC game similarly impacted the players by offering realistic feedback on their decisions, a subject matter expert (SME) in the domain of coastal resilience developed a set of Measures of Performance (MOP) for the players to analyze as feedback on their responses. The SME also provided a model for how each MOP would be impacted by players decisions.

Additionally, the current work explores the use of game-based learning and various game design methodologies with the intention of teaching participants about the impact of resilience-focused policies centered around sea level rise,

storm surges, and recurrent flooding. These goals were achieved by developing a serious game that simulates projected outcomes based on a deterministic model which accounts for investment decisions made by the group of players. By providing the players with feedback on the impacts of their decisions, the game provides them with an opportunity to explore various outcomes of policy decisions. This paper will provide additional information on how the Hampton Roads BRC Flood Game was designed to provide participants with an opportunity to learn about the need for a collaborative response toward building resilient communities. This paper serves as an extension of our earlier work (Ayaz et al., 2023) where we initially introduced the concept of the Hampton Roads BRC Flood Game in an extended abstract.

The remainder of this paper is organized as follows. The methodology and development section discusses the design elements and models used to develop this game. The results and discussion section provides details on the final prototype of the game. Finally, the conclusions and future work section concludes the paper and provides a discussion of directions for future work.

METHODOLGY AND DEVELOPMENT

The Hampton Roads' BRC game was designed to provide a first-hand experience of the role policymakers take part in when building resilient communities. The players role-play as policymakers with a set budget each year and will work together to allocate towards mitigation policies. Role-play allows the user to better place themselves at the center of the simulated scenario and explore how their character will act in the context of the game (Martens et al., 2008). A study conducted by Rumore et al. on the impact of role-playing games centered around climate change found that role-playing simulations most impacted players who were the least knowledgeable and concerned about the topic of climate change (Rumore et al., 2016). Because role-playing can help heighten situational awareness, especially for players who lack prior knowledge of the situation, it was determined it would be beneficial for participants in the BRC Flood game to virtually role-play as policymakers. The remainder of this section will discuss the design model as well as the game design elements used to enhance the players experience as policymakers.

Design Elements

The visual aspect of a game not only creates a more positive experience for a player, but visuals can also lead to increased motivation (Gee & Dolah, 2016). Increased motivation is a core element outlined by Murphy et al. that is incorporated in many successful games (Murphy et al., 2011).

The Hampton Roads BRC game was designed and developed utilizing "abstract design" principles. This design concept centers on a minimalist approach when designing elements of a game, including simplifying details, flat color usage, and creating a low-fidelity UI (Lee et al., 2019). The decision to use an abstract style for this game centered around the intention of the game: to inform the player of the impact resilience policies have on mitigating the effects of flooding. Simplicity leads to better retention (McCloud & Manning, 1998; Murphy et al., 2011) and helps avoid distracting the player from the intended purpose of the game.

Examples of how abstract design was incorporated into the Hampton Roads BRC game include the logo and panels (Figure 1) displayed throughout the game. The logo consists of a minimalistic design with flat colors and uses basic shading to create depth. Despite the minimalistic approach, the logo helps convey the purpose of the game using houses to convey community, trees to highlight environmental impacts, and water to emphasize a community's need to be resilient against flooding, sea-level rise, and storm surges.

Figure 1. Logo and Panels

Design Model

Persuasive games, such as the BRC game, that attempt to change players' attitudes about serious issues face challenges in conveying the message of the game in a manner that the player will be receptive to the message. Delivering information in a way that restricts a person's ability to freely think can result in resistance or rejection of the presented material. Humans resist information that feels forceful (Kaufman et al., 2016), so it is essential to embed the persuasive message in the game rather than directly force it on the player.

The Embedded Design Model is a framework that seeks to present information that will be more palatable to the learner (Kaufman et al., 2016). Of the methodologies presented, distancing, i.e., creating space between players and the characters and events in the game, was selected as the most promising. In the Hampton Roads BRC game, distancing was used to create a disconnect between the players' personal lives and the gameplay. Distancing is mainly achieved in the introduction of the game, which begins with a story of a region projected to be impacted by flooding. The players are placed in a hypothetical scenario where they role-play as policymakers and must fund resilient policies to mitigate the impact of flooding. Role-playing creates distance from their personal identities by forcing them to adopt a new one. The map shown in the introduction displays the Hampton Roads area in Virginia, but the players are not informed of the location and the map does not display labels. This prevents the players from associating the scenario presented in the game with their personal lives. Assuming players of this game will mainly reside in the Hampton Roads area, this separation is especially important and achieved by keeping the player uninformed about the location.

RESULTS

The game has 4 phases: Introduction/Projection, Plan, Commit, and Simulate/Analyze (Figure 2). The players will cycle through the last three phases annually, for a total of ten years. This process of repeatedly going through each phase not only supports the players' ability to develop and adjust longer term strategies, but also supports learning throughout the game, as repetition is an important learning element that enables the player to "revisit, review, and restate" as they learn (Bruner, 2001). By cycling through the phases, gaining feedback on their decisions, and repeating the steps every year, the player will learn from experience. The four phases implemented in the game and the purpose of each phase will be further discussed in this section.

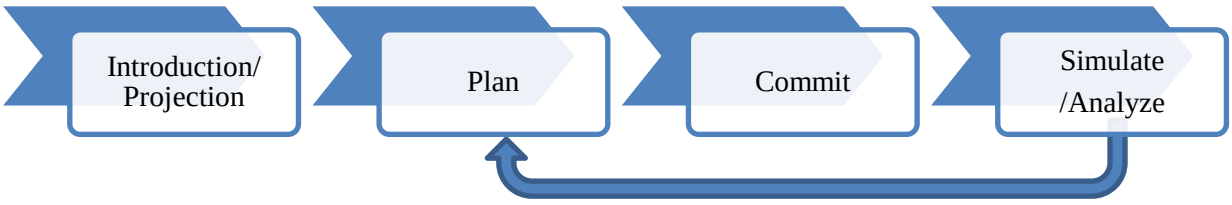

Figure 2. Flow of game play through the four phases of the HRBRC game

Phases

Introduction/Projection Phase

Initially, the user is introduced to the game and their role as a policy maker who will make budgetary decisions for the next ten years. Animations of the flooding along the coastline are shown to the player. The animations were created using a coastal risk screening tool by Climate Central (Climate Central, 2021). They are then presented with a dire situation of coastal flooding and the projection of flood zones over the next 100 years. Specific areas that will be underwater have been identified to further imply the projected outcomes of flooding, storm surges, and hurricanes (Figure 3). The introduction provides clear tasking for their role as a policy maker with instructions for each step and an outline of goal the player should achieve. Providing clear tasking enables the player to better understand the task at hand and achieve the goal (Murphy et al., 2011).

Once the user is introduced to the tasking, they will cycle through three phases throughout the game. A progress bar at the top of the page will provide feedback to the user on the current step and the current year out of a total of ten years. According to Murphy et al., progress indicators or counters to help users evaluate progress are effective ways to create flow in a game (Murphy et al., 2011).

Figure 3: Introduction

Plan Phase

The planning phase allows the players to explore budgetary decisions and assess the impact of their decisions on the Measures of Performance (MOPs) across time frames of one-year, five-years, 25-years, and 100-years (Figure 4). Immediate feedback is one of the eight major components Csikszentmihalyi defines for creating "flow" for a person completing an activity, as it allows the person better understands if they are correctly completing an activity (Csikszentmihalyi, 2004). Flow is also a core element outlined by Murphy et al. and is defined as a state in which the player is completely captivated by the experience/game which leads to better engagement throughout the game (Murphy et al., 2011). By giving the players immediate feedback of the impact their budgetary decision on the MOP's, they will better understand the outcomes of their decisions which will better engage them and create flow.

The options in the plan phase are divided into five sections: Building Code and Practices, Planning and Land Use, Engineering, Environmental & Ecosystem Management, and Government Outreach Policy. An overwhelming amount of choices at once can disrupt flow and overwhelm the user (Murphy et al., 2011). Often when a person is presented with too many choices, the human brain will try to group options to their own liking to help make a decision (Schwartz & Schwartz, 2004). To avoid having the player mentally group the options and to provide the user with enough options to achieve learning goals without overwhelming the player, the options are grouped under respective categories to help the decision-making process.

The left side of the screen consists of finance panels containing lists of mitigation investments under their respective category. Sliders adjacent to each mitigation option are utilized to select the investment amount. The total amount invested for each mitigation intervention is listed on a budget panel on the right of the screen.

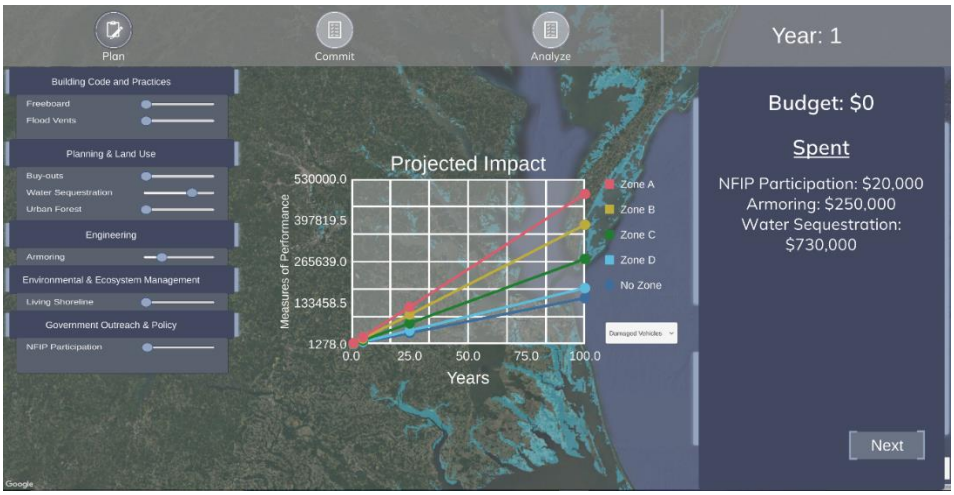

Figure 4. Plan Phase

A drop-down menu under the graph allows the user to select a MOP and view the projected impact on the selected MOP. The impacts are calculated using a model informed by a SME with a uniform uncertainty of $\pm$ 25%. Each budgetary decision will impact one or more MOP. As the sliders are adjusted, the investment amount on the budget panel and the graph will update.

Commit Phase

The commit phase allows the user group to review their spending for the year before committing to the spent amount (Figure 5). The spending decisions can be further discussed among the group. From this phase, the users have the option to return to the plan phase and adjust spending as desired or click the commit button to spend the amount chosen.

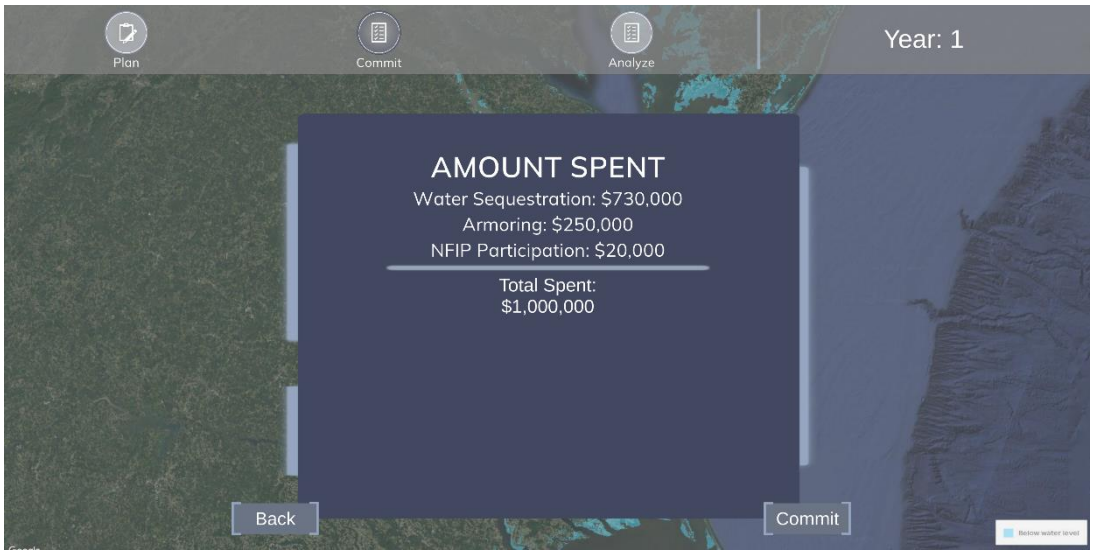

Figure 5. Commit Phase

Simulate/Analyze Phase

The Simulate/Analyze phase provides the player with data on the human and property impacts over a period of time. This phase implies that one year has passed. The first part shows the user statistics for the total casualties for each respective measure of performance (Figure 6). The data provided under each MOP is an accumulation of the impact on each MOP over the years the team has played through so far. This section of the game provides the user with some preliminary and big picture data on how flooding has impacted the community during the time frame the players have been allocating funds.

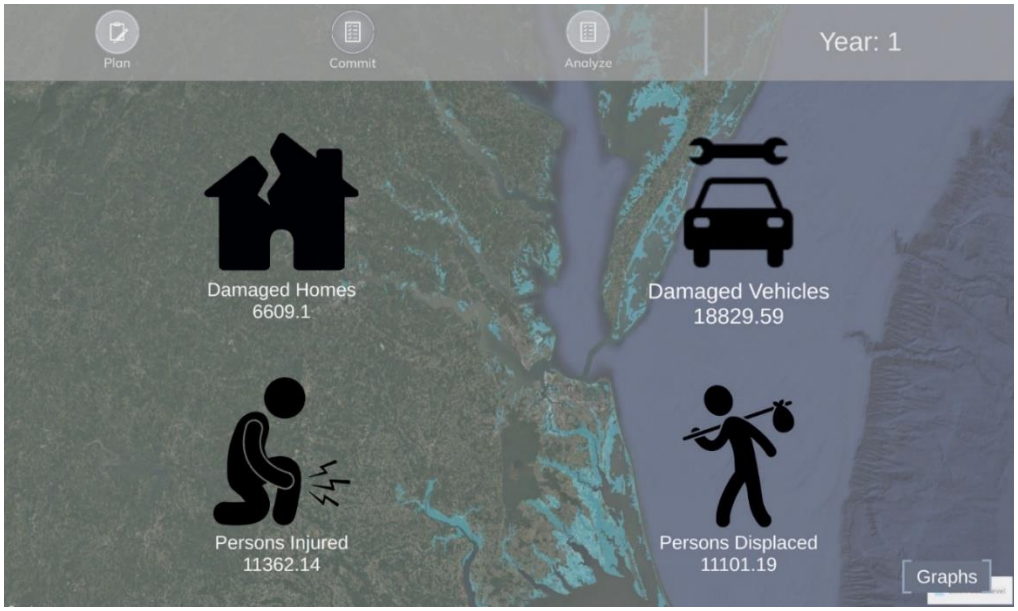

Figure 6. Total Casualties for each MOP

The next part of the phase shows the user how the MOPs were impacted one year after their investment (Figure 7). The one-year metrics are calculated by taking a sample from the triangular distribution of the one-year projection calculated in the plan phase. A graph showing the impact on the MOP is displayed and the user can select each MOP from the drop-down to analyze impact. The group will discuss amongst themselves the presented metrics and changes that would help better mitigate the effects of storm surges and flooding.

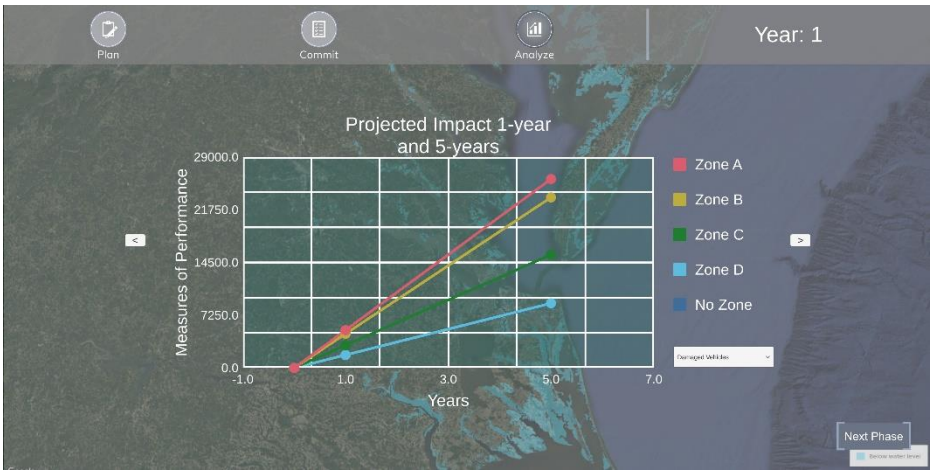

Figure 7: Analyze Phase

CONCLUSION AND FUTURE WORK

Serious games are a strategic and increasingly popular way to reinforce concepts and promote learning. The Hampton Roads' BRC Flood Game provides players the opportunity to explore mitigation strategies that can impact the effects of flooding on the population, environment, and community. The objective is to develop heightened awareness among role-playing participants, provide an opportunity to experience the impacts of their decision virtually, and foster thinking relative to community response to sea level rise, storm surge, and recurrent flooding. The players bring their perspectives and understanding of the situation and attempt to change the environmental impact based on their beliefs and the impact metrics presented throughout the game. Collaboratively, they will decide how to identify, prioritize, budget, and implement policies throughout the game and by the end of the "ten-year" period, have a better understanding of building resilient communities.

Future work includes exploring more game design elements that can be implemented to create a more positive user experience (and in turn promote learning) and testing the developed game with user groups to gather user feedback and assess efficacy. Currently, an initial prototype has been developed and will be modified based on user feedback and other game design elements that may be better suited for the nature of the game.

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