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# Development of a Serious Game as a Natural Hazard Planning Decision Support Tool

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**Abstract.** As coastal populations grow, so does the exposure to natural hazards such as hurricanes and flooding, creating the potential for increased social and economic disasters. The literature indicates coastal residents remain complacent when planning before, during, and after an event. There is a growing successful use of serious games in natural resources planning, and a growth in the use of digital and electronic games. We developed the serious digital game *Plan for It!* in response to identified needs and to capitalize on the public's familiarity with gamification and digital gaming.

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## INTRODUCTION AND BACKGROUND

U.S. population migration to the coast has increased exponentially since 1970. As of 2010, nearly 40% of the total population lived in a coastal county, with that number likely to grow based on the 2020 census (NOAA, 2013). As coastal populations increase in the United States, so does exposure to natural hazards such as tropical weather systems and flooding. Of the coastal residents, 40% fall into a vulnerable population (NOAA, 2013). Increasingly, these new community members are unprepared and unaware of the coastal hazard impacts to themselves and their property, and to mitigation measures implemented by their home municipality.

Natural disasters can develop into larger crises, including economic disasters (Telg et al., 2008; Thompson et al., 2012). Between 1960 and 2015, over \$927 billion were lost due to natural hazards (CEMHS, 2019). Although climate change plays a large role, studies have found that urbanization is the main driver behind the increasing losses (Bouwer, 2011; Depietru & McPhearson, 2018). One study found that 57% of structures are in hazard hotspots in the contiguous United States, with ~1.5 million buildings in hotspots for two or more hazards. These hazard hotspots comprise merely one-third of the contiguous United States (Inglesias et al., 2021).

Yet residents remain complacent. A survey of older Americans in coastal Florida found that the majority of those surveyed are influenced by individual hazard experience, tend to only make efforts for survival preparedness, but not in planning or structural preparedness, and do not heed advice from emergency managers (Wang, 2017). Over half of the participants of another survey indicated they would not leave their home if a major storm was approaching or would only leave if ordered by a local official (Mason-Dixon, 2011; Thompson, 2012).

Natural hazard resilience planning is a complicated task, balancing the desires of stakeholders with the established town character, resilience requirements and protecting vulnerable populations and resources. Coastal planners and emergency managers have additional layers, being tasked with ensuing measures are in place so the municipality is as resilient as it can be during and after tropical events. Along the Gulf coast, Extension and outreach professionals are tasked with providing support to municipal officials to promote community resilience. This includes educating the general public about mitigation and green infrastructure actions that can reduce storm risks and coastal flooding.

Although many excellent tools exist to educate the general public, we heard from Extension, Sea Grant, and outreach professionals that a gap existed in outreach tools for a short, interactive learning experience for outreach events that did not require an internet connection. Based on the identified gaps and, with input from these profes-

sionals, we developed a serious educational game (Abt, 1970). The body of literature shows that serious games in relation to natural resource conservation and planning are beneficial to outreach efforts, aiding in the understanding of complex matters and supporting decision-making processes (Ampatzidou et al., 2018; Janakiraman et al., 2021), increasing participant awareness of complex socio-techno-economic issues related to natural resource planning (Savic et al., 2016), weather-related emergency management (Terti et al., 2019), and provide the opportunity for experiential learning and repetitive play (Sandbrook et al., 2015). Further, digital gaming is a growing aspect of the lives of many people, with the digital games industry worth \$42 billion in 2010 (Chatfield, 2010; Sandbrook et al., 2015), and elements of gamification being incorporated into daily life (Sandbrook et al., 2015). In order to capitalize on the growing use of gamification and digital gaming, we selected to develop *Plan for It!*

## DEVELOPMENT AND GAME PLAY

We conducted an informal needs assessment with Extension and other outreach professionals around the Gulf coast to determine gaps in the existing coastal hazard resilience outreach and education tools and the subject matter focus we should pursue. Based on the input from these experts, we determined that *Plan for It!* should focus on green infrastructure and flooding, making it adaptable to areas outside of the coast. The major point surrounded by development was the need to make an electronic game for a single player that is not reliant on an internet connection. In many cases, outreach events take place outdoors, or internet connections are unstable due to the lack of rural internet infrastructure. With funding provided by the Mississippi-Alabama Sea Grant Consortium and assistance from Auburn University and Alabama Cooperative Extension System, we worked with Blue Urchin, LLC to provide graphic design and programming services to accomplish the production of this tool.

The easy-to-use interface and short gameplay make *Plan for It!* ideal for many outreach and education situations. This tool was designed for an audience of 6<sup>th</sup> graders through adults and can be paired with other curricula to discuss and support community resilience needs. According to Terti et al. (2019), role-playing games “are virtual simulations of real-world events especially designed to educate, inform and train players for the purpose of solving a specific problem” (p. 508). *Plan for It!* transforms the player into the community planner of a generic coastal town during the lead up to hurricane season and asks them to make real-life resilience decisions in risk-reward scenarios to better prepare their town. Gameplay involves fictional scenarios and real-life decision points that mimic real-world situations and ends after a category 3 storm event. Animations reflect player decisions to fictionalized—but realistic scenarios—over an 80-day timeline. For a serious game to be educational, it must include learning outcomes and provide direct feedback in response to player actions (Bogost, 2007; Terti et al., 2019). Therefore, real-time feedback through scoring and rewards or consequences during game play were included.

After playing the short game, players have a better understanding of the role of resilience measures and the tradeoffs in the planning process. *Plan for It!* is appropriate for players as young as 6<sup>th</sup> graders but still holds the interest of older children and adults. Being a stand-alone computer-based game, internet access is not necessary, making it ideal for any outreach or education setting. Currently available as a free download through the Microsoft store platform (<https://www.microsoft.com/en-us/p/plan-for-it/9mzwflxz310l?rtc=1&activetab=pivot:overview-tab>) and requires Windows 10 or higher or Xbox One operating systems. This tool is designed to be downloaded and installed prior to an event, and once installed requires no internet connection, making it portable and easy to use in field events.

## CONCLUSION

As coastal populations continue to grow, so does the need for tools to educate the public on coastal resilience and related actions. *Plan for It!* offers an educational tool in a gamified format with real-time feedback to real-world scenarios and decision coastal planners and emergency managers make daily. Although it was designed for coastal use, the graphics and format are generalized and can be easily adapted to waterfront communities further inland that experience effects of tropical systems and elevated flooding. *Plan for It!* is free to download, widely available, and can be adapted for classroom use.

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