

Complex Risk-Based Decision-Making using Serious Games in Wildland Fire Management

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Abstract: The authors describe the development and use of serious games for the purpose of bringing together diverse community stakeholders in the process of developing a wildland fire management plan. The primary goals of this serious game are to: 1) provide participants with an educational tool designed to support social learning in the complexities of developing a community wildland fire management plan in the Wildland Urban Interface (WUI); and 2) Create open and meaningful lines of communication for risk-based decision-making using a real-world scenario. Serious game participants are each given a role and play two rounds followed by a group debriefing.

Keywords — Wildfire, Serious games, Risk, Planning, Social learning, Strategy

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INTRODUCTION

Serious games are games that are used for a defined purpose beyond the entertainment value, such as education, training, and informing participants [1]. This project is based on the development and implementation of a serious game that engages participants in the social-ecological complexities of developing a wildland fire management plan. The game, known as Pyrotown [2], is a serious role-playing game (or social simulation) that supports social learning about the challenges and trade-offs involved in establishing a wildland fire management plan for Pyrotown, a fictitious town located in what is known as the Wildland Urban Interface (WUI), which are landscapes where urban development meets a natural area. During the game, players experience first-hand the challenges that multi-stakeholder groups and communities encounter when they attempt to develop a fire management plan in a constantly changing world. Two surprise crisis events interrupt the game in real time to introduce new complicating factors and heighten the urgency for decision-making. The game was developed by researchers at the US Forest Service and Wageningen University, the Netherlands. It was designed as an educational tool to teach graduate-level students about the human complexities surrounding wildland fire management. Nonetheless, the game can also be used with adults in a variety of settings, for example to engage community members in fire-prone areas in interactive, hands-on learning about complex decision-making processes that someday may impact their environment. The game highlights how communication plays a vital role in preparedness, response, and recovery during such events.

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In the following, we cover the rules, timeline, format, and processes for administering the game as an educational tool for developing a wildland fire management plan. The game is played in small groups of 5 - 7 people and is usually played over the course of an entire afternoon to allow for breaks. It does not require any special boards or pieces to play. The moderator only needs to print maps and instructions for the starting scenario and each role.

PYROTOWN – A SERIOUS GAME FOR WILDLAND FIRE MANAGEMENT

The fictitious town of Pyrotown has a population of 40,000 people and is located in the WUI. Pyrotown must develop a wildland fire management plan due to increasing fire danger in and around the town. The town council has put together a group of key stakeholders, known as the taskforce, to collaboratively develop the wildland fire management plan. The council has provided the taskforce with three assignments to include in the plan: 1) establish a five year strategy to reduce the risk of wildland fire for the three neighborhoods of Pyrotown (Forestown, Township, and Center); 2) develop multiple strategies for crisis and risk communication that are tailored to the diverse population and various interest groups within Pyrotown; and 3) establish wildland fire management strategies that can expand and contract depending on fire complexity. For example, developing standards for managing low-intensity, slow-spreading fires that are easily controlled to managing fires that spread faster and are more intense in fire behavior, and that require greater coordinated suppression efforts. Each group of participants in the taskforce is assigned a role to play (namely Mayor, City planner, Fire Chief, Public Health Officer, Farmer representative, Council member, National Park manager) along with scripts that describe their respective roles. The taskforce must negotiate how to develop Pyrotown's wildland fire management plan using the script and their own creativity. Individual participants can also decide on their goals and even have a secret agenda. The more seriously each participant gets into their role, the more fun the game is to play. The game is played in two main rounds. Round 1 is 30 minutes long and includes participants gathering with their role groups to discuss goals and ambitions with fellow colleagues. They must prepare what to say and how to be creative in communicating their agenda. Round 2 is 60 minutes long. Each role player gathers with their respective taskgroup in Town Hall to create a wildland fire management plan. The game ends with a 60-minute debriefing. The mayor in each taskforce provides a 2-3 minute summary of their taskforce's experience. The class then gathers for a larger group discussion by engaging a series of debriefing questions such as: was there a moment or outcome in the game that surprised you, and what did you learn from it? What was the most challenging aspect of devising a wildland fire management plan, and what made it successful? What decision made during the game had the most significant impact, and why? What communication difficulties did you have to overcome, both internally and with stakeholders?

During the role-group meeting in round 1, participants prepare for their role together. They use their respective role script to learn the details of their role, but participants are encouraged to use their own creativity. In addition to the assigned goals for each role, each player establishes a range of relationships with each of the other roles. For example, the mayor may have good relations with the planning department and public health officer but have a more complicated relationship with farmers and the Fire Chief. At the end of the role-group meeting, role players must agree on their goals, motivations, and possible secret agendas that they will bring to the taskforce meeting. In round 2, the taskforce begins the round with the mayor chairing the session. It is the mayor's responsibility to bring everyone to a final decision that is supported by the taskforce; therefore, consensus is key for them, and the overall wildland fire management plan is ultimately their responsibility. At the beginning of round 2 each player introduces themselves and uses the back of a map that is provided to write down notes and their management plan. The taskforce then begins negotiating. Approximately 20 minutes into round 2, the game leader introduces two unexpected wildland fire scenarios known as sudden breaking events. The first sudden scenario includes campers at a nearby National Park who start an illegal campfire and forget to extinguish it properly leading to a low-intensity fire, which follows with an evacuation warning in the local area. On the second day of this scenario, another more severe wildland fire begins north of Pyrotown, but this fire is a high-intensity wildland fire near urban areas that requires immediate suppression and an overwhelming number of resources. The game leader then provides each taskforce with the following questions: What do you and the taskforce do?; How will you respond to multiple crises?; Do you have to change your recently devised strategies, and if so, how?

On day 3 of the scenario, the wildland fire in the National Park remains contained; however, winds begin to gust during the afternoon, and higher temperatures along with lower humidity increase the fire danger greatly. The fire grows from a low-intensity to a high-intensity wildland fire, and it is spreading. The fire soon begins threatening to burn outside of the National Park boundaries and into newly constructed homes in the neighborhood of Forestown. The mayor of Pyrotown calls the fire chief and begs them to commit all their resources to the growing fire. However, due to some injuries and smoke inhalation among fire crews during the first days of the fire, the fire chief is only able to provide minimal resources. In addition, most fire suppression resources are fully committed to the larger fire burning north of Pyrotown so outside help is unavailable. The fire chief then takes to the local radio station to issue a mandatory evacuation order for all Forestown. People begin scrambling to pack necessary items and leave their homes as soon as possible, streaming towards the center of Pyrotown. The neighborhood of Township remains on evacuation warning, but many residents are worried and choose to leave voluntarily. The fire chief on the taskforce must carefully consider the safety of firefighters versus saving homes in Forestown. Finally, to make matters worse, the fire is now threatening to spread to the neighboring county and the mayor's phone begins to ring. Following reading this new scenario, the game leader asks the following questions: Which fire suppression strategies would you use now in this critical, life-threatening situation?; Does this information change the strategies your taskforce discussed so far?; How do you balance differences or resolve conflicts between

stakeholders on the taskforce?; Which communication strategies or models do you believe would be most helpful during this stage?

Round 3 of the game consists of a group debriefing where the mayor of each taskforce provides a summary of their experience and decision-making. A group discussion follows answering questions such as: How did you or your group prioritize the needs of the different stakeholders?; How did these priorities influence decision-making?; How did your taskforce's dynamics influence the outcomes of the game?; What could have been done differently? The game finally ends with group reflections on the various scenarios.

METHODS

Pyrotown was conceptualized by the authors and colleagues at Wageningen University, the Netherlands. Conceptualization began with a drawing on a napkin in a university café and evolved into a participatory crisis and risk communication approach to explore complexity in wildland fire management. After several in-person meetings (and a lot of coffee), we began developing a serious game for a graduate level course on Integrated Fire Management (wildland fire management that involves ecological, social, and economic considerations) [3]. We developed Pyrotown to be played in groups of 5-7 participants and to be played over a half-day class session. For maximum accessibility, we were intentional that the game not require any special board pieces to play. The game leader only needs to print maps and the sheets for scenarios and roles.

As with any serious game for the purpose of education, training, and risk communication rather than for pure entertainment, the game mimics the challenges of communicating in a wildland fire management system where participants explore how real-time decision-making and communication can impact actions with real world consequences. Ultimately, participants share their knowledge and understanding of the wildland fire system as a complex social-ecological system with diverse actors. The game was put into practice with assistance from the Wageningen University game hub who helped us test and streamline the game to meet the demands of creating a well-developed participatory research and learning approach to the complexities of wildland fire management and risk and crisis communication.

DISCUSSION

Serious games are an invaluable tool for risk and crisis communication across academia, government, healthcare, military, and the corporate sector [1]. Serious games have been gaining in popularity since the early 2000s and at universities are becoming a valuable pedagogical tool that combines entertainment, stories, and art to immerse students in learning [4,5]. The growth of serious games has led to serious game hubs across the United States and Europe such as at Purdue and Ohio University as well as Leiden and Wageningen University, the Netherlands. Game hubs provide academics with building participatory research into their research projects and classrooms to facilitate social learning for understanding complex systems such as social-ecological systems, and in our case wildland fire planning and management.

While serious games are designed to engage participants and can certainly be an entertaining educational tool, their purpose driven goals differ in important ways from games designed for pure entertainment. For example, communication of information is often perfect in games for pure entertainment, whereas communication in serious games is modeled after real world situations where communication is often imperfect and riddled with delays, misunderstandings, and missing information. Such difficulties are often the case in wildland fire planning and management. The wildland fire management system consists of a variety of federal, state, county, municipal, tribal, and private sector stakeholders with their own organizational goals and personal agendas. Hence, wildland fire management can often include stakeholders with conflicting priorities, risk tolerances, and a variety of interpretations about the natural role of wildland fire across landscapes. Serious games offer an opportunity for crisis and risk communication scholars, particularly those working across complex social-ecological systems, to engage students and stakeholders in the uncertainty of bringing people together to work through real world problems. They provide a venue to directly engage the deeply relational and fraught process of risk communication before, during, and after crisis events.

In the case of preparing for wildland fires, Pyrotown is being used both in the classroom at Wageningen University and with US Forest Service wildland fire managers. At Wageningen University, Pyrotown serves as a teaching tool in a graduate-level course on Integrated Fire Management. Students without experience in wildland fire management, and who come from various disciplines, learn about the social and ecological challenges and benefits of managing fire across landscapes, and that the process involves a social-ecological system where risk and crisis communication is socially constructed at the intersections of structure and agency [6], particularly the roles of self-, system, and joint efficacy in risk and crisis communication [7]. The same processes unfold when Pyrotown is used for the purpose of training wildland fire managers who have considerable experience with the ecological impacts of fire, but who need to raise their understanding of the complexities involved with managing wildland fire in a growing WUI with increasing risks to human communities. Serious games such as Pyrotown offer participants opportunities to engage real world social learning with the obvious advantages of safety, cost, and time.

CONCLUSION

Serious games for crisis and risk communication are particularly fruitful in transdisciplinary research and teaching from a complex social-ecological systems perspective. Due to multiple uncertainties related to climate change, increasing hazards

on the natural environment, and the expansion of the WUI, wildland fire is now less predictable and riddled with new challenges never encountered by wildland fire managers and stakeholders. Serious games serve as an invaluable tool in the wildland fire management education and training toolbox. They provide a pedagogical space where participants can prepare for how to communicate within the complexities of a wildland fire crisis where the stakes are extremely high and decision-making has real-world consequences.

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