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Ready for Drought? A Community Resilience Role-Playing Game

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Abstract: Drought is an abstract and complex phenomenon that can be difficult for many people to comprehend. Proactive planning to improve response during drought events is necessary but complicated because it involves stakeholders and decision-makers with competing interests. A category of games, called serious games, have proven to be helpful when learning about abstract concepts, and for improving communication and conflict resolution with respect to water-related issues. In this study, we present a new in-person role-playing game that serves as a drought educational tool in both classroom and professional settings. The message of the game emphasizes the importance of communication and cooperation between various communities and sectors that can be affected by drought. Furthermore, it also encourages discussions and collaborations between stakeholders involved in drought planning and can serve as an icebreaker activity. The game has been played in a variety of settings including university classes, university extension workshops, and drought workshops. This study describes the game itself, its development, and the results of surveys from game participants that were used to evaluate the usability of the game as an educational and icebreaker activity.

Keywords: serious game; drought planning; icebreaker; drought education; social learning

1. Introduction

In the context of planning and policy, drought is seen as a "wicked problem" [1] that can happen anywhere around the world at any time. It is an abstract concept that is not uniformly understood by the general public and the officials responding to it. Drought is different from other natural disasters because of its long duration (a season to a decade) and usually large spatial extent. Drought, often called a "creeping phenomenon", is a more gradual event than other natural hazards and is often hard to recognize until it demonstrates itself through drought impacts that are location and sector specific. These characteristics are why many people comprehend drought in very different ways. Drought education and planning are important to be able to lessen the socio-economic and environmental impacts of drought. Understanding what drought is, how it evolves, and how to prepare for it are key components of drought risk management to reduce drought impacts. Many stakeholder groups who manage water resources can be affected by drought. Similarly, as with other environmental issues, these groups often have competing interests. Water and drought management challenges arise when these competing interests are combined with an absence of communication, collaboration and coordination between different stakeholder groups and sectors [2]. The purpose of this article

is to present a new in-person role-playing game that delivers a message about the importance of communication, collaboration, and coordination between stakeholders during drought planning. The game is designed to serve both as a drought educational tool and as an icebreaker activity for team building and discussion between drought planners and stakeholders.

2. Framework

2.1. Serious Games

Serious games [3], by definition, are games that are used for purposes other than pure entertainment [4]. They have been extensively used in military, higher education, business, urban planning, water and natural resource management, and many other fields [5–10]. Their use has been promoted by the U.S. Department of Homeland Security for managing risk and has been identified to play a key role in disaster management [11]. Serious games retain certain game features like competition, cooperation, rules, players, and entertainment with a purpose to learn from the game experience [4]. The game features intend to help participants understand a certain, often complex, real-world situation by thinking of it as a game and experiencing it as a player rather than a stakeholder [12]. Game-based approaches used in the context of water use and management are fairly diverse in the audience they target, their intended purpose, and expected outcomes [13]. In their 2018 review of water-related serious games, Auber et al. found that a new emerging approach to engage players is to broadcast the message in an intuitive way for example using graphical representation of an intensifying phenomenon [14], such as a series of photos of the city's local reservoir drying in a drought event. Christen et al. also reported the storyline, the gameplay, and an appealing visual design being key factors for creating a successful serious game [15]. These game features, especially an appealing and engaging storyline, can motivate players to do better in the game [14].

2.2. Games and Learning

The complexity of water management and drought planning can be difficult for students and professionals to understand. By simulating real-world decisions, compromises, and trade-offs, games help players experience real-life situations and learn about water sharing in a timely, risk-free, and cost-effective way [9,10,16,17]. This can be especially valuable for students who may not otherwise be exposed to the challenges and uncertainty related to managing water resources [16]. In addition, active participation in multiplayer, role-playing games has been shown to improve knowledge acquisition, problem solving, critical thinking, teamwork and time management [10,18,19]. Plass et al. suggest that game-based learning fosters aspects of cognitive, behavioral, affective, and sociocultural engagement [20]. Serious games in water management encourage development of both soft and hard skills, which can be characterized as personality traits and specific knowledge, respectively. These skills can be transferred to real life situations and used to support decision-making. For example, during the Shariva Game, the players, represented by water professionals, gained the soft skills of conflict resolution or policy formulation [21]. On the other hand, students who played the game SeGWADE were more able to identify appropriate water management solutions as a result of the game [22]. Multiplayer role-playing serious games allow for realistic interactions between players that provoke social learning and collaborative task activities [23]—an important motivational factor in adult education [24–26]. Learning during serious games happens when players can observe impacts of and receive feedback on their decision-making. At the same time, summarizing the lessons learned and critically reflecting on the decisions, game process, and outcomes of the game after the game are also crucial [27].

2.3. Games and Drought Planning

Medema et al. state that "water management and serious games are connected through complexity and social learning" [28]. Water management and decision-making, including drought planning,

is "chaotic and messy" [29] because of the multitude of water uses and diverse stakeholder interests. For example, when water managers make decisions, they have to think about various water uses and stakeholder views, the relationships between environmental and anthropogenic water use, and the consequences of water-related policies on socio-ecological systems [30,31]. A decision during a drought might be, for example, imposing restrictions on non-essential surface water use by businesses, golf courses, and park departments to keep water in streams for the wildlife and crop irrigation use. The decision-making mechanism of governments, organizations, and corporations can incorporate public concerns, needs, and values in a process of public participation planning [32]. Due to the complexity of drought planning and management, bringing people with different perspectives together helps ensure fair and holistic solutions. Public participation in drought planning creates an opportunity for stakeholder and decision-maker discussions within and between various sectors [33]. However, drought decisions, like other environmental decisions, are often controversial. For example, water managers and farmers might disagree on the importance of different planning objectives. These disagreements and conflicts can create barriers for stakeholders to adapt water management practices in drought-related situations, participate in drought planning and discussions [34]. Serious games create a safe environment where players can experiment and be creative with their decisions without risking losses associated with a real-world situation [29,35]. Another benefit to game-playing is the ability to elicit participation in people that would otherwise stay on the sidelines of traditional conversations [36]. Multiplayer role-playing games have been found to increase the interaction and active discussions between diverse stakeholder groups [37,38]. Based on Petranek's principles of simulation and gaming, games with a simulation component also have an icebreaking capacity and stimulate dynamic participation, which can also promote group discussions [39]. Role-playing games have also been found to promote social learning, which is defined as the process of learning through others that takes place in a social setting [40] and is an important component of serious games role-playing element. Through social learning, players can better understand other stakeholders' perspectives and interests [37] while learning about the importance of building connections and cooperation within and across sectors [41]. Important outcomes of social learning include development of shared values and a sense of solidarity with the community resulting in the wellbeing of the group being prioritized over individualistic goals. All of these cooperative attitudes explained above can be obtained through the serious game framework and then transferred to a real-world environment [42].

Drought planning typically occurs in a non-drought period when water resources are not limited or scarce and after the immediate impacts of drought are resolved. However, as described in the "hydroillogical cycle" framework [43], during these times people often find themselves in a stage of apathy that might prevent drought planning efforts from being effective [44]. We hypothesize that serious games that use realistic drought scenarios and role-playing can simulate the feeling of urgency experienced during a drought situation and can remind players how they felt during drought. Therefore, serious drought games can be a beneficial activity to implement before drought planning meetings with a public participation component.

2.4. Objectives

Since serious games can be a valuable educational tool that can also serve as an icebreaker and to boost discussions between stakeholders, we developed an in-person role-playing game that focuses on the topic of drought impacts and planning. The intention of the developers was a game that might be used in classrooms as well as professional settings. Given the differences in motivation and experience between students and professionals, it was important to assess the effectiveness of the game for both audiences. We conducted a survey with diverse groups of players from both university and professional settings that test if the game: (1) is an effective icebreaker or teambuilding activity, (2) serves as an effective educational tool for drought impacts and planning, and (3) builds an awareness of the importance of communication, collaboration, and networking among stakeholders.

3. Materials and Methods

3.1. Game Development Process

The Ready for Drought? game was inspired by the Extreme Event game [45], developed by the National Academy of Sciences' Koshland Science Museum (currently LabX) in collaboration with the Resilient America Roundtable. The Extreme Event game, that served as a template for the Ready for Drought? game, includes three different natural hazard scenarios: an earthquake, a hurricane, and a flood. As the title eludes, the Ready for Drought? game focuses only on one natural hazard scenario, drought, but key design elements, such as the game phases and organizational structure, mirror the Extreme Event game. However, due to the differences of drought, compared to other natural hazards, several alterations were necessary to adapt the game to this scenario:

3.1.1. Location

The Extreme Event game, the template for the Ready for Drought? game, takes place in a hypothetical city with an unspecified geographical location. While urban areas in different regions might face similar challenges when affected by an earthquake, a hurricane, or a flood, drought impacts are generally more location specific and depend on drought severity and duration [46]. For example, while the most common drought impacts in the U.S. Midwest include reduced pasture growth, early culling of livestock, and low crop yield, the Southern U.S. might experience saltwater intrusion in river bays or reduced crawfish populations [44]. We developed the game for a specific geographic region that constrained the range of possible impacts but was large enough to allow a necessary impact variety. We set the game to take place in the Missouri River Basin region because of the research team's local expertise of drought impacts and the diversity of drought impacts in this area listed in the Drought Impact Reporter (DIR) [47,48]. These include, for example: deterioration in rangeland conditions, rise in beef prices, minimum flow water releases from dams, rise in mosquito populations, and many others. In the past 20 years, the Missouri River Basin area has witnessed multiple drought events of various severities and durations ranging from abnormally dry conditions to an exceptional drought as classified by the U.S. Drought Monitor [49]. A time series of percent area in the Missouri River Basin affected by drought conditions can be found on the U.S. Drought Monitor website (https://droughtmonitor.unl.edu/Data/Timeseries.aspx) with Hydrologic Unit Code 10 selected as the area of interest. The borders of the Missouri River Basin region used in the game correspond to the National Oceanic and Atmospheric Administration's National Integrated Drought Information System (NIDIS) Drought Early Warning System (DEWS). Using the regional DEWS delineation is convenient for the purpose of the game because DEWS regions are expected to experience similar drought impacts. Additionally, the ongoing government efforts in drought mitigation, education, and outreach happen on this scale of delineation [50]. Using a specified region can be beneficial for players that come from this region because they have likely experienced drought impacts used in the game and therefore can relate to them. However, this can also be a disadvantage because players from other regions might find these impacts not relevant. A solution to this issue would be an adaptation of the game to different geographic regions, which we discuss in Section 3.4. of this article.

3.1.2. Communities

It is unlikely that one community would experience a wide range of drought impacts as opposed to the other natural hazards that often impact a wide range of sectors on a smaller area. For example, a large municipal center might not experience any agriculture-related impacts but rather might have to deal with blackouts and brownouts caused by a higher electric consumption and a lower hydropower supply. Therefore, we created six hypothetical communities of various population sizes (rural, urban, and metropolitan) scattered around the Missouri River Basin region. This differs from the one hypothetical city used in the Extreme Event game. By constructing communities of different sizes, a wide variety of drought impacts experienced in this region could be addressed. This also

served as a learning opportunity to demonstrate how drought impacts vary based on the size of the community, rural versus urban setting, and the impacted sectors (e.g., agriculture, public health, or tourism and recreation).

3.1.3. Surprise Challenge

The Extreme Event game uses a surprise challenge to prolong the disaster response phase of the game and to even out the pace in which different teams are playing the game. In the Extreme Event game, that surprise challenge is a gridlock that decommissions some of the neighborhood resources. For a drought scenario, the gridlock was not relevant. Therefore, we developed a wildfire challenge that is applicable to any of the community in drought. During the surprise wildfire challenge, the communities need to allocate additional resources that the team did not know about beforehand.

We implemented other minor adjustments to better illustrate the importance of communication and cooperation within and across various sectors and communities when planning for and dealing with drought.

3.2. Game Description

The Ready for Drought? game is an in-person role-playing game that can be played with 12 to 42 people. The game consists of four phases: (1) prepare, (2) response, (3) recover, and (4) adapt phase (Figure 1) during which the game package materials (Figure 2) are used.

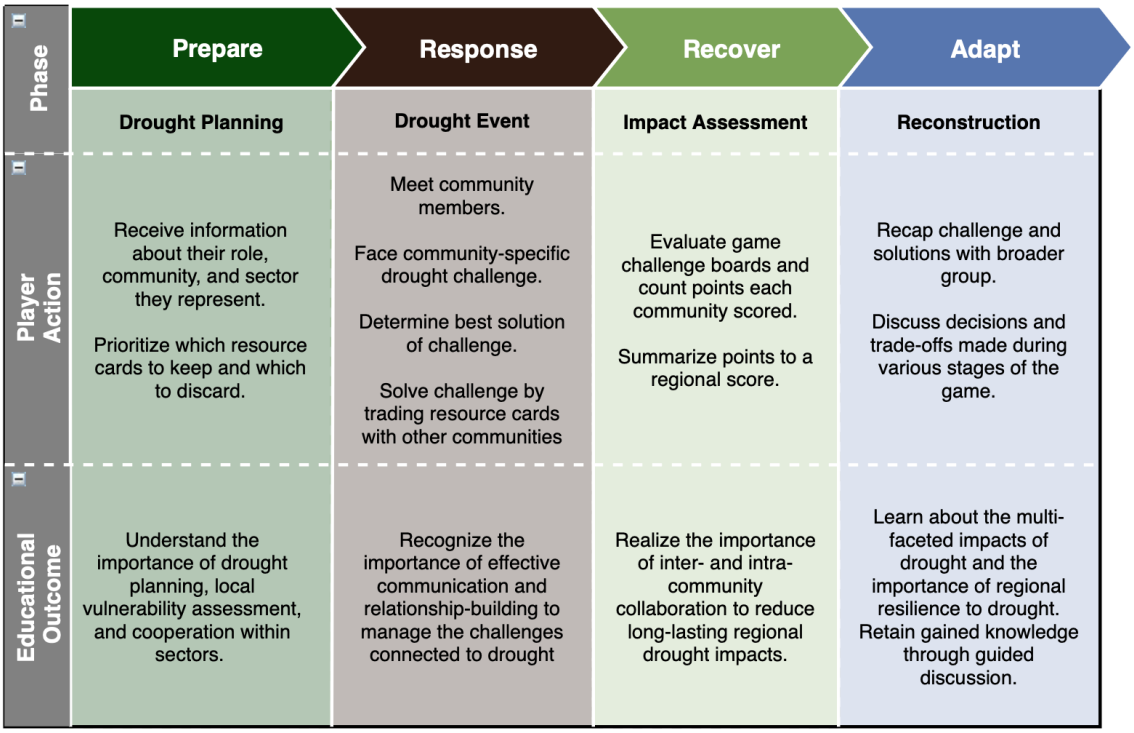

Figure 1. Flowchart of the game phases with corresponding player actions and educational outcomes.

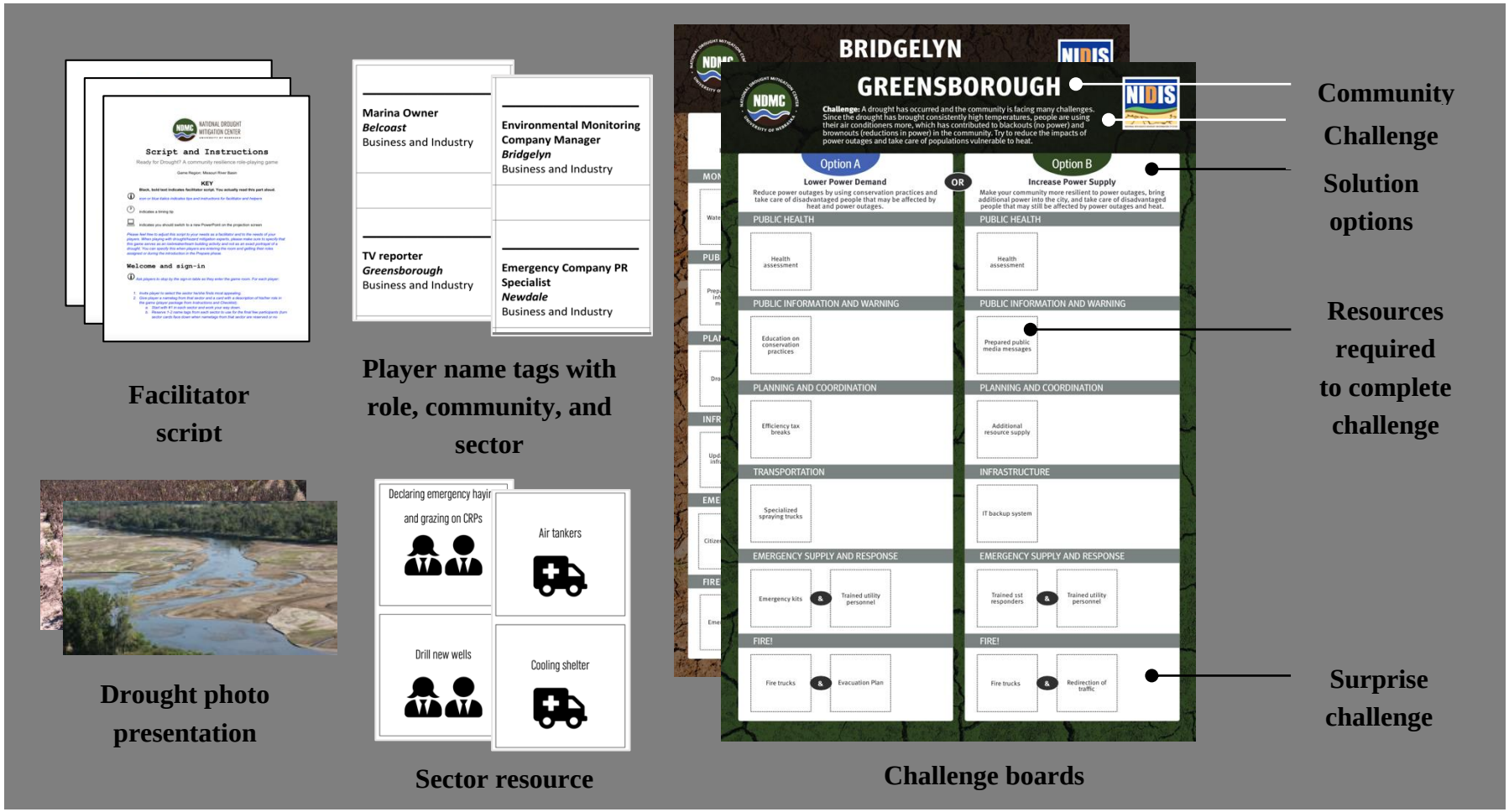

Figure 2. An example of the most important game package materials that are freely accessible and can be downloaded on the National Drought Mitigation Center website.

3.2.1. Prepare Phase

At the beginning of the prepare phase, each player receives information about their assigned unique role. Some of these roles were directly adapted from the Extreme Event game while others were identified by a team of drought experts with participatory drought planning experience. The roles represent important community leaders and are associated with a certain sector and a hypothetical community. Sector types include private citizens, community groups, federal government, local decision makers, business and industry, and first responders. An example of a player role is a marina owner associated with the business and industry sector from Belmont, a community that is affected by low lake water levels directly impacting the business of a marina. At the beginning of the prepare phase, the game facilitator directs players to gather in groups based on the sector they represent. Each sector group receives 24 cards representing resources that are known to be useful when mitigating and responding to drought in their sector. As a group they have to prioritize 12 resources to invest in and keep for the remainder of the game and 12 to discard. After the players decide which resources to keep, they distribute the cards evenly across the players in the sector. We carefully considered the resources from the Extreme Event game and kept those that were relevant for a drought situation. The remaining resources developed for the Ready for Drought? game were identified using the Federal Emergency Management Agency (FEMA) Thread and Hazard Identification and Risk Assessment (THIRA) capabilities [51] and experts' knowledge of drought mitigation and adaptation strategies. The resources were developed to be compatible with various sectors. For example, the private citizen sector resource pool includes cards for "citizen volunteers" and "strong interpersonal relationships" while the federal government sector includes "grant funding" or "national guard convoy" cards. This means that the resource cards have a different monetary value in real life or might have a value that cannot be expressed with money. In the game, the monetary value is purposely omitted to make the drought planning decisions less complex and to emphasize the importance of essential non-monetary resources. The prepare phase simulates a simplified process of drought planning.

3.2.2. Response Phase

After the sector groups distribute selected resources among the players, the game moves to the Response phase that simulates a drought event. Players, together with their resources, leave their sector groups and regroup based on the community they represent. During the response phase a slide deck of drought-related images is projected to create an atmosphere of urgency. Each community faces a unique drought-related challenge that players must solve to score points in the game. The challenges are associated with drought impacts that can be experienced by communities of various sizes in the Missouri River Basin DEWS. Relevant drought impacts were identified using the DIR database [47]. Drought severity and duration, which are both factors influencing drought impacts, were not introduced to make the game less complex and easier to comprehend for the players. The specific drought challenges are: West Nile Virus outbreak, brownouts and blackouts, municipal pump failure, low water levels in a river and a reservoir, high nitrate concentration in drinking water, and a low amount of produced forage to support livestock production. Each community challenge has two viable solutions. The game facilitator encourages players to discuss the trade-offs of these two solutions and to choose the one they find more appealing. These trade-offs include, for example, the decision between keeping an intact breeding herd of cattle versus saving the pasture by selling a majority of the herd, or maintaining a reservoir's water levels for recreation versus sustaining the stream flows in a river to protect the fish and wildlife dependent on it. Each solution has a predefined list of resources needed for addressing the challenge and scoring points that are revealed after the community chooses a solution. Players allocate their resource cards that are identified on community challenge game boards (Figure 2). They are allowed to trade unused resource cards with other communities in exchange for more useful resources. The trading component emphasizes the importance of cooperation and established partnerships between the communities when facing a natural hazard. Some or all communities are faced with the surprise wildfire challenge that requires two additional resources to solve. This surprise challenge

is used to even out the pace at which communities are solving their drought-related challenges. The response phase ends after all players cannot allocate any more resources to solve their challenge.

3.2.3. Recover Phase

During the Recover phase, players are seated together in their communities while the facilitator determines game scores. Each community is able to score 600 points based on the number of resources they were able to allocate. Finally, all community points are added to create a regional drought resilience score. This phase serves as a transition from the interactive phase to a collective group discussion phase and to highlight the common goal of all the communities—to help each other reduce the regional impacts of drought and to achieve a better score in the game.

3.2.4. Adapt Phase

During the Adapt phase, the facilitator leads a discussion to emphasize the most important aspects of the game. In the beginning of this phase, players are asked to present their community challenge to players from other communities. This reviews the variety of different impacts that can be encountered in the Missouri River Basin DEWS region. The players also discuss the two solutions of their challenge and are encouraged to identify the trade-off between these solutions. Other guided discussion questions focus on reinforcement of the learning outcomes and of the key game takeaways. These include the importance of regional resilience, cooperation between communities and sectors, drought planning, drought risk and vulnerability assessments, and establishing relationships between communities and sectors. A list of suggested questions is included in the game materials and can be found in the facilitator script on the NDMC website (https://drought.unl.edu/archive/documents/ndmc/droughtgame/game_materials/2_Script%20and%20Instructions.pdf).

3.3. Assessment Methods

A preliminary version of the game was tested in a university classroom setting. The players consisted of undergraduate and graduate students of various backgrounds, as well as faculty and staff volunteers from the School of Natural Resources, University of Nebraska-Lincoln (UNL SNR). The diverse background and age composition of the players was beneficial for obtaining initial feedback on the game play, materials, and the overarching message of the game.

The finalized version of the game was tested with three groups of professionals and three groups of university students. The game was played at three drought-related meetings: the Central Platte Natural Resource District drought planning meeting organized by an environmental consulting firm, the FEMA Region 8 drought workshop, and the North Central Agricultural and Natural Resources Academy. The professionals were affiliated with various institutions including universities, state and federal agencies, local governments or agencies, and non-profits organizations or community groups. They identified with a multitude of sectors including water resources, emergency management, recreation and tourism, fish and wildlife, agriculture, and others. The student participants were of diverse age and academic discipline. The game was played with two separate groups of freshmen students from an introductory course on natural resource science and with a group of junior and senior graphic design majors at the University of Nebraska-Lincoln (Figure 3). After each run of the game, participants were asked to fill out a post-evaluation survey. The response rate for student participants was 100% as completing the survey was a part of their class assignment. For the professional events, the post-evaluation survey was requested but not required. The estimated professional survey response rate was 95%. A total of 137 participants from all game events filled out the post-evaluation survey, of which 80 were professionals and 57 students. We asked participants to express the level of their agreement on a 5-point scale from completely disagree to completely agree with various statements about their experience playing the game. The participants also indicated situations where they would recommend the game. We report descriptive statistics, and the results of Pearson's Chi Squared test to evaluate if answers of students and professionals significantly differed ($\alpha = 0.05$). Only the professionals

were asked a set of questions referring to the usefulness of the game in facilitating new connections and collaborations between the game participants, so only descriptive statistics are reported for these questions. An example of the survey for professionals can be found in Supplementary Materials. The student survey was similar to the professional survey with irrelevant questions excluded (e.g., their affiliation or a sector they identify with).

Figure 3. University of Nebraska-Lincoln (UNL) students are trading resources during the Response phase of the Ready for Drought? game. Photo by: Robert Matteson, National Drought Mitigation Center.

3.4. Adaptation to Other Regions

Due to the location-specific characteristics of drought impacts, we limited the scope of the game to the Missouri River Basin DEWS. Therefore, if played with a group from another geographic region, some of the drought impacts (challenges) might be irrelevant or unfamiliar to the players. We developed and tested a process for adaptation of the game to a different location. We tested this approach with scientists from the National Disaster Management Research Institute of South Korea. The adaptation process follows the process we took when developing the game. First, we asked the scientists to create a list of drought impacts from both rural and urban settings in South Korea. They were then instructed to evaluate the identified impacts based on their importance and diversity and to select six of them to represent challenges for the game. The scientists came up with two general solutions for each challenge and the possible resources needed for each solution using both mitigation and response strategies. Other parts of the game, such as the sectors and roles, can be adapted directly from the original game with minor adjustments. This can be, for example, a role associated with specific identified communities and drought impacts, such as fisherman, if a fishing community is impacted.

For adaptation of the game resource cards, we recommend using an existing emergency framework similar to the THIRA used in the Ready for Drought? game.

4. Results and Outcomes

The feedback of the trial game participants from UNL SNR was generally positive and encouraging. Multiple players expressed enjoyment of the game and thought the game was a fun educational activity. They also provided input for improvements (e.g., changing the wording on a resource card, including explanation of resources, etc.). Based on the participant feedback, we implemented small changes in the game. For example, we created resource description sheets that briefly explain each resource card. During the trial game we noticed that players started solving drought-related challenges (placing resource cards on challenge boards) without paying attention to the description of these challenges. The challenges, representing drought impacts, are an important part of the educational component of the game. The players should first read and think about the challenges and their solutions. In later iterations of the game, we decided to cover part of the challenge board that indicates the necessary resource cards at the beginning of the response phase and reveal it only after the community group discussed their challenge and its solutions.

Participant Survey

The majority of the game participants indicated that the drought scenarios provided a realistic context for decision-making (45% somewhat agree, 36% completely agree), and that the game pace (32% somewhat agree, 49% completely agree) and length (39% somewhat agree, 45% completely agree) were appropriate (Table 1). Other relevant survey results are summarized in Tables 1–3 and are presented in the following paragraphs together with corresponding research questions.

Does the game serve as an effective icebreaker or team building activity?

We asked participants to express their agreement with a statement that the game is an effective team builder or icebreaker activity. Based on combined answers from all participants, 93% of them agreed with the statement (37% somewhat agree, 57% completely agree, Table 1). The professionals agreed with the statement in 94% of cases (29% somewhat agree, 65% completely agree, Table 1). The game would be recommended by 80% of all participants for improving networking among stakeholders (Table 2). When only answers of professionals were considered, 84% of them recommended the game for that purpose (Table 2). We did not find a statistically significant difference between the responses of students and professionals in these categories.

Does the game serve as an effective drought impact and planning educational tool?

A total of 83% of participants expressed agreement with the statement that as a result of the game they are more familiar with the drought planning process (50% somewhat agree, 33% completely agree). The responses of students were significantly different from responses of professionals. A total of 79% of all participants agreed that the information they got from the game will likely inform their future decision-making related to drought management and 88% agreed that the game is an effective tool to build awareness about drought (33% somewhat, 55% completely). The game would be recommended by 82% of the players for learning about drought impacts. The responses of students and professionals in this category were significantly different with 98% of students and 67% of professionals recommending the game for drought impact education. A total of 82% of the professionals indicated a level of positive likelihood for considering a different approach to problem solving, decision making, and/or planning related to drought as a result of the game.

Table 1. Responses of the participants (in percent of received responses) to a question about their level of agreement with various statements about the game. Difference in responses between students and professionals was measured using Person's Chi Squared and is presented using the associated probability value.

Statement	S/P [1]	Completely Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Completely Agree	Difference in Response
The drought scenario challenges provided a realistic context for decision making.	S	3.51	3.51	10.52	38.60	43.86	No, P = 0.603
	P	3.80	5.06	11.39	49.37	30.38	
The pace of the game was appropriate.	S	1.79	3.57	14.28	28.57	51.79	No, P = 0.567
	P	1.25	8.75	8.75	35.00	46.25	
The length of the game was appropriate.	S	1.75	7.02	10.53	35.09	45.61	No, P = 0.882
	P	1.25	6.25	6.25	41.25	45.00	
I am more familiar now with the process of planning for droughts than I was before participating in the game.	S	0	1.75	3.51	49.12	45.61	Yes, P = 0.011
	P	5	3.75	16.25	51.25	23.75	
I learned information during this game that will inform my future decisions related to drought management.	S	3.57	3.57	12.5	42.86	37.5	No, P = 0.701
	P	2.5	2.5	17.5	50	27.5	
The game is an effective team builder or icebreaker activity.	S	1.75	1.75	3.51	47.37	43.86	No, P = 0.114
	P	1.25	0	5	28.75	65	
The game is an effective tool to build awareness about drought.	S	0	3.51	5.26	28.07	63.16	No, P = 0.491
	P	1.25	3.75	8.75	37.5	48.75	
The game is an effective tool to build awareness about the need for communication and cooperation in managing drought.	S	0	1.79	0	25	73.21	No, P = 0.259
	P	1.25	1.25	7.5	25	65	

[1] Students/Professionals.

Table 2. Responses of the participants (in percent of received responses) to a question about their recommended purpose of the game. Difference in responses between students and professionals was measured using Person's Chi Squared and is presented using the associated probability value.

Purpose	S/P [1]	Yes	Maybe	No	Difference in Response
Networking among stakeholders.	S P	75.44 83.58	22.81 14.93	1.75 1.49	No, P = 0.522
Learning about drought impacts.	S P	98.25 67.16	1.75 26.87	0 5.97	Yes, P = 0.0
Improving communication among stakeholders.	S P	80.70 76.12	17.54 22.39	1.76 1.49	No, P = 0.797
Demonstrating the importance of communication and coalitions.	S P	94.74 86.57	5.26 13.43	0 0	No, P = 0.125

[1] Students/Professionals.

Table 3. Responses of the professionals (in percent of received responses) about the likelihood of various statements resulting from the game.

Statement	Very Likely	Somewhat Likely	Not Applicable	I Don't Know	Not Likely
Pursue new projects or collaborations with someone you have worked with before?	21.52	45.57	6.33	16.46	10.13
Pursue new projects or collaborations with someone you have NOT worked with before?	15.19	45.57	7.59	16.46	15.19
Follow up to learn more about another aspect of drought mitigation?	29.49	44.87	2.56	11.54	11.54
Consider a different approach to problem solving, decision making, and/or planning related to drought?	40.51	41.77	2.53	11.39	3.80

Does the game build awareness of the importance of communication, collaboration, and networking among stakeholders?

A total of 93% of the participants expressed agreement with the statement that the game is an effective tool to build awareness about the need for communication and cooperation in managing drought (68% completely agree, 25% somewhat agree). The game was recommended by 90% of all participants for demonstration of the importance of communication and coalitions during drought and by 78% of participants to serve for improving communication among stakeholders. The responses of professionals and students were not significantly different for these questions.

5. Discussion and Conclusions

We developed a serious role-playing game that simulates real-world drought situations, presents examples of drought impacts, and simulates decision making in difficult resource-sharing circumstances. Our objectives were to create an exercise that would be suitable for both university students and drought professionals, enhance learning about drought impacts and the planning process, emphasize the importance of communication and collaboration between stakeholders and decision makers, and that would serve as an icebreaker or team building activity for drought-related meetings. We followed an established game structure of the Extreme Event game, a gold-medal winner of the 2015 International Serious Play awards [52]. We were able to create a low-cost downloadable version of the game that is accessible for free to the general public through the National Drought Mitigation Center's (NDMC) website (https://drought.unl.edu/Education/DroughtGame.aspx). The NDMC uses other games for drought education, outreach, and planning. The Invitational Drought Tournament [53] is used for adult audiences to develop comprehensive drought management strategies [54] and the Water Banking for children to explain the concept of water sharing during a drought [55]. The Ready for Drought? game complements these exercises both in terms of target audience (students and adults), and the purpose of the game (education and team building). The complexity of drought planning and drought itself is addressed differently in these exercises. The Water Banking game uses a simplified scenario and focuses solely on the concept of sharing water resources before and during drought. On the other hand, the Invitational Drought Tournament simulates decision making using more realistic scenarios, incorporating drought severity and duration. The Ready for Drought? game introduces the complexity of drought planning, and the relationships between various stakeholders and sectors affected by drought. However, it purposely omits certain factors, such as the monetary value of drought resources or the drought severity and duration, which might otherwise take players' attentions away from the main messages of the game. Excluding the drought severity and duration factors allows the game to be played in a limited time frame (optimally 1.5 h) and be used as an icebreaker during a longer drought planning meeting or as an educational activity during one class period.

Some barriers might exist for using water-related games in educational and professional settings. These include an overall cost associated with organizing and purchasing the game, technology requirements, expert knowledge, and others. We designed the Ready for Drought? game to be easy to use by the general public, applicable in various settings, low-cost, and having low technological requirements. Future enhancements such as a video tutorial and instructions on playing, organizing, and facilitating the game may be helpful. Even though the game is purposely simple and low-cost, we paid attention to small details that can be important for the creation of a successful game such as a strong narrative and appealing visual design as recommended by Christen et al. [15]. The game materials include a facilitator script, which ensures that the narrative of the game is followed. The materials are color-coded and contain pictograms that illustrate different sectors presented in the game (Figure 2). The materials also include a presentation that can be played during the drought response phase of the game. It contains photos of drought and drought impacts representing the intensifying phenomenon and is used to induce the feeling of urgency of the situation. This corresponds with the findings of Auber et al. that graphical representation of an intensifying phenomenon is an emerging approach in many water-related serious games [14].

In their review of water-related serious games, Auber et al. found that many of the reviewed games provoke collaboration with a role-playing component and conclude with a discussion section that summarizes the learned outcomes [14]. The Ready for Drought? game follows this format and includes a guided discussion as a final phase of the game. During this phase, the players can reflect upon the newly-gained knowledge and can discuss different views and experiences from the game. The facilitator script included in the game materials provides a detailed set of questions to guide the discussion in the correct direction to review and emphasize some of the most important learning outcomes, and it helps to put the game in the perspective of a real-world situation.

Incorporating local drought impacts and planning challenges can also serve to greater motivate players. Research shows that adult learners are driven by experiences that are relevant and that help effectively incorporate new knowledge into their responsibilities and real-life issues [56]. At this time, the game exists only for one geographic region, the Missouri River Basin DEWS. The game can be used in other regions under the assumption that the drought impacts used in the game are relevant to that location. The game can be adapted to other geographic regions as outlined in the methods section. However, a database of location-specific drought impacts, similar to the DIR, as well as drought expert knowledge and familiarity with the game are necessary for its adaptation. There is currently no detailed documentation that would describe the necessary steps to adapt the game to other locations. Therefore, to better illustrate the adaptation process, future efforts should focus on developing and testing a framework and detailed workflow of this process.

Based on the game participants survey results, we developed a viable game that is of appropriate pace and length and of relevant context for drought decision-making. The objectives of the game were to serve both as an educational and icebreaking tool for university students and drought professionals. Based on the survey results, the game fulfilled our objectives. The participants identified that they learned about drought impacts, the process of drought planning, and the importance of communication and collaboration when managing drought. The only statistically significant difference between the responses of students and professionals were found for the educational aspect of the game in terms of learning about drought impacts and planning. The students more strongly agreed that as a result of the game they are more familiar with the process of drought planning and they were also more likely to recommend the game for learning about drought impacts. This is an expected outcome since some of the professionals were likely already familiar with the process of drought planning and impacts. Almost all participants thought that the game is a good icebreaker and can serve as a tool for networking between stakeholders. Based on these findings, we suggest that the main purpose of the game can be different for various participant groups. The prior knowledge of drought, its impacts, and planning might determine if the game is used primarily for educational purposes or for an icebreaking purpose. To fully assess benefits of the game as a drought educational tool, a comparison of different teaching approaches to this topic would be necessary. Additionally, to determine the knowledge gained during the game is long-lasting, a follow-up survey of the game participants would be needed. Communication, collaboration, and coordination are crucial for effective drought planning and response. No matter if the participants were students or professionals, the game was able to teach them about the importance of communication and collaboration between various stakeholders and decision-makers. This knowledge, if retained and transferred to real situations, could be beneficial when dealing with controversial water-related issues and during drought planning and response.

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