Can climate change games boost public understanding?

Roberta Kwok, *Science Writer*

In 2014, ecologist Josh Lawler watched as his 8-year-old son became engrossed in video games. The games' hold made him wonder: Could researchers exploit the medium to teach players—both children and adults—about climate change? "I figured we're having trouble getting the message about climate change out," says Lawler, who is at the University of Washington (UW) in Seattle. "The thought was that video games could play that role of being the messenger."

The following year, Lawler and his colleagues started EarthGames, a group that encourages students and professional software developers to produce environment-themed games, exploring topics ranging from soot pollution to the survival of small mammals called pikas in a warming world. EarthGames is one of a multitude of teams keen on incorporating climate change into board, video, and role-playing games. Some are creating simple prototypes at events called game jams. Others have devised elaborate simulations drawing on real climate modeling.

The efforts are driven partly by a realization that traditional science communication methods based on the "information deficit model"—the idea that people simply need to be given more information about the topic conveyed in an understandable way—aren't particularly effective (1). One-way transmission of information, such as reports or films, has failed to motivate international action to sufficiently reduce emissions, says Juliette Rooney-Varga, an environmental scientist and director of the Climate Change Initiative at the University of Massachusetts Lowell. Studies by Rooney-Varga and others suggest that games can help participants grasp complex concepts, elicit emotional responses, and increase motivation to act.

Time to Play

Soon after his climate-change–game brainstorm, Lawler approached Dargan Frierson, an atmospheric scientist at UW. Frierson was immediately intrigued. "So often, when you start talking about global warming, everybody just shuts down," he says. "It's a downer." Games, Frierson thought, could make the learning more fun.

To form EarthGames, the pair teamed up with experts in computer science and game design. In 2015, the group hosted a climate-themed game jam, part of a national program spearheaded by the US White House Office of Science and Technology Policy in Washington, DC, and various partners. EarthGames gathered about 2 dozen people, mostly university students and faculty, to crank out games in 48 hours. Participants formed their own teams and could use climate data or consult with climate and game experts. The games had to focus on climate adaptation, such as building seawalls or planting drought-tolerant crops, but developers otherwise had free rein.

In the board game *KEEP COOL*, players must decide to build carbon-emitting or carbon-neutral factories to meet their countries' economic targets while keeping global temperature below a critical threshold. Image credit: Keep Cool GbR.

In one team's game, *Climate Quest*, players read about a series of disasters around the United States, such as sea-level rise and heat waves. For each event, they had to dispatch one of four experts—an urban planner, ecologist, agricultural scientist, or climate scientist—with the right skills to solve the problem. Players earned high scores based on how many crises they successfully addressed during the allotted time. The game was meant to show the many impacts of climate change and highlight concrete ways to prepare for them, Frierson says.

In the case of a cooperative board game called *AdaptNation*, people played city leaders who had to manage resources such as water and food while preparing for drought, ocean acidification, and other climate-related challenges. If players made it through four rounds of play without running out of resources

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Among the tasks for players of the digital game *Soot Out At the 0 C Corral*: control a net to grab soot particles in Alaska and summon researchers to help clean up the pollution. Image credit: Rikki Parent/EarthGames.

too many times, they won. *Climate Quest* and *AdaptNation* placed first and third, respectively, in the national contest and were on display at the Smithsonian National Museum of Natural History in Washington, DC. Visitors could play *Climate Quest* on computers and *AdaptNation* at a table with guidance from members of the development team.

Frierson later started teaching a game-development class, and undergraduate students added their projects to EarthGames' repertoire. One undergraduate team and a professional software developer created *Life of Pika*, in which users help a pika—a small mountain mammal sensitive to rising temperatures—run and collect food without overheating. The game is meant to show the impacts of climate change on these vulnerable animals and make players empathize with the creature's plight.

Other projects brought the idea of climate change closer to home. In 2018, Andrew McDonald, an undergraduate at the University of Washington Bothell, released a game called *The Other World* that users can play on mobile devices as they roam the UW Seattle campus. Similar to *Pokémon GO*, the game uses augmented reality. Players receive a plea for help from a character in a world beset by environmental catastrophes. Images are superimposed on the user's view through the device's camera—a campus square appears to be flooded, a building engulfed in forest fires, or a fountain overrun with locusts. McDonald, who was inspired to create the game after visiting the Dakota Access Pipeline protests, hopes the experience will make people think about the world they're leaving for future generations.

So far, EarthGames' 13 games available free on Apple's App Store or Google Play have been downloaded more than 10,000 times. The team has presented them at museums and shared them with Washington schools, Frierson says. But EarthGames hopes to expand its reach by creating software modules that other game developers can use. One module in the works simulates and visualizes how changes in greenhouse gas emissions affect global climate and the probability of regional extreme weather events. Frierson has started posting the code on the EarthGames website and plans to provide it to Eric Holthaus, a meteorologist in St. Paul who's leading the development of a climate strategy game called *Flourish*. That project, still in the early stages, may allow users to play leaders with different traits—such as a high-tech innovator or organic farm proponent—navigating the challenges presented by climate change, Frierson says. The module could be used to determine how different emissions pathways lead to varying temperatures or extreme events.

Eventually, EarthGames would like to build a climate change game that reaches a mainstream audience. The main barrier is funding, Lawler says. And it's tricky to design a game that people want to play. "If the game isn't fun, the message won't get across," he says. (See Science and Culture: Quantum games aim to demystify heady science, https://www.pnas.org/content/115/8/1667.)

Changing Attitudes

Can such games, however well-intentioned, actually help people learn about climate change? Could they change the public's attitude toward the science and help illuminate the impact on people and ecosystems?

Early studies suggest they do have some potential. Rooney-Varga and her colleagues published a study in 2018 on *World Climate*, a role-playing game in which users are delegates at United Nations negotiations who must reach a global agreement to keep Earth's warming within 2 °C above preindustrial levels (2).

Climate Games

Various games, available in a variety of formats, aim to educate and inform about the effects of climate change:

AdaptNation
https://earthgames.org/games/adaptnation/
Climate Quest
https://earthgames.org/games/climatequest/
KEEP COOL
www.climate-game.net/?lang=en
Life of Pika
https://earthgames.org/2018/12/08/life-of-pika-is-now-available/
The Other World
https://earthgames.org/2018/06/06/the-other-world-a-new-augmented-reality-experience/
World Climate
https://www.climateinteractive.org/programs/world-climate/

Participants usually meet in person in a room to set targets for emissions reductions, give speeches, and negotiate. A facilitator enters commitments into a real climate model software program that calculates whether their collective actions will meet the 2-°C goal. So far, the freely available game has been played by more than 50,000 people in 85 countries.

World Climate attempts to address a key obstacle to successful science communication: People often discount information from sources who don't share their political values. A self-identified conservative is likely to dismiss Al Gore and climate scientists as unreliable. But in *World Climate*, "the participants are the messengers," Rooney-Varga explains. A player representing poor countries might plead with rich nations to take action. And the game does not dictate how participants should meet emissions targets. "We let people discover everything by themselves," she says. For instance, players can decide how much to cut emissions, reduce deforestation, and convert other lands to forest. Often, they realize that their collective actions are not enough to meet the target.

In the study, Rooney-Varga's team analyzed survey responses from more than 2,000 participants around the world who played in settings ranging from high schools to business executive graduate programs. After playing, people reported increased feelings of urgency and hope. Participants probably realize they can't achieve a worldwide target of 2 °C "unless it's all in and it starts now," Rooney-Varga says. And they might feel more hopeful because they manage to reach a cooperative solution.

After the game, players also showed a better understanding of how carbon dioxide builds up in the atmosphere, and more said they believed that human activity contributed to a warming world, Rooney-Varga says. The researchers now plan to investigate if student participants take concrete action afterward, such as registering for a class on the topic or changing career choices.

Games also can underscore the consequences of inaction. In a study published in 2018, researchers analyzed how 235 students in Germany responded to the climate change board game *KEEP COOL* (3). In the game, designed by a resource economist and a physicist, each player represents a group of countries that must make money by building either carbon-emitting or carbon-neutral factories; participants' decisions influence global temperature and the likelihood of climate-related disasters. If the temperature exceeds a certain threshold, everyone loses.

The researchers found that players who built a lot of carbon-emitting factories—essentially free-riding off other players who kept the planet cooler by building more expensive, carbon-neutral factories—were more likely to believe afterward that an effective international climate agreement would be reached. These free-riders may have realized that the consequences of their actions could be catastrophic if their lack of cooperation made the global temperature cross the threshold, says coauthor Jasper Meya, an environmental economist at the Carl von Ossietzky University of Oldenburg in Germany.

It's not yet clear whether climate change games can actually reach a new audience. "There's a danger that the only people who play these games are people who are already converted," says Sean Walton, a computer scientist at Swansea University in the United Kingdom and founder of the game company Pill Bug Interactive. But Rooney-Varga notes that *World Climate* is played in settings that are unrelated to climate change—executive MBA classes for example—suggesting that not all participants belong to a self-selecting group of people who are concerned about the issue. Walton's team hopes to conduct a scientific study on the effects of games, in particular, those produced at a game jam they organized, on a broad swath of the public that includes climate change skeptics. The researchers envision recruiting broadly and crafting a study description that excludes specific mention of climate change to ensure that skeptics are not deterred from participating.

All these efforts share a sense of urgency—and the desire to use any means necessary to educate the public. Conventional messaging approaches have fallen short, Lawler says. "We need to move faster," he adds. "We need the message to appeal to more people."

1 Simis MJ, Madden H, Cacciatore MA, Yeo SK (2016) The lure of rationality: Why does the deficit model persist in science communication? *Public Underst Sci* 25:400–414.
2 Rooney-Varga JN, et al. (2018) Combining role-play with interactive simulation to motivate informed climate action: Evidence from the World Climate simulation. *PLoS One* 13:e0202877.
3 Meya JN, Eisenack K (2018) Effectiveness of gaming for communicating and teaching climate change. *Clim Change* 149:319–333.