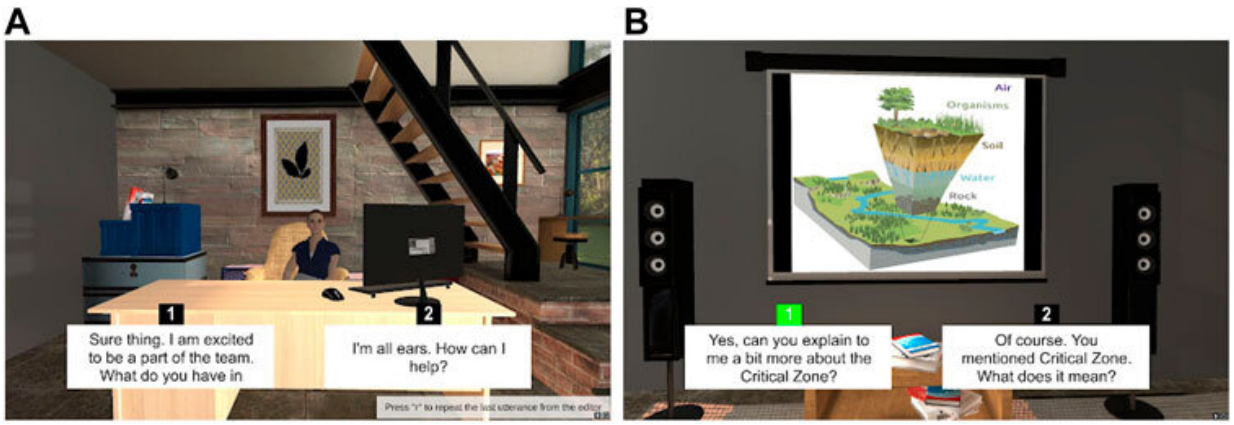
Computer games may be a key to ecological learning, study says

October 12 2022, by Jonathan F. McVerry



The office of the newspaper editor. Interaction with the newspaper editor (A), briefing about the CZ (B). Credit: *Frontiers in Environmental Science* (2022). DOI: 10.3389/fenvs.2022.957204

Computer games are an effective way to teach ecological issues and build pro-environment policy support, according to published research by an interdisciplinary group of Penn State scholars.

The study compared the effects of reading a website to playing "CZ Investigator," a narrative-based computer game designed by co-author Pejman Sajjadi, where players interact with a virtual natural environment. The purpose of the study was to test how the game would affect players' understanding of the "critical zone"—the CZ in the

game's name—which is the area of land ranging from the bottom of groundwater to the top of trees, critical to all life on the planet.

The researchers say understanding the critical zone helps people learn how environmental systems are connected. For example, cutting down trees can affect water flow, which can hurt wildlife, or some farming practices can affect water quality which can contaminate water where fish that people eat live.

The study appears in the journal *Frontiers of Environmental Science*.

Sajjadi, a post-doctoral researcher at Penn State's Center for Immersive Experiences, indicated that "CZ Investigator" is a type of "serious game"—games that are not purely for entertainment but is also used for educational reasons. However, that doesn't mean they're not fun, he said.

"Games are inherently an engaging medium," Sajjadi said. "If they're designed well, we can leverage these characteristics and try to deliver a meaningful message. We can create serious games that are fun and engaging."

Sajjadi reported that the interdisciplinary team—involving experts in communications, earth and mineral sciences, game design, and psychology—was vital to building the game and designing the study.

The virtual world in "CZ Investigator" is a digital replica of Central Pennsylvania. Sajjadi used a program to mimic the area's geographic characteristics and then added trees and other vegetation. Players explore the location, experience consequences for specific actions, and then reflect on the experience. The researchers proposed and found evidence that the game generates users' "systems thinking."

"Systems thinking is the ability to see connections among things," said

Janet Swim, professor of psychology at Penn State. "Exploring how water flows through a system can help players understand how water is connected with the rest of the environment."

Swim added that once people start thinking about how systems work, they may be more likely to understand the importance of their behavior and environmental policies that can influence a chain of events.

More than 150 users participated in the study remotely on their home computers. Participants reported their level of science knowledge. Eighty read a static website with information about the critical zone, and 72 participants played "CZ Investigator." All participants filled out a survey after completing these parts of the study.

In the game, the player roleplays a journalist whose editor tells them to cover a story about a logging company deforesting an area in Central Pennsylvania. The editor explains the critical zone and how the player will investigate and collect evidence.

With regular updates from an "expert," players are tasked with examining the flow and storage of water in wells located in the virtual environment. Other objectives include building an understanding of how rainwater infiltrates the systems and how human intervention affects the system. The game is complete when the player reaches all the objectives.

"Learning in this context should go beyond memorization and recall," Sajjadi said. "It should reach a level where people can infer their own knowledge … and ultimately theorize and form hypotheses that they can test in the game environment."

Because the internet is a common information source and way to teach information online, the researchers compared the effects the serious game had on players to the participants who read the web page that

featured the same information in text format.

The research team confirmed that using a serious game to teach about complex environmental systems enhanced the "ability to think in terms of distinct, but related systems." Participants in both the "CZ Investigator" and web page conditions displayed systems thinking and policy support, but the game was more effective. The researchers found that the game's benefits were more potent for people without science backgrounds.

"It worked out nicely. The science people think it's cool and interesting," Swim said. "But for the other people, we've found a way that they could do something that engages them. Once you make a game available, they might try it."

The team hopes a final game version could be available at schools and libraries. Future versions of the game will include a virtual reality option. Swim said greater immersion with virtual reality could enhance the game's effectiveness, but its effectiveness should be tested.

More information: Pejman Sajjadi et al, Promoting systems thinking and pro-environmental policy support through serious games, *Frontiers in Environmental Science* (2022). DOI: 10.3389/fenvs.2022.957204

Provided by Pennsylvania State University