Racing game proves effective in teaching scientific reasoning

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An online game that has students race through a course and learn about scientific argumentation during pit stops has proven effective at a crucial time in American education. Researchers and developers at the University of Kansas who created the game hope to expand it and making new versions available to cover additional subject matter free of charge to schools across the country.

Reason Racer, an online game that allows middle school students to compete with their peers while learning about scientific argumentation, was first available online a few years ago. The game proved so effective that developers in KU's Center for Research on Learning are seeking funding to expand it and hope to make a math version available soon. They developed the original game with students in a Kansas middle school and tested early versions with students in five schools across the state.

The first iteration of Reason Racer focused on scientific argumentation, helping students learn not only scientific facts, but how to properly come to conclusions, verify findings, defend results and more. The newest version of the game will focus on mathematical reasoning and discourse about conjectures.

"We're not just looking for what the answer is, but how did they get to that answer and what was the reasoning used to get there," said Jana Craig-Hare, assistant research professor at the Center for Research on Learning and one of the game's developers.

As many as 20 students can join a race simultaneously. Each game features a topic such as "Worm Glue," in which they learn about how certain types of worm saliva can be used to mend bones, and other youngster-approved topics such as "Panda Poop to the Rescue," "Was Einstein Wrong" and "Energy Drinks." Each module shows a video at the beginning exploring a scientific reasoning concept such as replicating results, and then it's off to the races. Students make mandatory pit stops in which they must answer a series of questions before they can move on. Each stop focuses on a different area of scientific reasoning such as determining whether a statement is fact, opinion, data or theory. Wrong answers slow a racer down, a disincentive to guessing.

At the end of the race, students enter a chat function in which they discuss with their peers their justification about their decision to accept, reject or withhold judgment about a claim. They discuss why they came to the answers they did, supporting evidence and more. The chat serves several purposes. It keeps students thinking about scientific argumentation while giving them a chance to write out their own thoughts, defend them and challenge their teammates. A patented peer-scored chat function allows racers to award or subtract points to their fellow students based on the strengths of their arguments. The chat function has proven effective and even had some surprise results.

"Our data suggest that kids' use of Reason Racer over time greatly helps them improve in the area of scientific reasoning. And with the chat function they stay on topic," said Marilyn Ault, associate research scientist at the Center for Research on Learning and a game developer. "It's not just idle chitchat; it has shown to be on the topic at hand. Plus we've found that students tend to go back and help their classmates who might need a little more help in some areas."

While students have proven to benefit from the game, developers had teachers in mind as well. Educators who use Reason Racer can keep

track of individual students' progress, monitor and print discussions in the chat function and produce reports on student progress. The teacher's component of the game also features resources including how to include scientific argumentation in lesson plans, how to use reports for formative assessment and how to access the game's videos outside of the game.

The timing of the original version of the game and its subject matter was fortuitous. Scientific argumentation is part of the new Next Generation Science Standards, and is a topic that can be difficult for teachers to incorporate and for students to grasp. The game has shown it can improve students' grasp of the concept and includes resources on how teachers can use the game to meet the requirements of the Common Core Standards as well.

"It's coming at a really good time. Teachers are telling us they need resources in this area, and Reason Racer can really help," Craig-Hare said.

The game, resources, tutorials and more are all available for free at reasonracer.com. Any school can use it; all that is required is the creation of an account at the site. Users can also download an iPad app version of the game at the Reason Racer site.

Developers hope to have the mathematics version of the game available in the next few years. Both the original and the proposed new version are rare due to the fact that students have been involved in the games' development from the beginning. While most games, both educational and those purely for entertainment, are developed solely by professionals and later tested with target audiences, Reason Racer involved students and teachers in the development, testing and refining of the product. Students provided ideas and feedback on everything from design, color palettes, functionality and format in which the questions are presented. The result was a game featuring highly regarded design qualities such as

competition, speed, autonomy for users, feedback from users and awarding achievements.

"That was a real design consideration we embraced," Ault said of involving students. "We'd go out to schools and play games with them, watch them play the games and talk about games. It meets a national need, is nationally available, stable, and it's fun."

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