Engaging Students in Science Controversy Through an Augmented Reality Role-Playing Game

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Abstract: POSIT (developing Public Opinions on Science using Information Technology) is an augmented reality role-playing game for networked handheld computers. It is designed to improve engagement in science controversies and develop skills in evaluating evidence and forming arguments. Groups of high school or college students investigate a scenario based on a fictionalized science controversy. They gather evidence from virtual characters and items situated in real locations and compete to develop the most persuasive arguments. Preliminary results suggest that this is a promising approach and further design experiments are needed.

Introduction

Increasingly, we are faced with science controversies that have broad implications for society. Students need both greater engagement in the science controversies that affect them, and better tools to evaluate evidence and form arguments. Here we report preliminary design experiments with a game aimed at meeting those needs.

POSIT (developing Public Opinions on Science using Information Technology) is an augmented reality role-playing game for networked handheld computers. Groups of high school or college students are introduced to a scenario based on a fictionalized science controversy, gather evidence about it, and rate each other on their arguments.

POSIT builds on previous technical and pedagogical work with augmented reality games. We have chosen to situate the game and the players in the real world using handheld augmented reality technologies, because we have seen in previous work creating such games outdoors (Klopfer & Squire 2006) and indoors (Rosenbaum, Klopfer & Perry 2006) that information from real world surroundings plays an important role in decision-making. Studies of other augmented reality games have shown for example that students can become strongly engaged in their simulated worlds (Facer, 2004), and can synthesize and evaluate evidence within the game in sophisticated ways (Schrier, 2006).

The design of POSIT also builds on related work using technology to track student opinions (Yoon, 2006) during discussions around controversies in science. Yoon's work demonstrated the importance of providing tools for students to reflect on their own opinions and that of their peer groups. There are also non-technological games that influenced the design of POSIT, including Democs (Smith, 2005), a card-based activity which engages small groups in debating public policy issues.

Research questions

While POSIT is the center of a larger research program, for this initial study we chose to focus on two particular questions of interest:

1. Does POSIT engage students' interest in a science controversy?
2. Does POSIT lead to improvements in the skills of evaluating evidence and forming arguments?

Game overview

In our initial scenario, players face the question: "Should the University build a BSL-4 lab?" BSL-4 is the highest bio-safety level, required for the study of the most deadly pathogens. Players are given a briefing on the game the day before, then a short introduction on the day of the game. They play the game for 2 hours. Partway

through the game and again at the end players meet and form pairs in order to rate each others' arguments. At the end of the game, there is a wrap-up discussion.

Each player is randomly assigned one of ten roles, including a brief description of their background and their potential stake in the proposed lab. These include a university student who lives near the proposed lab site, a local parent, a city councilor and a biotechnology executive. Players enter their opinion on the question using a slider that ranges from -5 (no, the university should not build the lab) to +5 (yes, it should). A dynamically updated histogram allows them to see the opinions of the other players.

Players walk to various buildings on campus in order to gather evidence. The handheld device detects which building the player is in and displays the relevant game content. An actual construction site on campus represents the proposed lab site.

A variety of virtual characters representing a range of opinions are distributed throughout the buildings in the game. They are situated in realistic locations (e.g. there are virtual students in the actual dorms and virtual nurses in the actual medical center). Players can "interview" them to get textual responses with their opinion on the controversy. Virtual items such as newspaper articles, journal articles, technical documents, informational pamphlets, photographs and advertisements are distributed among various locations. News flashes, text messages and other bulletins arrive at fixed times, to a subset of players according to their role. This dynamic content is used to create story lines that develop through the course of the game.

Players can select the most persuasive evidence they have gathered (items, announcements and responses from virtual characters) and add it to their "evidence portfolio." To receive scores, players form pairs in which one player rates the other's argument. The arguer sends her evidence portfolio to the rater, allowing the rater to examine it. The arguer delivers a brief verbal argument, and the rater gives her a score according to a three-part rubric (basis of the argument in facts, relevance of the argument to the arguer's role, and response to a rebuttal).

Research Methods

POSIT is currently being pilot tested with high school and university level students. Formative evaluation surveys, and video of game play and focus groups discussions are currently being analyzed. Additionally, a pre/post transfer test to assess skills in forming arguments has been pilot tested.

Results

During pilot tests we observed that students were able to manipulate the POSIT user interface, gather evidence, and present their arguments to each other. Students were engaged in the fictional scenario content, and appeared to understand how to play their roles and how to rate each other's arguments.

On surveys, students reported enjoying the story lines and "news flashes." Aside from technical glitches, they disliked walking around a lot, having to read messages that were too long, and receiving inaccurate ratings from their peers. We hope to address these problems with more densely placed game locations, shorter texts and the addition of videos, and improved game mechanics.

Some students also reported that the rating system helped them improve their arguments because e.g. it "made you realize some things did not back your argument as much as you thought," it "made people have to back up their ideas" and it "[made] your argument stronger and efficient." Some students reported changing their opinions on the controversy due to testimony from virtual characters. For example: "reading the messages from the characters helped me view different perspectives of these characters like the firefighter, Molly [etc]." Some students were affected by the physical situation of the proposed construction site in forming their opinions. For example: "I saw the spot where the building was set to be built on and it was very scary how many students and people walked by it constantly."

Analysis of the pre/post test suggests that after playing the game students form more arguments that are better based on facts and more representative of a role. Additional studies with a larger number and variety of students will be needed to clarify these results.

Future Directions

The game mechanics have evolved throughout our pilot tests. In an initial version, the game was primarily focused on players' opinions. The goal was to sway your fellow players toward your position in order to affect a vote at the end of the game. The incentives for gathering evidence and attempting persuasion were insufficiently clear. In our first attempt to give players a clearer goal, we created a simple dynamic opinion model for the virtual characters, so that players could "persuade" them. Players could send their evidence portfolio to virtual characters in order to change their opinions. If the portfolio contained highly persuasive evidence that had not yet been "seen" by the virtual character, its opinion would change. The virtual characters would then also participate in the vote at the end of the game.

To increase the focus on players interacting with each other (instead of only persuading virtual characters), we introduced the argument rating system described above. This system gives players a clear incentive to pair up and deliver verbal arguments, and gives immediate feedback in the form of a score. One problem with this system is that it does not prevent unreliable ratings, including cheating. To partly mitigate this we divide the students into two groups; within groups they compete for highest argument score, but they only give each other rating scores across groups.

In future tests we hope to evolve the argument rating system to further clarify the game goals for the player while rewarding effective argumentation techniques. One possibility is to give each player a "weakness," which is the category of argument to which they respond (e.g. scientific or emotional). Players are rated according to how well their argument matches the rater's weakness. This adds the elements of considering the audience when formulating an argument, selecting evidence to match argument categories, and using evidence flexibly to make different types of arguments.

Conference Demo

The demonstration will include a playable demo version of the game running on several handheld computers. In the demo version, most game functionality and content is available, without the wireless location-awareness feature. Video of students playing the game will be available as well.

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