Sick at South Shore Beach: A Place-Based Augmented Reality Game as a Framework for Building Evidence-Based Arguments

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Abstract: Recent research on Augmented Reality (AR) gaming suggests that place-based AR games embedded in larger curricular units provide contexts and scaffolding for developing students' scientific argumentation skills. This project explores the potential of one specific place-based AR gaming unit, *Sick at South Shore Beach*, to develop students' argumentation skills and increase their understanding of the role that social interactions play in the development of scientific arguments.

Introduction / Statement of Problem

The National Science Educational Standards (National Research Council, 1996) identifies the following scientific literacy goals for fifth through eighth graders: (1) Use appropriate tools and techniques to gather, analyze, and interpret data. (2) Develop descriptions, explanations, predictions, and models using evidence. (3) Think critically and logically to make relationships between evidence and explanations. Despite these goals and recent initiatives to support them, students still struggle to construct, justify, and evaluate scientific arguments (Kuhn, 2005; Weinberger, et al., 2006). Many researchers trace this problem to the nature of traditional school-based science, which tends to center around well-defined problems that train students to look for one right answer (Chinn & Malhotra, 2002; Lemke, 1990). This approach does not address socio-cultural contexts that shape argumentation and meaning making in science and does little to help students understand the nature of scientific inquiry outside the classroom. It may also lead students to view science as the accumulation of facts instead of a negotiation of knowledge within scientific communities (Chinn & Malhotra, 2002).

Our Project

Sick at South Shore Beach is a place-based AR game and curricular unit designed around South Shore Beach, a mixed-recreational park in Milwaukee - an urban city of 600,000. Students role-play as water chemists, public health doctors, or wildlife ecologists who have been called upon to investigate a collection of illnesses that are linked to the beach. During the unit, players visit South Shore Beach to play the AR game on a GPS-equipped PDA. The information gathered during the game/visit, along with research conducted in the classroom, provides students with evidence to formulate, present and defend their final hypotheses. Using a situated cognitive view of learning, the game and curriculum attempts to situate students' learning around authentic contexts and position them as active participants in the inquiry process, allowing them to use the language and practices of doctors and scientists to investigate and discuss similar "real-world" problems (Shaffer, 2004). The design of *Sick at South Shore Beach* builds on earlier research surrounding AR games (Squire & Jan, 2007; Klopfer, Squire, & Jenkins, 2003; Squire, et, al., 2007) and pays special attention to the use of differentiated roles, game challenges, and local place as tools for structuring student learning. More specifically this micro-study, which is an offshoot of a larger research project, seeks to identify design elements that address students' difficulties in developing causal arguments at both the data interpretation level (e.g., misinterpreting charts and graphs) and the procedural level (e.g., tying faulty evidence to claims, making claims based on single pieces of evidence, and ignoring non-causal evidence) (Kuhn, 2005).

Methods / Data Collection / Analysis

Sick at South Shore Beach was implemented in nine classrooms across five schools and four subject areas. Participants were chosen to allow for comparisons across school setting (e.g., SES, race), content area, grade level, background knowledge, and reading level. Each teacher implemented the entire 15-hour gaming unit, modifying the base curriculum to meet his or her local classroom needs (e.g., student reading levels, course content, reading comprehension strategies). We observed sample lessons and game play activities, conducted individual and focus group interviews with teachers and students, and collected student work. We paid special attention to students' notes and final presentations in order to identify areas where they struggled to develop causal arguments and then used this analysis to redesign specific components of the game and curriculum.

Findings

Our initial implementations suggest that *Sick at South Shore Beach* provides a semi-structured framework that guides the inquiry process and scaffolds students' ability to develop causal arguments. Other

findings suggest that we need to better align the game with the range of conceptual knowledge and reading levels found in typical middle school classrooms and pay special attention to students who struggle with data interpretation (e.g., it was hard for students who misinterpreted data to use that data to develop sound arguments). While problems surfaced with many students' arguments, the following game-based design elements emerged as particularly influential in helping students, albeit to various degrees, develop causal arguments:

1. Game Challenge: The goal of identifying the source of the illnesses in order to prevent additional people from getting sick motivated students during the inquiry process and provided a clear cause and effect inquiry framework (Kuhn, 2005). Many students reported that the mystery nature of the game motivated them to solve the problem and made them feel like they were working on an authentic case.
2. Local Place: Allowed students to draw from prior knowledge, provided a "real-life" context that anchored the inquiry, and allowed students to gather evidence through empirical observations they made during the fieldtrip.
3. Differentiated Roles: Role-specific skill sets, tools, and data proved helpful in developing collaboration between players, getting students to recognize that different professions view problems differently, and encouraging students to use domain specific language (Gee, 2003).
4. Collaboration/Competition: Inter-role collaboration within groups, along with informal and formal cross-group discussions encouraged students to (re-)evaluate, present, and defend their hypotheses (Weinberger, et al, 2006), and allowed teachers to identify areas where students needed additional scaffolding.
5. Checkpoints/Staged Access to Data: The game incorporated checkpoints where students accessed (unlocked) additional data they could use as evidence to support and/or modify existing hypotheses. While these checkpoints did not always generate sound scientific thinking (e.g., some students stuck with a hypothesis despite the fact that they had access to new evidence that could have disproved their claims) they did provide opportunities for teachers to redirect students to the central inquiry question, gauge their understanding, and challenge their claims and supporting evidence.

Implications / Re-Design

These findings are being used to re-design our next generation of place-based AR games. We developed and implemented two new games in the fall of 2007, and are in the process of revising these designs for spring implementation. Based on our findings, we increased the level of differentiation between roles (e.g., provided more unique tools, tasks, and skills to individual roles), added more explicit opportunities for making observations during the game/site visit, incorporated direct instruction related to data interpretation, and added additional organizational tools (e.g., charts and concept maps) to help students classify and analyze their evidence.

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