

Mad City Murder is an augmented reality game for Earth science students and has been played with groups ranging from 4<sup>th</sup> and 5<sup>th</sup> grades to adults. The game begins with an opening story: The students, who are role playing as doctors, environmental scientists, and government officials, learn that a friend of theirs, Ivan Illych has fallen in a nearby lake and drowned. They learn that Ivan was depressed and had been drinking, but they also soon learn that there are a number of toxins in the environment that could have contributed to the death. Players race against the clock (about 90 minutes, for most classes) to provide the police examiner (played by a real person) enough data to open an investigation into the causes of the death. While the cause of the death is ultimately unknown, mercury found in fish, TCE (trichloroethene) found in the factory where Ivan worked, and PCBs (polychlorinated biphenyls) found in ground water and fish are potential causes. Through the course of the game, players talk to virtual characters to learn life histories and access documents describing chemicals, conduct simulated tests for PCBs, TCE, and mercury, and must piece together an argument about the cause of the death. Willy Loman, non player character who is an insurance representative trying to prove that the death was a suicide serves as a foil to students.

This paper discusses results from running Mad City Murder with 10 pairs of high school environmental science students at an alternative high school for students performing poorly in school. Using discourse analysis techniques (Gee, 1992), we examine the students' argumentation patterns in situ while playing Mad City Murder. Specifically, we analyze how players develop, adapt, and refine hypotheses in response to new evidence emerging in game. Contrary to earlier findings in scientific reasoning, these students routinely reformulated hypotheses in the face of new data and experiences (Kuhn, Amesel, & O'Loughlin, 1988). On average, groups developed and articulated 5 different hypotheses through the course of the game.

We argue that specific game design features led to this robust scientific argumentation. These include (1) Distinct, compelling roles for players to inhabit, (2) differentiated roles where students each had different skills (i.e. doctors can take physiological readings, but scientists cannot), (3) differentiated information so that players were required to collaborate to access the all of the data, (4) emotional compelling goals that drove activity, and (5) playing the game in a physical setting which allowed students to mobilize what they already knew about the space to solve the problem. As an example, one participant was an avid fisher, and knew a good deal about mercury which he used to help solve the problem. We speculate that playing the game in an augmented reality space creates a fruitful context for connecting new information to what students already know (and their lived identities within that space), both of which are very robust features for recruiting deep learning (Bransford, Brown, & Cocking, 1999).

Bransford, J., Brown, A. & Cocking, A. (1999). *How people learn*. Washington, DC: National Academy Press.

Gee, J.P. (1999). *An Introduction to Discourse Analysis: Theory and Method*.

Kuhn, D., Amsel, E., & O'Loughlin, M. (1988). *The development of scientific thinking skills*. London: Elsevier.