Towards Collaborative Argumentation in "Losing the Lake"

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Abstract: *Losing the Lake* is an educational simulation game exploring the impact of climate change on declining water levels in Lake Mead. This paper briefly describes the game and explores options for incorporating collaborative argumentation into the next iteration, including several technological options. We explain how Walton's argumentation framework is useful in generating critical questions for collaborative argumentation on many topics related to climate change and water resource management.

This paper reports on a design project, *Losing the Lake*, and efforts to incorporate collaborative argumentation into the learning environment. *Losing the Lake* is a computer-based educational resource designed to teach students about climate change and its effects on the local environment. Research suggests that many students harbor a number of misconceptions about human-induced climate change (Nussbaum, Sinatra, & Owens, 2011) due to the complexity of the phenomenon across multiple time and spatial scales, but teaching about the issue in the context of a concrete, local phenomenon aids student understanding and engagement with this issue (Moser & Diller, 2007). The phenomenon focused on in this project is the rapidly declining water levels in Lake Mead, which have been caused by an extended drought in the Rocky Mountain snowpack. This drought will be made worse by climate change.

Description of *Losing the Lake*

The educational computer system that was initially developed in this project consists of five activities designed first to explore household and community water conservation options and then the nature of climate change (and the relationship to snowpack and lake levels). The penultimate activity is for users to run a visual simulation of declining water levels (based on an actual climate model, HADCM2-A1B) and to compare their predictions of how many years each regional conservation option will delay lake levels from falling below a level where no more drinking water can be pumped from the lake.

A major design decision was not to explore climate change first because that could create fear among users, which can cause disengagement and denial (Moser & Diller, 2007). Instead, users first grapple with conservation actions they can take to build a sense of efficacy. Users start with topics that are more familiar and meaningful to them (i.e., household conservation) and then progress to exploring more complex systems.

In a study of the effectiveness of playing *Losing the Lake* as a stand-alone game among 113 seventh-grade earth science students, compared with a control group which viewed an unrelated earth science website, the game led to significantly increased knowledge gains on some topics (e.g., water conservation, the difference between weather and climate), but not others (e.g., relation of snowpack to lake levels). (Results of the study are reported in Nussbaum et al., 2012.) There was also a small increase in student interest as measured by a 10-item Likert scale instrument ($F(1, 110) = 3.98$, $p < .05$, $d = .23$), particularly in home water conservation options.

While the results are encouraging, focus group sessions with science teachers revealed that—in the next iteration of the game—it might be better to use the game over a five-day period (or longer), where each activity is played, reviewed, and analyzed by small groups of students and/or a whole class. In addition, we are in the process of incorporating argumentation activities into the game.

Integrating Collaborative Argumentation into *Losing the Lake*

Our original intent for developing *Losing the Lake* was that it could be a resource to foster student argumentation and in turn conceptual change about climate change. (Financial limitations, however, prevented the development of computer-supported argumentation features in the first iteration of the game.) Collaborative argumentation (Andriessen, 2006) involves individuals working together to construct and critique arguments, and there is evidence that, under the right conditions, it can foster conceptual change and better critical thinking (Asterhan & Schwarz, 2007; Mercer, Dawes, Wegerif, & Sams, 2004). There are a number of CSCL systems that support argumentation (see Scheuer, Loll, Pinkwart, & McLaren, 2010, for a review).

In developing *Losing the Lake,* a number of topics suitable for collaborative argumentation were identified. Some relate to natural science (e.g., Would greater and earlier melting of the snowpack increase or decrease lake levels?); some are socioscientific in nature (e.g., What are the costs and benefits of building a

water desalination plant?). Some have aspects of both but primarily involve estimation and modeling (Which would save more water, covering a swimming pool or washing cars only at a car wash?).

In designing the next iteration of the game, an open question is how best to incorporate collaborative argumentation. Some options include: (1) Using only face-to-face collaborative argumentation as described above; (2) using existing chat systems that support "dialogue games," such as *InterLoc* (Ravenscroft, McAlister, & Sagar, 2007); or (3) using an argumentation mapping system, such as *Araucaria* (Reed & Rowe, 2004) that provides a list of "critical questions" for different types of arguments, known as argument schemes (see Nussbaum, 2011; Walton, 1996). For example, for an *argument from sign* scheme, one critical question is "How strong is the correlation of the sign with the event signified?" (e.g., "Is a ten-year drought strong evidence of climate change?"). For an argument from verbal classification scheme, "Is *a* really an example of category *A* or is there room for doubt?" (e.g., "Is a ten-year warming trend really an increase in *climate*?"). Such critical questions are used to evaluate arguments tied to specific argumentation schemes.

We have found Walton's argumentation framework useful because it encompasses both scientific and socioscientific/policy arguments, all of which are relevant to climate change (Nussbaum et al., 2011). Many extant computer-supported argumentation systems are either too specific, in that only one type of argumentation is scaffolded (e.g., scientific), or overly general: Scaffolds are included to promote counterargumentation or argumentation mapping without much reference to logical or epistemic criteria for evaluating arguments.

Critical questions provide such criteria. One issue, though, is how best to seed the discourse with critical questions. The next iteration of *Losing the Lake* will likely involve face-to-face argumentation and role playing activities to make the game more fun and exciting; critical questions could then be introduced into the discourse by teachers during class discussions, or by students if they are taught to ask critical questions (as in Nussbaum & Edwards, 2011). Computer-supported argumentation could be used to supplement these activities (to promote greater reflection and participation). We have found some systems such as *InterLoc* (involving locution openers) to be distracting to students and not specifically focused on critical questions. An open question is whether a structured graphing system, specifically *Araucaria*, would be useful or whether generic asynchronous discussion, with question prompts reflecting specific critical questions, would suffice.

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Acknowledgments

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