Project Abstract

Collaborative Research: Development and Evaluation of a Natural Hazard Interactive Laboratory for Improving Decision Making

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Given a wealth of data, varying background information and expertise, and social and emotional factors, how can people make the best decisions about natural hazards and related policy? This work examines the impact of a fully developed, interactive, computer-based, role-playing laboratory on decision making based on scientific data. The overall goal of the project is to examine educational design principles that promote higher-order cognitive and critical thinking skills.

Eruption is a role-playing simulation of a volcanic hazard. In *Eruption*, students take on different roles related to a volcanic eruption. Some act as scientists and gather scientific data from volcano monitoring instruments, using the information to predict eruption likelihood. Some act as policy makers deciding when and how much of neighboring villages to evacuate, taking into account monetary and social factors related to evacuation. Our previous work showed the "proof of concept" of *Eruption* and its impact on decision making (Taylor, Renshaw, & Jensen, 1997). This work used an innovative evaluation strategy that incorporated cognitive science methodologies. The evaluation methodology examines stability in decision making based on available scientific data. In other words, it examines the extent to which such decisions remain stable in the face of other distracting, but irrelevant information. For example, work in Cognitive Science has shown that people make different decisions about the same data depending on whether the information is framed positively (e.g., survival rates) or negatively (e.g., death rates).

Our previous work also allowed us to identify specific design principles that impact higher-order, critical thinking skills and increase the effectiveness of CAI laboratories (Renshaw & Taylor, 2000; Renshaw, Taylor, & Reynolds, 1998; Sinclair, Renshaw, & Taylor, 2004; Taylor, Renshaw, & Choi, 2004; Taylor, Renshaw, & Jensen, 1997). Incorporation of these principles into the fully implemented *Eruption* will increase its impact on higher-order cognitive skills such as decision making, problem solving, and critical analysis.

Work on this project began in June 2005. The first step, which is underway, is to program *Eruption* using the *Director/Shockwave* development environment. *Shockwave* and *Director* include standardized technologies for developing interactive content using web-based networking and 3D imaging. Including networking options significantly increases the complexity of both the use and support of CAI software. While we hypothesize that the increased perspectives gained by including networking will increase the program's effectiveness, it

remains an empirical question. Even if correct, the educational improvements must outweigh the increased difficulty inherent in adding networking. It may be that the increase in effectiveness is only slight and more than offset by the additional time and support needed to use a networked program. Consequently, evaluation of the effectiveness of the networked version of *Eruption* in developing higher-order skills relative to the effectiveness of non-networked versions of the program is essential. The next stage of the work, after development, will be evaluation with a feedback loop to re-design.

The completed implementation and coincident assessment will further inform the relationship between educational exercises and higher-order critical thinking skills. This work will also allow further refinement of our cognitive science based assessment methodology. By creating an objective measure of educational impact, we can identify specific design principles that increase the potential for reaching student populations with weaker math and science backgrounds and/or those traditionally under-represented in the sciences. Further, in fully developing *Eruption*, we plan to make the software more modular and separating the instruction components (types of volcanoes, description and theory of monitoring equipment, etc.) from the application component (the *Eruption* simulation). In our experience, separating the instructional components from the application components significantly increases the potential dissemination of the CAI laboratory.

References

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