Global Resources for Online Education (GROE)

New research visions in computational teaching and learning
NSF – CRA Supported Research

Executive Summary and Charge

> "Any nation's most precious natural resource is its children and new technology is needed to leverage this resource by tapping into the children's innate capacities to learn, share and create."
>
> GROE Proposal to CRA, May 2008

Project Overview

Theories about complex information systems begin to address the implications of cyberspace as a collaborative and cognitively supportive learning space (Bellman, 2001). However, prior attempts to shift education through technology often simply automated or replicated existing teaching strategies (e.g. radio and television reproduced lectures), and their impact on learning was limited. The next revolution in education will couple far more advanced computational technologies with far deeper knowledge about human cognition, developing dramatically more effective constructivist and active instructional strategies. The impact of such a revolution will encompass not only new modes of learning and pedagogy, but new organizational systems for education as well.

Purpose

The purpose of the **Global Resources for Online Education** (GROE) initiative is to identify the next big computing ideas in education, in order to achieve open access of global educational resources and the reuse, repurposing, and sharing of such resources. Workshops are being convened during 2009-2010, funded by the National Science Foundation through the Computer Research Association to explore issues encompassed by this goal. Based on these discussions and views of researchers in the field, white papers will be prepared to recommend a research agenda for future funding.

Process

Through a series of facilitated collaborative workshops, leaders in several disciplines will engage in a creative national conversation that casts computation as a basis for education, in core ideas as well as simulations and data management and recommends a research agenda for federal funding. Our intention is to expand computer research (facilities for experimental hardware, software and networks), encourage large-scale deployment, and assure real educational impacts. This process will provide the rationale for increased government funding to solve the education challenge, to identify big ideas that are not being pursued, and to target computational models, reasoning, experimentation and implementation of mobile and ubiquitous pedagogical software.

Challenge

Participants in this process are addressing two broad challenges

In what ways might computational technology be fully utilized in education to achieve the promise of open access to global resources and greatly enhanced and larger scale use of information technology in teaching and learning?

What is the research agenda for federal funding that can make this happen?

Research Themes

The challenge will be addressed for each of five research issues or themes (the following is a starter list):

- **Cognitive learning**. How to build cognitive partnerships, services and computational tools for enhanced learning based on improved understanding of human cognition.

- **Shared understanding**. How to increase the bandwidth between computers and people (e.g., speech and gesture) to support individual productivity.

- **Learning communities**. How to use networking, collaboration, mobile and ubiquitous computing to create seamless social learning.

- **Organization and assessment of learning resources.** How to build predictable robust deposits of computational services and assessment tools to enable powerful applications of learning technology.

- **Instantiated personal computing**. How to accelerate learning by providing software and hardware for personal computer literacy.

The field experts participating in this initiative will form into study groups (one for each identified theme). For each theme, the respective study group will identify and articulate priority actions for research regarding the theme in the context of learning technology.

Other Issues that might arise in the discussions

As a function of the primary purpose, we expect that this process will also identify and/or address such issues as:

- a business case for education
- how distributed intelligence can be coordinated into common learning activities
- how to blend real and virtual worlds
- open questions about how people learn.
    - What is the role of feedback in adaptive learning?
    - How do the interactions of social agents promote learning?
    - What are the cues and characteristics of social agents?

Charge to the Study Groups

The study groups are charged with preparing a working paper (30 or so pages in length) that addresses the GROE challenge from the perspective of each respective theme. The paper should establish a baseline review and assessment (including strengths and limitations) of current trends for the theme, and suggest the most important research opportunities in the field for the theme with an explanation of why the stated research opportunities should be given a priority for action (urgency/need, value/benefit, etc.).

The document should "tell a story" that convinces a wide variety of stakeholders (i.e. academe, industry and government) of the imperative for further investment in computational technology in teaching and learning. In developing their papers, the study groups should draw upon as full an inventory as possible of agenda-setting research and activities in the field, and the document should reference any publications of any kind that have been generated by these earlier efforts. A brief first draft of the document will be prepared and submitted at the conclusion of the first set of working sessions (Spring and Summer 2009).

Each study group may design its own process for preparing the paper, so long as it is a collaborative effort (all members participate), with findings and recommendations that are developed by consensus (as a group, the participants generally agree with the content; no one person or sub-group dominates).

Underlying Values and Beliefs

This project is guided by several fundamental values and beliefs, including the following:

The advances we address can only be accomplished through intense, concerted long-term efforts championed by federal agencies, led by committed researchers and involving breakthroughs in computational science, cognitive psychology, and the science of learning and education.

We expect that the research agenda will bring forward new computational perspectives in which systems harness the deluge of scientific and learning data flowing through them, monitor themselves (through machine learning) and raise new issues (e.g., dynamic student assessment, personalized feedback and lifelong learning).

We believe that global education based on customized teaching is effective. As we transfer to global (on-line) education for everyone, the cost of education can drop by orders of magnitude. Many more people will be educated at much reduced cost per person. We suggest that pilot programs based on the shared perspectives of teachers and learners should be established to identify the challenges to interoperability, open standards and effective learning. These coordinated pilot programs will provide concrete examples to inform our continuing discussions.