Cyberlearning Community Report:

Emerging Design Themes in U.S. TEL

The Center for Innovative Research in CyberLearning

Authors: Jeremy Roschelle, Wendy Martin, and Patricia Schank

Abstract

The cyberlearning community in the United States parallels EC-TEL in Europe; both research communities bring computer scientists and learning scientists together to design and study innovative learning technologies. We report on six design themes emerging across multiple US-based, NSF-funded cyberlearning projects, based on the analysis of a team of over a dozen researchers who worked together to create a more extensive "Cyberlearning Community Report".

This work is driving the need for new learning sciences in areas such as embodied cognition, identity, and affect, and requires advances in methods, such as multimodal analytics, and in computer science, such as in context-sensitive computing. By sharing this overview of US-based work with European colleagues at EC-TEL, we aim to foster international connections and stimulate mutual thinking about next steps in research as well as the potential to strengthen positive societal impacts.

Illustrative Cyberlearning Designs

Classes of designs ("genres) that organize the growing body of research. For each, the report highlights computer science (CS) and learning science (LS) innovations, provides examples, and discusses opportunities and challenges.

1. Community Mapping: Moving and Discovering across Contexts

by Katie Headrick Taylor and Nichole Pinkard

Advances in mobile and location-aware technologies create new possibilities to understand how learning happens as individuals actively move across settings, and then make sense of their movement and environments.

CS Innovation: Mobile computing with geospatial data visualization

LS Innovation: Learning in context, at a community scale

Collecting place-based data with Mobile City Science

2. Expressive Construction: Enabling Learners to Represent Powerful Ideas

by Matthew Berland, Erica Halverson, Joseph Polman, & Michelle Wilkerson

New tools are enabling more people to build their own creations with technology. However, constructive activities are not always deep learning activities. How can we maximize the opportunity to learn within the opportunity to create?

CS Innovation: computing as a creative literacy.

LS Innovation: STEM learning grounded in interest-driven, collaborative, constructive activities

Exploring a digital underwater environment using Oztoc at NYSCI

3. Classrooms as Digital Performance Spaces

by Tom Moher and Noel Enyedy

What if classrooms could be reconfigured as a "digital performance space" where students move in order to fully engage with a simulated scientific phenomenon?

CS Innovation: "Experience servers" that enable multiple people and devices to work together on a complex activity

LS Innovation: Reorganizing classroom spaces to facilitate movement and interaction

In RoomQuake, students measure the distance to a simulated earthquake epicenter

4. Virtual Peers and Coaches: Social and Cognitive Support for Learning

by Judith Fusco, Wendy Martin, H. Chad Lane, and Catherine Chase

Pedagogical agents draw upon sophisticated AI techniques and high-end animation systems to support both social and cognitive interactions.

CS Innovation: computational models for complex, realistic social and cognitive agents

LS Innovation: virtual peers and coaches that provide affective, cognitive, and social supports for learning processes

Virtual peer Alex recognizes and models verbal and nonverbal behavior

5. Remote Scientific Labs: Authenticity at Distance

by Jeremy Roschelle, Kemi Jona, Patricia Schank, and Wendy Martin

A remote laboratory lets educators and students conduct scientific experiments over the internet, and access sophisticated scientific apparatus, often at low cost, with greater safety, and more convenience than school-based labs.

CS Innovation: Interfaces that increase realistic presence as people engage in complex tasks in remote settings

LS Innovation: Understanding how to make authentic scientific experiences available to many more learners, and what aspects of authenticity are most important to learning.

iLabs: A lab in every pocket

6. Enhancing Collaboration and Learning through Touch Screen Interfaces

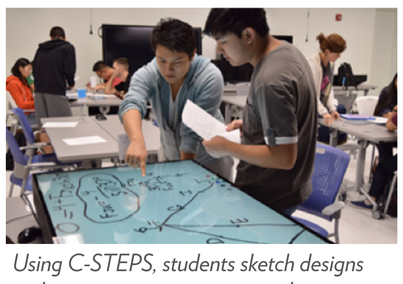
by Chad Lane and Emma Mercier

Using multi-touch interactions to support learning of challenging intellectual content and for collaborative learning.

CS Innovation: Expanding computer-supported collaboration via tabletop computers, mobile devices, and sketch interfaces

LS Innovation: Pedagogical designs for collaborative learning and for supporting effective teaching.

Using C-STEPS, students work either on shared multi-touch tables, which provide a single workspace for the co-construction of solutions, or on software that allows for the syncing of groups of tablets, creating a single workspace across multiple small tablets.



Using C-STEPS, students sketch designs and co-construct engineering solutions

Illustrative Cyberlearning Methods

Advances in methods that support innovative approaches to data collection, analysis, and more productive interactions between learners.

1. Multimodal Analysis

by Marcelo Worsley

CS Innovation: Combining multiple forms of data and applying machine learning algorithms and probabilistic models to make sense of how people interact with technology

LS Innovation: Using the streams of data from different devices to find new patterns in how people learn in complex environments

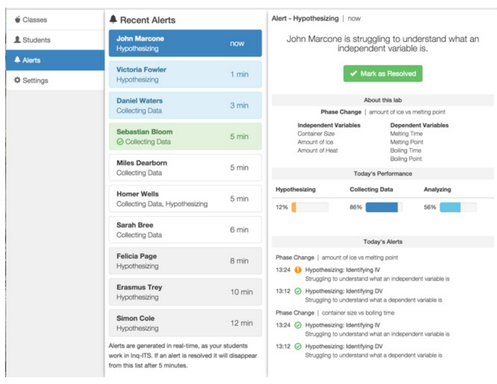
ELASTICS collects data on body movement & explores how it enhances learning

2. Learning Analytics

by Jodi Asbell-Clarke and Judith Fusco

CS Innovation: Developing new data analysis techniques to understand relationships, structures, patterns, and causal pathways in data that is automatically collected as students play games.

LS Innovation: Connecting "implicit" to "explicit" learning can integrate games and classroom instruction into an adaptive learning system.



Inq-Blotter dashboard shows students' progress

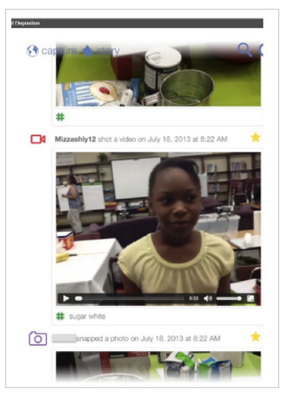
3. User- and Community-Centered Design Methods

by Amy Ogan

Research on the user experience in cyberlearning environments pushes the fields of both Human-Computer Interaction and the Learning Sciences forward in unexpected ways.

CS Innovation: Design methods that engage users and user communities in shaping the technology they will use.

LS Innovation: Design methods that engage learners and learning communities in shaping the technology they will use.



SciencKit lets youth share their science queries, ideas, and observations

Commitments of Cyberlearning Researchers

Six commitments broadly inform this work:

1. **Orientation to the horizon,** imagining how new forms of technology become more prominent than today's most common tablets and laptops;
2. **Focus on equity,** including people and perspectives in early stage design research to design for a future society that more fully enables a diverse range of learners to have valuable learning opportunities;
3. **Learning as community centered and cross-context,** going beyond a focus on individuals or small groups in a single physical setting;
4. **Research through design,** seeking advances through empirical studies that explore how people learn with tools and content that have been newly designed to investigate the learning potential of new affordances;
5. **Youth as producers,** expanding beyond commonplace ways in which institutions categorize youth in familiar roles such as "students" (in school) or "visitors" to museum, to explore how youth can be expressively and constructively engaged across settings;
6. **Convergent science,** forming teams that bring together different disciplines (most often learning sciences and computer science) and dedicating time and effort to develop a coherent, integrated research approach.

Follow us, contribute, stay connected: CIRCLCenter CIRCLCenter Email: **circl@sri.com** Online: **circlcenter.org**

This document is published by CIRCL, a project at SRI International, under NSF grant numbers IIS-1233722 and IIS-1441631. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

SRI Education · Digital Promise Accelerating Innovation in Education · EDC Learning transforms lives. · NORC