Emerging Design Themes in U.S. TEL Cyberlearning Community Report: 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”.

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 Kate Hadlock Taylor and Nicole Parkard
   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

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

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 social 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

   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

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

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 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 tables.

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

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.

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 unexplored 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.

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 museums, 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: