Fostering Learning in the Networked World: The Cyberlearning Opportunity and Challenge

A 21st Century Agenda for the National Science Foundation

Report of the NSF Task Force on Cyberlearning
July 2008
The Future of Cyberlearning: A vision of the year 2015…

- Virtual Laboratory Simulations
- Visualizations of real-time data from remote sensors
- Mobile technology access to school materials and assignments
- Virtual interaction with classmates
- Supplemental content
- Lifelong “Digital Portfolio”
What Is Cyberlearning?

- The use of *networked* computing and communications technologies to support learning
- Interactions among communities of learners across space and time
- Customized interaction with diverse materials, on any topic, at any age
A Brief History of Technological Advances Making Cyberlearning Possible
Why Is Cyberlearning Important?

• Leverages learning through
  – Communication technologies
  – Students’ technology skills

• Extends capacity of educational institutions into life-long learning opportunities
  – Increases public understanding of science
  – Prepares citizens for complex, evolving, global challenges
Why Cyberlearning Now?

- Powerful new technologies
- Understanding of how people learn
- Demand for solutions to educational problems
- New, more responsive methods of development and testing
- NSF funding for interdisciplinary programs in cyberlearning
- Cyberlearning

Credit: John Sondek, University of North Carolina, Chapel Hill

Using data to teach geoscience thinking
Credit: Tracy Gregg
State University of New York
Buffalo
Task Force Charge

Advisory Committees
• Directorate for Education and Human Resources
• Office of Cyberinfrastructure

Task Force
• Opportunities
• Research questions
• Partners
• Strategies
• Existing resources

NSF’s US-based Charter

STEM
- Science
- Technology
- Engineering
- Mathematics

SBE
- Social Science
- Behavioral Science
- Economics

Arts

Humanities
Task Force Members

• **Christine L. Borgman (Chair):** Professor of Information Studies, UCLA
• **Hal Abelson:** Professor of Computer Science and Engineering, MIT
• **Lee Dirks:** Director of Scholarly Communication, Microsoft
• **Roberta Johnson:** Director of Education and Outreach, UCAR
• **Kenneth R. Koedinger:** Professor of Human Computer Interaction / Psychology, Carnegie Mellon University
• **Marcia C. Linn:** Professor of Development and Cognition, UC Berkeley
• **Clifford A. Lynch:** Executive Director, Coalition for Networked Information
• **Diana G. Oblinger:** President, EDUCAUSE
• **Roy D. Pea:** Professor of Education and the Learning Sciences, Stanford University
• **Katie Salen:** Executive Director, Institute of Play
• **Marshall S. Smith:** Director of Education, Hewlett Foundation
• **Alex Szalay:** Professor of Astronomy, Johns Hopkins University
Key Strategies and Opportunities for NSF

- **Strategies:** To promote the growth of a cyberlearning infrastructure
- **Opportunities for Action:** Greatest short-term payoff and long-term promise
- **Themes**
  - Develop and advance technologies
  - Enable students to use data
  - Harness learning data
  - Support broader audiences
  - Sustain cyberlearning materials
Develop and Advance Technologies

• **Strategy**: Promoting new talent and new technology

• **Opportunity**: Using technologies to
  – Coordinate learning across contexts
  – Connect students with remote and virtual laboratories
  – Access interactive virtual or “mixed reality” environments

Ann Myers Medical Clinic in Second Life
Image credit: Scienceroll blog
Enable Students to Use Data

- **Strategy:** Transforming STEM disciplines and K–12 education
  - New ways of looking at and understanding content
  - Preparing students for “computational thinking”

- **Opportunity:** Teaching students and teachers how to harness large amounts of data
  - Scientific research
  - Responsible use of data

Adviser Caroline Zundel uses the galaxyzoo.org website to classify a spiral galaxy.

GALAXY ZOO.org
Harness Learning Data

**Strategy:** Leveraging the data produced by cyberlearning systems
- Teachers interacting with students and their school assignments
- Students’ educational histories

**Opportunity:** Encouraging shared systems that allow large-scale deployment, feedback, and improvement

Pittsburgh Science of Learning Center’s DataShop: learnlab.web.cmu.edu/datashop
Support Broader Audiences

• **Strategy**: Addressing problems and opportunities with
  – Reapplication of tools and resources
  – Scaling of technology for larger communities

• **Opportunity**: Funding development of resources usable for both research and education

*Students learning about photosynthesis in classroom & online activities*  
*Images courtesy of Bill Sandoval, CENSEI*
Sustain Cyberlearning Materials

• **Strategy:** Sustaining cyberlearning innovations beyond their initial funding

• **Opportunity:** Guaranteeing future availability of Open Education Resources

SimCalc Project
http://www.kaputcenter.umassd.edu/downloads/products/technical_reports/tr1_1.pdf

iLab Inverted Pendulum:
Mark Schulz, iLab
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1. Build a vibrant cyberlearning field

- Promote cross-disciplinary communities of cyberlearning researchers and practitioners including
  - Technologists
  - Educators
  - Domain scientists
  - Social scientists
- Publish best practices
- Recruit diverse talents

*Relationships Among Scientific Paradigms*

(Credit: Research & Node Layout: Kevin Boyack and Dick Klavans (mapofscience.com); Data: Thompson ISI; Graphics & Typography: W. Bradford Paley (didi.com/brad); Commissioned Katy Börner (scimaps.org))
2. Instill a “platform perspective”

• Platform = shared, interoperable designs of hardware, software, and services
• Incorporate and support
  – New technological innovations
  – Fully tested modules for classroom use
• Widely usable now and in the future
• Guidance from expert panel
Current NSF “platforms” to review

- National Science Digital Library (NSDL)
- Innovative Technology Experiences for Students and Teachers (ITEST)
3. Emphasize the transformative power of technology

- Potential for learning, from “K to grey”
- Information and communication technologies that
  - Allow interaction with data, visualizations, remote and virtual laboratories, and experts
  - Bridge multiple learning environments and technologies
- Support teachers’ professional development through
  - Training programs
  - Professional societies
  - Collaborating to create new teaching materials
4. Promote open educational resources

• Make materials available on the web with permission for unrestricted reuse and recombination

• New proposals should plan to make their materials available and sustainable
5. Sustain NSF-sponsored projects

- Maintain cyberlearning innovations beyond the funding of a grant
- Extend initiatives across NSF divisions and create external partnerships
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