New Technology-based Models for Postsecondary Learning

Chris Dede
Harvard University
Chris_Dede@harvard.edu
http://isites.harvard.edu/chris_dede

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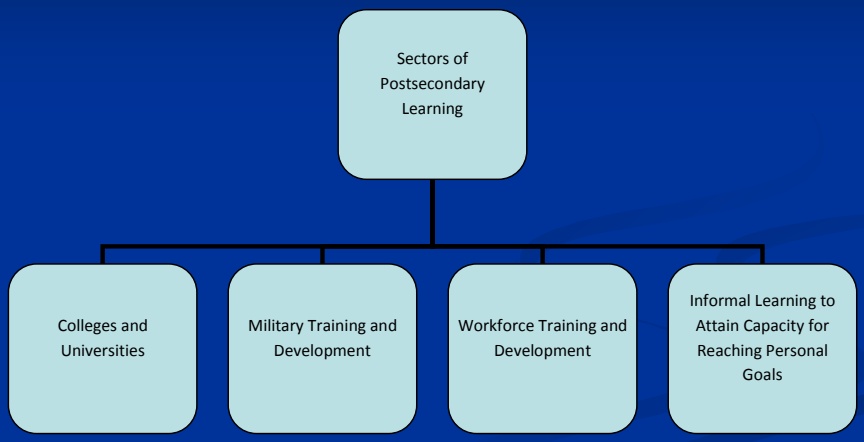
- Funded by NSF, sponsored by CRA, hosted at MIT
- Co-Conveners: Chris Dede, Harvard; Eric Grimson, MIT
- Participants:
  Daniel E. Atkins,, U. Michigan
  Lori Breslow, MIT
  John Cherniavsky,, NSF
  J.D. Fletcher, Institute for Defense Analyses
  Diana Oblinger, EDUCAUSE
  Roy Pea, Stanford
  James Pellegrino, U. Illinois—Chicago
  Bror Saxburg, Kaplan
  James Shelton, US. Dept. Education
  Russell Schilling, DARPA
  Greg Tobin, Pearson Higher Education
  Ellen Wagner, Western Interstate Commission Higher Education

Types of Postsecondary Learning



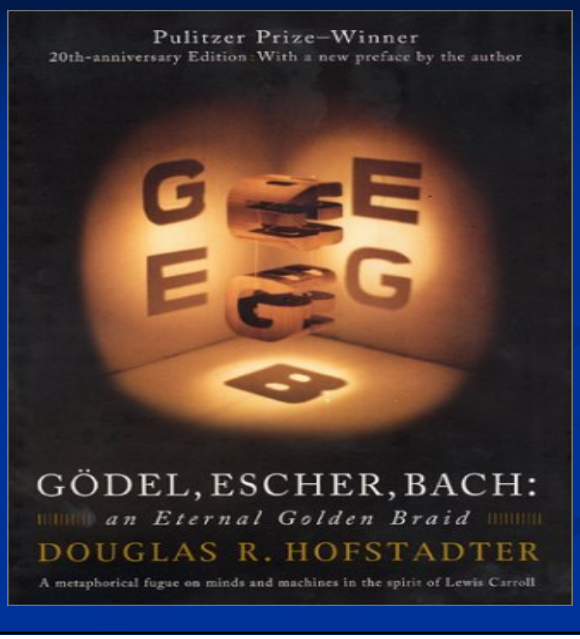
Rethinking Learning Outcomes

- Expertise as tacit rather than explicit
- Distributed understandings and performances rather than "in the head" knowledge and skills
- Situation resolution rather than solving routine problems
- Affective and social dimensions of competence given equal weight with cognitive

Rethinking Educational Processes

- Credentialing/certification based on competency rather than time
- Many sources of accredited learning, based on alternative business models and new marketplaces
- Continuous improvement via analytics applied to rich databases and embedded A/B experiments
- Generic tools and media repurposed for learning

Evocative



"Next Generation" Motivation and Learning

- Virtual Peers in Complementary Study Group
- Synchronous Back-Channel with Archives
- Virtual Worlds
- Local Augmented Realities
- Virtual Performance Assessments

Interfaces for "Immersive" Learning

- **Multi-User Virtual Environments:**
  Immersion in virtual contexts with digital artifacts and avatar-based identities
- **Virtual Reality**
  Full sensory immersion via head-mounted displays or CAVES
- **Ubiquitous Computing:**
  Wearable wireless devices coupled to smart objects for "augmented reality"

January 2009 issue of *Science*

EcoMUVE Module 1: Pond Ecosystem

Modeled after Black's Nook Pond in Cambridge, MA

http://ecomuve.gse.harvard.edu

Naturalist	Microscopic Specialist	Water Chemist	Private Investigator
Find out how the populations of pond organisms: largemouth bass, bluegill, minnows, and great blue herons change over time.	Find out how the populations of microscopic bacteria, bluegreen algae, and green algae change over time.	Use the atom tracker to find out what happens to the carbon atom on different days.	Gather clues from the landscaper, the golf course manager, the utility worker, the park ranger, the birdwatcher, other people near the pond.
Use the field guide to learn about the different fish species.	Measure the dissolved oxygen in the water on different days.	Measure the dissolved oxygen in the water on different days.	Observe the weather on different days; collect measurements of temperature, cloud cover, and wind speed.
Use the atom tracker to find out what happens to the carbon atom on different days.	Use the atom tracker to find out what happens to the oxygen atom on different days.	Use the atom tracker to find out what happens to the phosphorus atom on different days.	Measure chlorophyll a in the water on different days.
Measure the turbidity in the water (and use your eyes) to see changes over time.	Measure the temperature in the water on different days.	Measure the pH in the water on different days.	Measure the temperature in the water on different days.
Measure the dissolved oxygen in the water on different days.	Measure chlorophyll a in the water on different days.	Measure the nutrients (phosphates and nitrates) in the water on different days.	Measure the nutrients (phosphates and nitrates) in the water on different days.
Work together to create a concept map that represents the causal relationships of the pond ecosystem based on whole team's observations.			

EcoMOBILE:

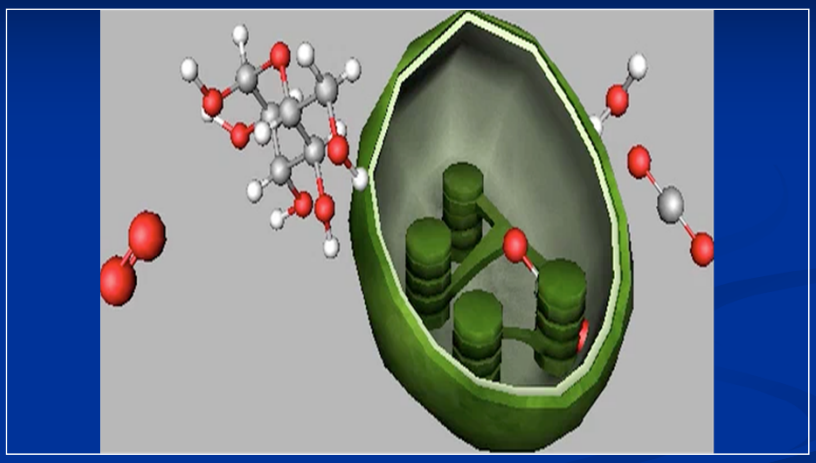
Ecosystems Mobile Outdoor Blended Immersive Learning Environment

- Taking on scientific roles
- Individualized pathways
- Making connections
- Seeing the unseen

NSF DRK-12
http://ecomobile.gse.harvard.edu

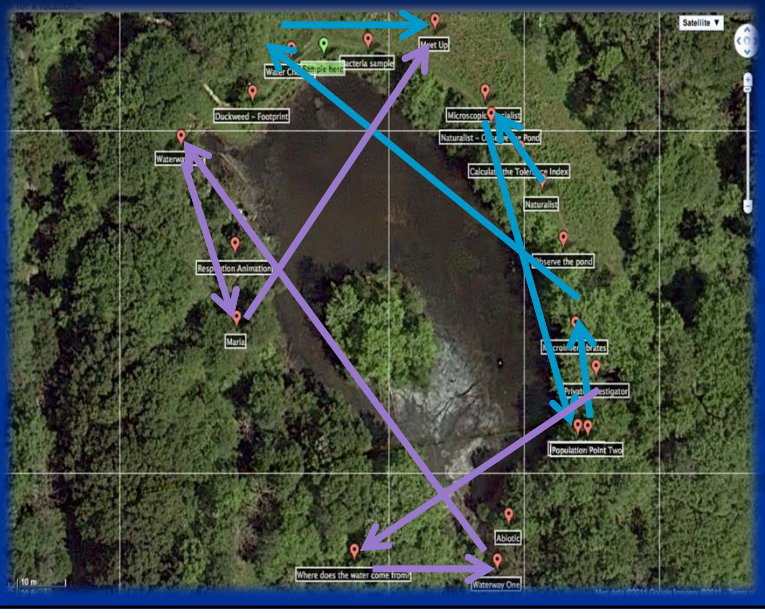
Naturalist	Microscopic Specialist	Water Chemist	Private Investigator
Observe pond for similarities to EcoMUVE	Observe duckweed	Observe pond for similarities to EcoMUVE	Talk to virtual golfer
Observe virtual fish	View 3D model of duck	Measure dissolved oxygen	Observe storm water pipe overlay
Calculate fish population size	Video of starch decomposition by bacteria	Video of how oxygen dissolves in water	Find inlet and outlet of pond
Collect macroinvertebrates	Observe virtual bacteria	Measure water temperature	Talk to young girl about what a watershed is
ID macroinverts and calculate tolerance index	Measure pH	Measure phosphates	Measure turbidity
Work together to create video that summarizes the health of the pond based on whole team's observations			

Seeing the Unseen

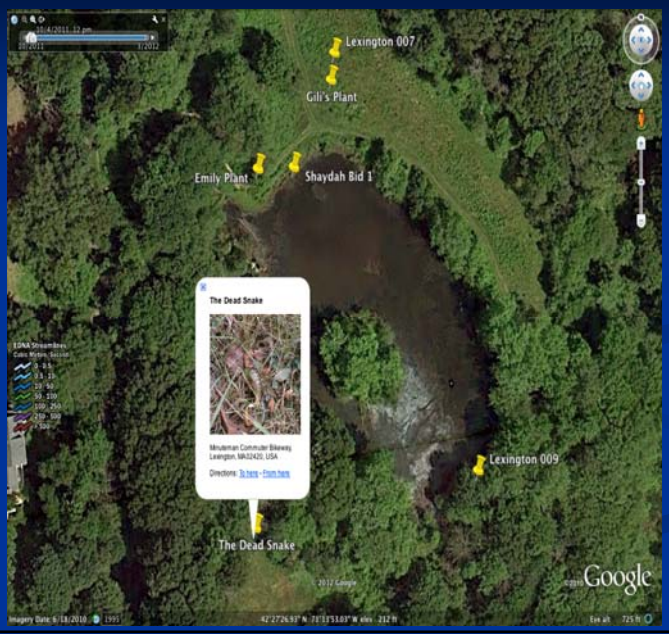


Animated models of photosynthesis
and other atomic-level processes.

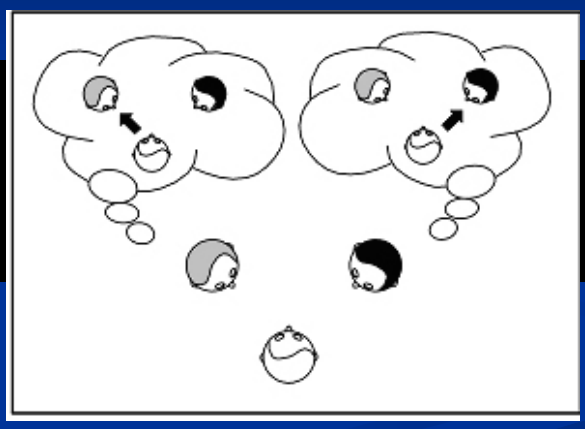
Individualized Pathways



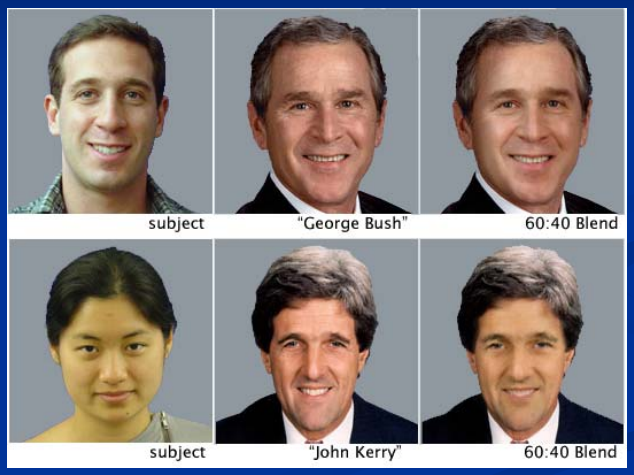
Making Connections



Transformed Social Interaction (TSI): Augmented Gaze



TSI: Facial Identity Capture



Unobtrusive Assessment

- Capturing exploratory paths
- Analyzing usage of guidance systems
- Interacting with animated pedagogical agents
- Attaining "powers" through accomplishments
- Documenting progress and transfer in similar settings

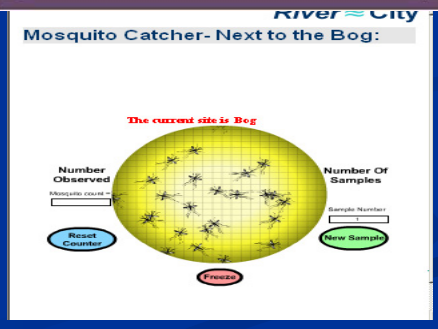
http://www.k12center.org/rsc/pdf/session4-dede-paper-tea2012.pdf

Path Analysis for Defined Tasks

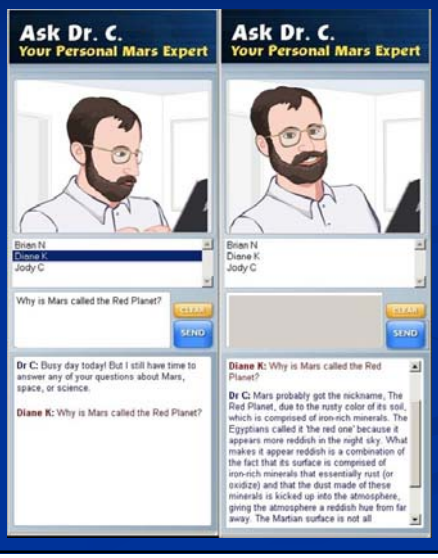
Individual and Group Paths

Heat Maps

Usage of Individualized Guidance



Interacting with Animated Pedagogical Agents



Documenting Progress and Transfer in Similar Settings

- Student takes on identity of a scientist
- Students complete quests
- 60 minutes
- Four Phases:
  1. Orientation
  2. Problem Identification
  3. Experimentation
  4. Competing Explanations

http://vpa.gse.harvard.edu

Attaining "Powers" Through Accomplishments

Mysterious Mansion

Access to Special Experiences

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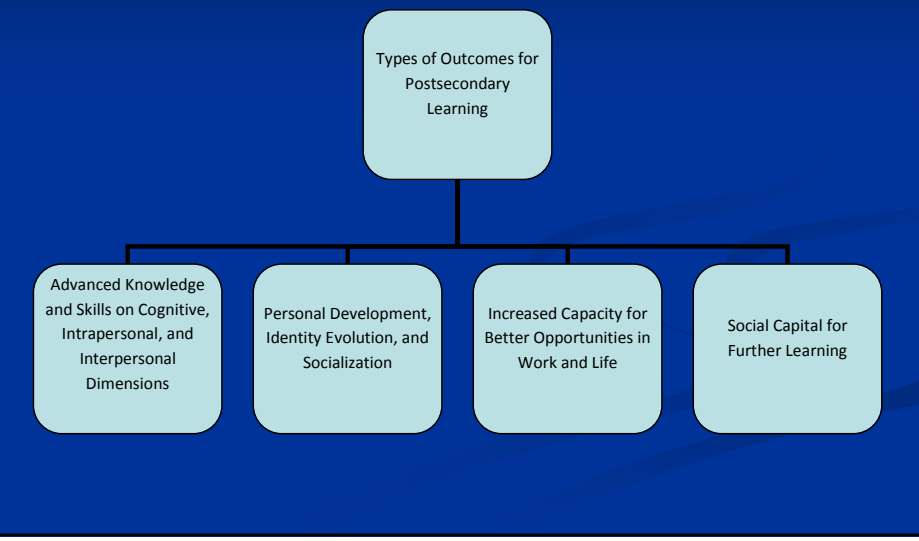
Interrelated Dimensions of Postsecondary Learning

Desired Outcomes of Postsecondary Learning



Dimensions of Advanced Knowledge and Skills

Cognitive Outcomes	*Intrapersonal Outcomes*	*Interpersonal Outcomes*
Cognitive processes and strategies	Intellectual Openness	Teamwork and Collaboration
Knowledge	Work Ethic and Conscientiousness	Leadership
Creativity	Positive Core Self-Evaluation	Communication
Critical Thinking	Metacognition	Responsibility
Information Literacy	Flexibility	Conflict Resolution
Reasoning	Initiative	
Innovation	Appreciation of Diversity	

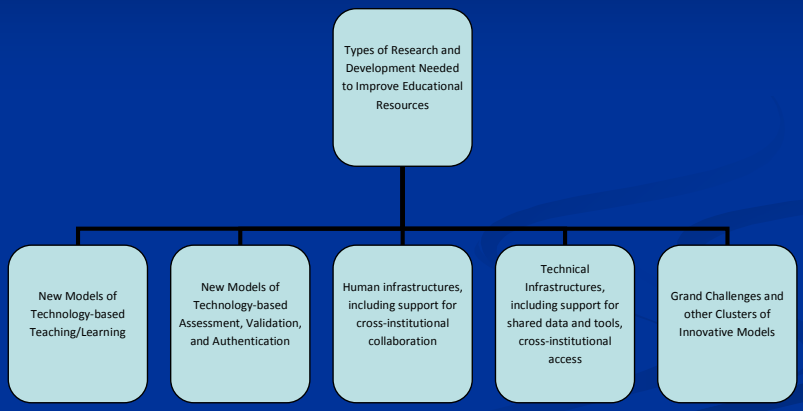
Desirable Characteristics of Postsecondary Learning

- Serves a wide range of learners
- Good return on investment by learners and by society
- Self-improving via research and continual feedback

Organizational Strategies for Adoption and Scale

- Develop authentic assessments based on outcome objectives
- Select initial innovations carefully so that strong models of learning are implemented
- Emphasize user-friendly interfaces
- Study design strategies for effective media that have scaled
- Accomplish tasks instructors/institutions want to relinquish
- Use organizational development strategies to change culture

Types of Research and Development Needed



Sources for Illustrative Research Agenda

- NSF Cyberinfrastructure, 2003
- FAS Learning Federation Project, 2003
- CRA Cyberinfrastructure and Learning, 2005
- NSF Cyberlearning, 2008
- U.S. ED National Ed Tech Plan, 2010
- PCAST Designing a Digital Future, 2010, 2013
- NRC Learning Science via Games/Sims, 2011;
- REAL Commission Recommendations, 2012
- U.S. ED Expanding Evidence Approaches 2013

Recommendations for Future Workshops and Meetings

- Creating and validating encompassing learning maps (desired outcomes, evidence for their achievement)
- Exploring competency based models for alternative certification and credentialing
- Scenario-based planning on alternative futures for postsecondary learning

Transformation of Formal Education

Link to a Pre-Release Version of the Report

http://cra.org/uploads/documents/resources/rissues/Postseconday_Learning_NSF-CRA_report.pdf