Roadmap for Education Technology

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The Child's Experience <u>Outside</u> of School

All information is instantly available.

Change is constant and rapid.

Distance and time do not matter.

Powerful tools are taken for granted

Multimedia entertainment is omnipresent

Multi-tasking is how people work
(not effectively).

<u>No wonder students are bored in school !</u>

Learning is Different

Students learn at / with:

- Twitch speed vs. conventional speed
- Parallel processing vs. linear processing
- Graphic vs. text based
- Connected vs. stand alone
- Active vs. passive
- Fantasy vs. reality

No wonder students are bored in school !

(Catherine Beavis, Digitel Conference, 2010)

Seeds of a New Educational System

New entities are directing education away from the traditional classroom. Informal learning is pervasive.

Home schooling (1.5 million students);

Charter schools (3,400 schools and 1.5 million students);

Learning centers (e.g., Sylvan and Kaplan are fast growing companies);

Workplace learning;

Distance education;

Adult education;

Collins and Halverson, 2009

Schools are not going to disappear

But we need good tools that support learning in schools. Classrooms and curriculum may become less important as technology becomes the way that people learn.

Collins and Halverson, 2009

National Education Technology Plan (NETP)

U.S. Dept of Education

The NETP enthusiastically endorses the potential for information

It recommends that funders support research for learning outside as well as inside schools and talks about "connected teaching" in which teachers are connected in learning communities with access to on-line resources of many kinds.

Written simultaneously with this Roadmap, the reports have many synchronous discussions, especially educational challenges.

However, the

the promise of the NETP.

National Educational Technology Plan 2010, US Department of Education, March 5, 2010 http://www.ed.gov/ technology/NETP

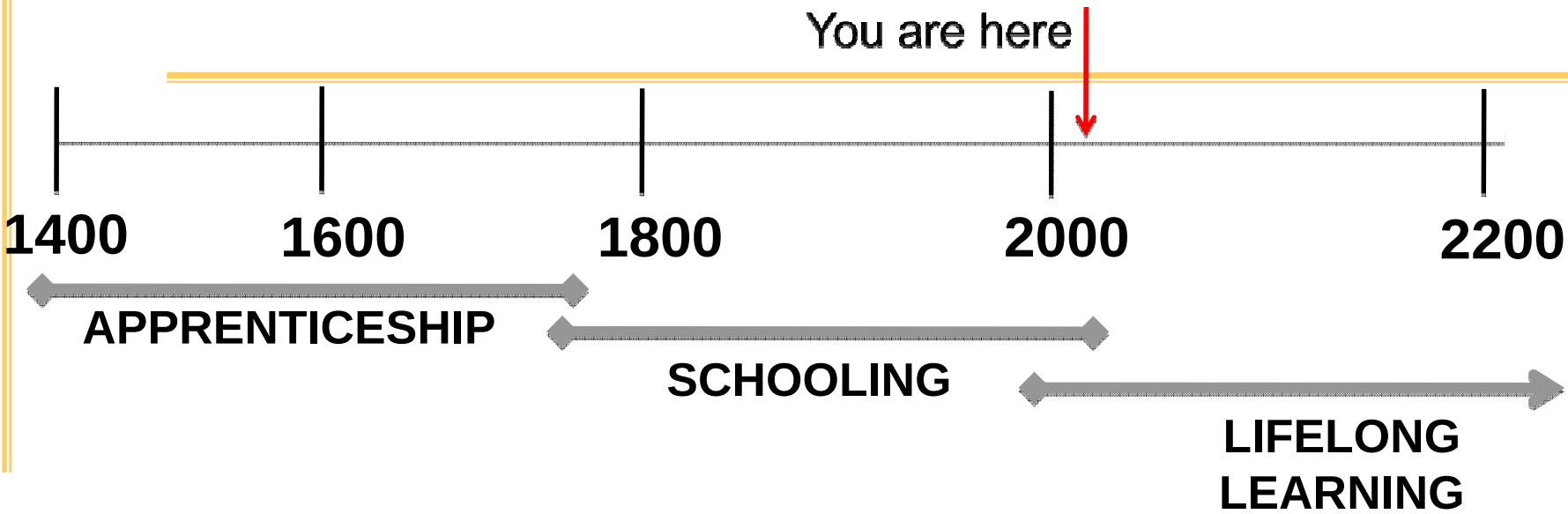
An Intentional Approach to Technology is Needed

Educators opportunistically use any “cool technology:”

→Powerpoint slides, Wikis, blogs, podcasts. These were designed for business and entertainment, not for education;
→MAPLE and Define (built for mathematicians) used to teach high schoolers.

We need to produce technology for true education reform.

A New Era in Education



	Apprentice	Schooling	Lifelong-Interactive learning
Responsibility	Parents	State	Individual
Pedagogy	Apprenticeship	Didacticism	Interactivity
Assessment	Observation of student	Testing Student	Embedded and work-related
Culture	Adult (Tasks that adults want done)	Peer	Mixed
Relationships	Personal, bonding	Authority figure	Computer-mediated, interactive

Collins and Halverson, 2009

Key Educational Challenges

- Personalize Instruction
- Assess Student Learning
- Support Social Learning
- Diminish Boundaries
- Support Stakeholders

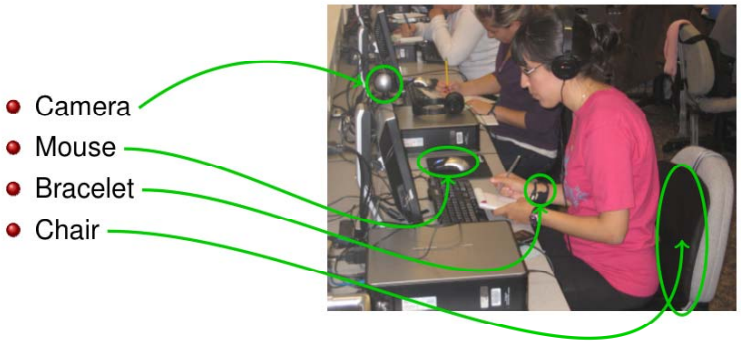
The following slides report the results of the GROE* workshops: 40 researchers from USA, Europe and Australia who asked about the future of education technology, sponsored by NSF and Computing Research Association. This report is meant to open the conversation. We welcome your comments.

*Global Resources for Online Education

❖ Personalize instruction

Educational Challenge. Personalize education to harmonize with each student's *traits* (e.g., personality, learning style) and *states* (e.g., affect, level of engagement).

Develop computational tools that understand an individual as might a human tutor and support instruction based on a student's weaknesses, challenges and motivational style (e.g., wants competition, needs acknowledgement).



Data Accelerates Improvement

⇒ Data improves home / school connection.

⇒ Data models predict student performance. How quickly or slowly do students learn? What are the underlying factors that make items easier or harder for students? How should lesson design and curriculum be modified?

⇒ One contest used half a million student records—50 hours/year/student using the Cognitive Tutor—and 5 datasets of logged student behavior to develop and test a model of learning.

⇒ Worldwide competition: KDD Cup (Knowledge Discovery and Data Mining), PCLS Data Shop. The best model was selected.

How can Technology Support Personalized Education?

⇒ Represent what learners know and can do. When and how was knowledge learned? What pedagogy worked best for a given learner.

⇒ Manage vast amounts of data, effectively store, make available and analyze data for different purposes and stakeholders.

⇒ Simulations and representations that explain themselves to learners. Address the communicative interaction between learners and software and use multimedia to switch modalities as appropriate.

Promising Tools:

- User Models
- Serious games
- Intelligent Environments
- Data Mining

These technologies will be described later

❖ Assess student learning

Educational Challenge. Assessments should be *seamless* and *ubiquitous* and occur everywhere. They should be available every time a student learns and move beyond the model of Teach / Stop / Test.

Seamless refers to the removal of false boundaries between learning and assessment and ubiquitous refers to the constant nature of assessment that will feed back results and implications into learning, anywhere and anytime.

Photo Credit: One Laptop Per Child

Photo Credit: Tak-Wai Chan

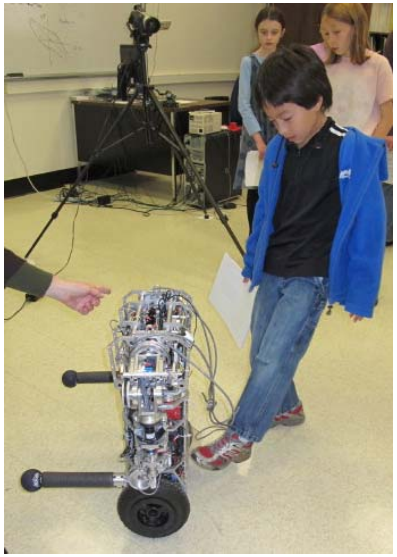


Photo Credit: Stephen Wolf

How can Technology Support Assessment?

⇒ Understand the full complement of student characteristics. What are learning competencies? How do they relate to each other and how do we acquire evidence about them?

⇒ Fuse assessment and learning. What are new sources of assessment? How do they flow to, from and with learning, and how can we tear down barriers between assessment and learning?

⇒ Render assessments useful to all parties. Who makes what decisions? What information do they need, how does assessment provide evidence for those decisions, and how can we best communicate the complicated results of assessment to each party?

Promising Tools:

- User Models
- Intelligent Environments
- Data Mining

❖ Social Learning

Educational Challenge. Social learning is already pervasive. We need to expand it and to support continuous learning by active students working in groups in ways that are highly distributed and valued.

Photo Credit: Tak-Wai Chan

Photo Credit: Tak-Wai Chan

Photo Credit: Mike Sharples

Autonomous Virtual Humans

⇒ Twin guides at the Boston Museum of Science have meaningful interactions with humans.

⇒ They use speech understanding and natural language processing to motivate interest and enhance the experience. Target audience 7-12 year old children.

⇒ Developed by the Institute for Creative Technology (ICT)

Photo Credit: Chad Lane, ICT, Boston Museum of Science

How Can Technology Expand Social Learning?

⇒ Examine how learning communities interact, sustain, build on and share knowledge.

⇒ Address infrastructure (API, management) and application level (representations) issues. How can we achieve more than just technical interoperability and also support semantic interoperability? What integrations / mashups of devices / platforms would more effectively support social learning?

⇒ Treat the social group as a cognitive unit, but not to the exclusion of the individual. What analyses are needed to relate the two?

Promising Tools:

- Serious Games
- User Models
- Intelligent Environments

❖ Diminished Boundaries

Educational Challenge. Re-examine, cross, mitigate and/or eliminate many of the artificial and non-productive boundaries established within educational institutions, including *place of study* (home, work, institutions), education *level* (school, college, university and professional development), personal *ability* (special and typical students) and *type of learning* (formal and informal).

Develop education that is seamless, ubiquitous and pervasive across place of study, educational level and type of learning.

Photo Credit: Stephen Woolf

Photo Credit: Winslow Burleson

How can Technology Help Diminish Boundaries?

⇒ Develop tools and resources for learning that are available across society. How can we support seamless transition between formal / informal environments?

⇒ Increase opportunities for informal learning. When does learning occur? How should learning outside of traditional academic settings (e.g., at home and informally) be supported?

⇒ Support students to transition, transfer, apply, and enhance their knowledge, experience, and discovery and imaginative inquiry across boundaries.

Promising Tools:

- Mobile Tools
- Intelligent Environments
- Rich Interfaces

❖ Alternative teaching modes

Educational Challenge. Education should prepare students to be citizens in the high-technology world of the 21st century where reasoning, disciplined thinking and teamwork are vital.

Students should solve complex problems in innovative ways and think clearly about vast amounts of knowledge; should work across disciplinary domains, in collaboration and employ inquiry reasoning.

They should be engaged, excited, active and joyful.

Photo Credit: Mike Sharples

How can Technology Support Alternative Teaching?

⇒ Improve students' communication skills and creative abilities. Which tools match learners with other learners and/or mentors taking into account learner interests?

⇒ Enhance exploratory, social, and ubiquitous learning. Explore games and mobile solutions to support engagement and excitement.

⇒ Teach collaborative inquiry as students become exposed to diverse cultures and viewpoints. What is the process by which teams generate, evaluate, and revise knowledge?

Promising Tools:

- Mobile Tools
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❖ Role of stakeholders

Educational Challenge. Stakeholders (teachers, students, parents, administrators and employers) should be able to trust the technology to do what it claims to do and be assured that students have absolute privacy. It should prove itself trustworthy. Stakeholders should become more effective at using technology as part of instruction and in some cases integrate it fully into their teaching.

Teachers will continue to be of primary importance in schools and will take on different roles in connection with technological tools.

How can Technology Support Stakeholders?

⇒ Extend a teacher's significance to informal and formal settings and increase their interactions with students in broader and more diverse contexts.

⇒ Develop more tailored and higher quality information for teachers to inform their decisions.

⇒ Address the historical imbalance between children and teachers. Which activities and environments make teachers' experiences as engaging and motivational and productive as that of children?

Promising Tools:

- Mobile Tools
- Intelligent Environments
- Rich Interfaces

Now, Some Promising Technologies

- Serious Games
- Mobile Tools
- User Models
- Rich Interfaces
- Intelligent Environments

Photo Credit: Mike Sharples

Serious Games

Research Agenda:

- Demonstrate that games are inherently more motivating.
- Evaluate the impact of games on student development of "soft skills" (leadership, negotiation, communication).
- Identify features that make people spend so much time in games; remember 10,000 hours are required to acquire academic mastery.
- Identify the factors that make up immersion, e.g., realism, engagement, and involvement.
- Identify the relationship between immersion and learning.

Mobile Tools

Research Agenda:

- Note: 78% of USA teenagers own cell phones.
- Develop mobile learning tools for exploration, investigation, discussion and recording data.
- Identify how short learning objects (e.g., when entire contact time is a few minutes) support larger learning goals.
- Demonstrate that mobile tools can promote higher quality learning, more active and social learners, and students involved in ubiquitous learning.
- Evaluate the teacher's role vis-à-vis mobile tools; demonstrate the wide variety of environments in which teachers can operate.

Photo Credit: Mike Sharples

User Models

Research Agenda:

Show that user models (UMs) can track student skills, cultural preferences, personal interests, and knowledge and can identify when students learned, which pedagogies worked and for whom

Develop UMs that support:

- Formative issues (the degree to which students learned how to learn)
- Summative issues (what was learned for accountability and promotion).

Develop machine learning techniques that learn rather than being programmed with knowledge, e.g., to identify misconceptions.

Develop UM shells (e.g., environments that contain the basic components of expert systems and methods for building applications).

Photo Credit: One Laptop Per Child

Rich Interfaces

Research Agenda:

Photo Credit: Winslow Burleson

- Develop interfaces that sense, analyze and recognize human action, whether cognitive, meta-cognitive or affective.

- Develop interfaces that accommodate full sensory input based on radio frequency identification (RFID), global position sensors (GPS), smart phones, cameras, and capabilities based on haptic, augmented reality and brain-computer (fMRI-like capability and EEG) components.

- Develop virtual agents, embodied and robotic creatures

- Develop interfaces that support social and personalized interactions (attuned to motivation, self-efficacy and affect) and mixed reality.

- Develop interfaces that support lifelong and lifewide learning at home, work, school and university.

Intelligent Environments

Research Agenda:

- Develop dialogue interfaces that support students' free text and continuous speech understanding.
- Develop systems that allow learners to seamlessly move between real and virtual worlds (e.g., worlds that are too small, molecular level, too large, model of Mars, too long, erosion by a river, or too quick, humming bird's wing).
- Develop autonomous virtual characters (e.g. MoScience Twins) that are authority or peer role models.
- Develop truly interactive and self-explanatory representations that adapt to a learner's needs and take into account students' interests, intentions and goals.
- Address knowledge engineering and cognitive task analysis.

See the full report and brochure

Educational Challenge:

- Personalize Instruction
- Assess Student Learning
- Support Social Learning
- Diminish Boundaries
- Support Stakeholders

Promising Technology:

- Serious Games
- Mobile Tools
- User Models
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- Intelligent Environments

available at

CRA CCC GROE on your browser

http://www.cra.org/ccc/groe.php

Policy Changes

Education should be a civil right for people. A knowledge society requires all people to have knowledge and to learn rapidly.

A possible solution is a global repository of numerous teaching modules available for free for all people

However, it is naive to think that policy reforms as customarily understood will result in the needed changes.

We need to think in terms of systemic, broadly-based changes, in terms of social movements.

If society is to embrace the scope and scale of needed changes, social movements must be launched and sustained over protracted periods of time. For example, in the USA, disability assistance and smoking bans each took around 40 years to achieve.

We need to rethink high school

High school students don't want to be in school (even advanced ones).

Dropout rate in the USA is around 50% for minorities.

Students feel they are in prison; they will take jobs if they can find them.

Collins and Halverson, 2009

Early College High Schools

An Example Education Policy

High risk underserved srtudents to leave high school at 16 and after two / three years study in Early Colleges receive both a high school diploma and an Associate's Degree—tuition free. Boards of Education support 200 schools (400,000 students) in 24 states and the District of Columbia.

Results: 90% stayed in school, vs. 70% in the city as a whole. 90% of graduates go to college. Program is ~30 years old.

Students develop a "future orientation," gain motivation, and the campus mitigates the usual teenage behavior.

High school faculty have an enhanced role, gaining privileges of college faculty, etc.

(The Bill & Melinda Gates Foundation, Carnegie Corporation of New York, Ford Foundation, and the W.K. Kellogg Foundation)

We need to rethink learning

Very difficult to adjust practices that evolved over 200 years.

We need new questions:

- What is important to learn? Technology changes what is needed and available.
- What is the new literacy? Websites, multimedia negotiation, cultural sensitivity?
- How can we improve learning, not just improve the curriculum? (e.g., since the computer is a huge memory machine, can we reduce the memorization effort in school?)
- What kind of tools are needed?

Collins and Halverson, 2009

We need to rethink motivation

The current system is not motivating. For example, we should:

- Make effective tutoring programs freely available to all learners.
- Develop computer-based games that foster deep knowledge and entrepreneurial skills.
- Develop handhelds that teach reading and arithmetic.
- Foster self-directed learning towards learner control.

What is LOST

as education moves out of schools

- Equity – Horace Mann said that the US educational system would provide for all; with technology people can buy their own education.
- Citizenship – Fewer students will learn about their own culture.
- Social Cohesion – students will not be forced to cohere with their peers and will pair up based on broader horizons.
- Diversity – students will become more isolated.

Collins and Halverson, 2009

What is GAINED

as education moves out of schools

- More engagement – personalized and fun learning.
- Less competition – students do not compete with classmates.
- Customization – individualized learning and more personal responsibility.
- Less peer culture – students do not pair with classmates, choose their own partners.

Collins and Halverson, 2009

We welcome your comments

This is a growing discussion and your input is valued.

The report and brochure are available at
CRA CCC GROE on your browser
or
http://www.cra.org/ccc/groe.php

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Thank You !!

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