Thinking broadly about educational technology

Edward Price
eprice@csusm.edu

California State University
SAN MARCOS

Department of Physics
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CSUSM IITS

Hewlett Packard Technology for Teaching
Microsoft External Research

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I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks.

The education of the future, as I see it, will be conducted through the medium of the motion picture... where it should be possible to obtain 100% efficiency.

Thomas Edison, 1922
Typical classroom- today

Earliest known example of a school-room from Sumer, circa 3000 BC
Will computers ‘fix’ education?

What do we mean by learning?

Knowledge
Comprehension
Application
Analysis
Synthesis
Evaluation

Problem solving
Communication
Collaboration
Management of complex tasks
Nature of science
• Before thinking about technology specifically, what do we know about teaching/learning?
• What are our goals?
Scientific teaching involves active learning strategies to engage students in the process of science and teaching methods that have been systematically tested and shown to reach diverse students.
Learning principles

1. Learning builds on prior knowledge
2. Learning is a complex process requiring scaffolding
3. Learning is facilitated through interaction with tools
4. Learning is facilitated through peer interactions
5. Learning is facilitated through establishment of norms and expectations

• Where does technology come in?
• How can we think about how technology gets used and changes the classroom?
What do we do with clickers?

Technology ≠ pedagogy

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Mazur, Peer Instruction (1997)  Beaty & Gerace 2009; Lasry, 2008;
Clickers vs how we use them

Clickers as a tool
- Fast, easy, private
- Limited answer choices
- Response from all students
- Formalize participation
- Automate sharing
- Provide referent for discussion
- Save data for review, grading, research

Pedagogies featuring class response
- Reading quizzes
- In class conceptual questions
- Peer Instruction (Mazur)
- Question sequences (Bao)
- Question driven instruction (Beatty)

Beaty & Gerace 2009; Lasry, 2008; Mazur, 1997; Reay, Li, & Bao, 2008
Thinking about tools
Thinking about tools

• Affordances
• Constraints
• Tools *shape* what we do
• Enable new possibilities
• Not deterministic

Finkelstein, et al., 2005; Lasry, 2008; Norman, 1988; Thornton & Sokoloff, 1990
Tools & pedagogy... is that it?

• Norms
  – sense making
  – responsibility for generating ideas
  – responsibility for evaluating ideas

• Roles
  – Who does what

• Instructor actions, grading practices lead to norms, perceived by students

• Classrooms/instructors have variation in norms and practices

• Implications for feedback and how it is used

James & Willoughby, 2011; Turpen & Finkelstein, 2010
S2: I was thinking that, yeah, C, because it slowed down right when he let go. Like it started slowing.
A framework for thinking about the physics classroom

A student learning physics is engaged in an activity as...

- part of a community... (Other students, instructor)
- with rules/norms... (How do things work here?)
- and roles... (Who does what?)
- using tools... (‘‘Technology’’ but also representations, language, etc)

In a broader context

Cole, 1996; Engeström, 1987; Kaptelinin & Nardi, 2006; Nardi, 1996
YOUR TURN
For MBL and/or simulations...

• How does the use of this tool relate to your goals?
• For the ways you (might) use them, how does the tool
  – Reorganize who does what?
  – Change participation?
  – Allow new/different norms?
  – Reinforce/support existing norms?

Finkelstein, et al., 2005; Lasry, 2008; Norman, 1988; Thornton & Sokoloff, 1990
A whiteboard-intensive physics class

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Whiteboards provide good collaborative space, but are volatile and fixed in size.
Tablets as digital whiteboards

• Student groups use Tablet PCs and work on slides prepared by the instructor
• Student slides can be projected for whole class discussion and are archived on the web
Projecting student work during whole class discussion
Archiving student work

Students found online archive very useful, many page views, including student solutions

We had lots of ideas for how to use this to close the loop, but...
Tablets and collaboration

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Digital photographs and Flickr.com

Whiteboards + archiving

• Cameras w/ wireless-enabled SD cards
• Course-specific Flickr account
• Images can be organized
• Tags and comments
Students find online archive very useful, many hits before quizzes, emphasis on student work
Feedback and revising thinking

Before Flickr was used

– Student work was seldom edited after the class discussions.

With Flickr archive

– Students began to edit whiteboards after whole class presentations... “fixing” mistakes
– The photo now captured an edited solution
“Closing the loop”

• Photographing whiteboards motivated a final round of instructor feedback and student revision.
• Unintended and unexpected
• Students now take responsibility for evaluating, correcting their work
• Arose from student interest in their work as a resource, facilitated by the technology
YOUR TURN AGAIN
For online homework systems

- How does the use of this tool relate to your goals?
- For the ways you (might) use them, how does the tool
  - Reorganize who does what?
  - Change participation?
  - Allow new/different norms?
  - Reinforce/support existing norms?

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STUDENTS’ WRITING OF SCIENTIFIC EXPLANATIONS IN A LARGE CLASS

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Adapting a small, discussion-lab course to large, lecture format

Can we do this?
What does it look like?
Does it work?

Development supported by NSF ESI-0096856 and DUE-0717791
Calibrated Peer Review

A web-based tool that supports students’ construction and evaluation of explanations.

3 stages:

1. Text entry
2. Calibration
3. Peer review
Calibrated Peer Review

Text entry stage
- View background material & prompt
- Enter text / upload images

Evaluation questions and scoring rubric

Calibration stage
- Evaluate & score calibration texts
- Receive feedback on calibrations

Calibration texts

Peer/self review stage
- Evaluate & score 3 peers’ texts
- Evaluate & score own text
- Review results & feedback

Other students’ texts

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CPR Task Example

**CPR Task**  Students use an alignment model of magnetism to explain a nail’s being magnetized by a magnet, and demagnetized after being hit with a hammer.

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In my diagram, I drew an unmagnetized nail by randomly orienting the tiny magnets inside the nail. The nail is unmagnetized because the magnetic effects due to the random collection of tiny magnets cancel each other out producing no magnetic effect.

Hammering made the nail become unmagnetized because when the hammer smashed the magnetized nail with all the tiny magnets perfectly aligned, the tiny magnets became randomly oriented again canceling each other out and producing no magnetic effect.

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CPR Task Example

Evaluation questions:
“Does the first paragraph correctly describe that within the unmagnetized nail there are (many) tiny magnets that are randomly oriented; that is, their NPs (or SPs) point in different directions, or something similar?”

In my diagram, I drew an unmagnetized nail by randomly orienting the tiny magnets inside the nail. The nail is unmagnetized because the magnetic effects due to the random collection of tiny magnets cancel each other out producing no magnetic effect.

Hammering made the nail become unmagnetized because when the hammer smashed the magnetized nail with all the tiny magnets perfectly aligned, the tiny magnets became randomly oriented again canceling each other out and producing no magnetic effect.
Writing scientific explanations – average final exam performance of students in two types of courses

Students in courses that included 5 CPR tasks (LEP) outperformed students in courses with traditional assignments (PET)

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Price, Goldberg, et al., in preparation
CPR as a tool

• Supports goal of students being able to construct, critically evaluate explanations

• With CPR,
  – Instructor as developer, but students as graders/evaluators
  – Task development is intensive, but grading/administration is minimal
  – Implicit suggestion that students can develop (some) expertise

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FLIPPING THE CLASSROOM
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For screencasts (and books) and flipped classrooms?

• How does the use of this tool relate to your goals?
• For the ways you (might) use them, how do these tools
  – Reorganize who does what?
  – Change participation?
  – Allow new/different norms?
  – Reinforce/support existing norms?
MOOCS, ONLINE COURSES, & THE WHOLE FUTURE OF EDUCATION
Instruction for Masses Knocks Down Campus Walls

by Tamar Lewin

The pitch for the online course sounds like a late-night television ad, or maybe a subway poster: “Learn programming in seven weeks starting Feb. 20. We’ll teach you enough about computer science that you can build a Web search engine like Google or Yahoo.”

But this course, Building a Search Engine, is taught by two prominent computer scientists, Sebastian Thrun, a Stanford research professor and Google fellow, and David Evans, a professor on leave from the University of Virginia.

The big names have been a big draw. Since Udacity, the for-profit startup running the course, opened registration on Jan. 23, more than 90,000 students have enrolled in the search-engine course and another taught by Mr. Thrun, who led the development of Google’s self-driving car.

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Evaluation of Evidence-Based Practices in Online Learning
A Meta-Analysis and Review of Online Learning Studies

Students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction. Learning outcomes for students who engaged in online learning exceeded those of students receiving face-to-face instruction, with an average effect size of +0.24 favoring online conditions.

The mean difference between online and face-to-face conditions across the 51 contrasts is statistically significant at the p < .01 level. Interpretations of this result, however, should take into consideration the fact that online and face-to-face conditions generally differed on multiple dimensions, including the amount of time that learners spent on task. The advantages observed for online learning conditions therefore may be the product of aspects of those treatment conditions other than the instructional delivery medium per se.
The Cow Tipping Point

I propose to widen the context gradually so that we always know the vantage point from which we are viewing the [physics education] landscape. Eventually, the basic truths of the matter should be fairly clear, if they aren’t already; and the conclusions we ought to reach about the technology will be obvious. ... As we move further and further from the original narrow context, we gradually leave the realm of science and medicine and we enter the territory of ethics, economics, and social well-being.

MOOCs, online courses, & the future of education

- In these models, what are the implicit (or explicit) theories of learning? Are they consistent with research on learning? Compared to what?
- Roles of faculty, instructional developers, teachers, students
MOOCs, online courses, & the future of education

• In these models, what are the implicit (or explicit) views about the purposes and mechanisms of education?
• Providing access – of what sort, for whom?
• Who profits?
Technology in the classroom

A classroom is a community, learning is a social process. Technology should be designed and used to support this.

Clickers, video-based experiments, and online archives can extend and enrich the classroom, and support/structure interactions.
Technology in the classroom

Let pedagogical goals drive the use of technology. Technology ≠ pedagogy. What you do is more important than the tools you use. But tools can reorganize activities, roles, and norms. Keep an eye on the broader context in which we work.
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