Teaching Physics at Scale

$100 million
Approximate annual cost of physics textbooks

5000 physics courses
Approximate redundancy in assessment creation

Underutilized gains from PER
Active learning
Blended learning
Intelligent tutoring systems
...

$5 million
Content costs of a physics ITS

Expert Approach

8.MReVX: Mechanics ReView

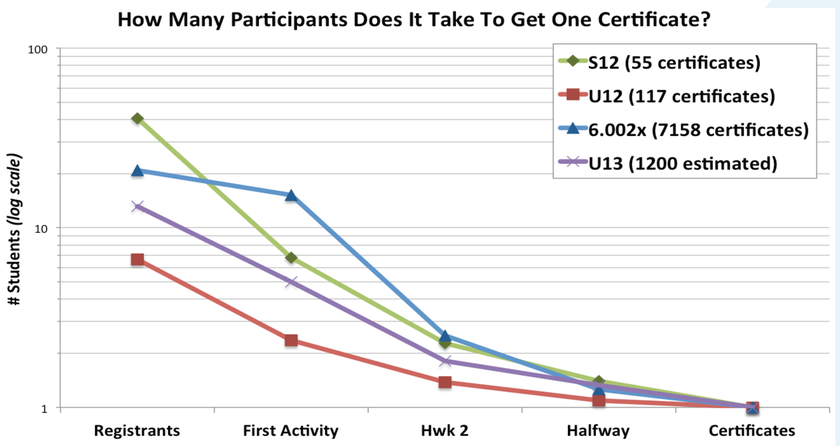
8.MReVx is organized into weekly modules each containing a short e-text with supplemental videos, simulations, and embedded questions. Each module features homework problems at three levels (including challenging MIT exam-like problems) and a weekly quiz. Discussion forums follow each module and problem, enabling participants to learn from each other and from our cadre of alumni staff members.

Pedgagogy by MIT RELATE

Our pedagogical approach, Modeling Applied to Problem Solving, presents a unified conceptual framework for the standard mechanics syllabus that closely ties into solving problems. It improves students' overall expertise and general problem-solving skill, and leads to enhanced performance in students' subsequent physics course in Electricity and Magnetism. The course imparts more conceptual learning than traditionally taught on-campus courses.

Special section targetted at teachers

Teachers in Massachusetts can receive Professional Development Points (PDPs) at no charge to teachers for completing the course, while teachers in a different state receive Continuing Education Units through the American Association of Physics Teachers at ½ their usual cost. Course resources are available to teachers for their own classes, and ultimately through a course-building application that will allow deploying them to students through edX.org. 542 teachers signed up this summer.



Vision

A common resource
Contains everything needed for a course
Created once
Free for all instructions
Integrated with best practices from PER
Easy to find, use, and deploy
Develops problem solving skills
Enjoyable and student-centered
Multi-pronged approach
A community-owned commons

Summary

We attempted two approaches for teaching in-service teachers.

The 8.MReV xMOOC is a course in mechanics, covering the same material as the MIT freshman physics course. It is a mature, developed course, based on PER pedagogy. Over it's past iterations, over 25% of the "students" have been teachers. The course is being continously expanded and improved.

Second, a recent pilot of a hybrid cMOOC/xMOOC, called Maker Physics, was created to introduce participants to specific areas of ed-tech and PER pedagogy, develop their comfort level with the edX platform and encourage the creation of physics content. Two working groups showed community style interactions during the creation of over 50 educational resources, although the pilot did not develop a course-wide community. We are currently working to develop a second iteration of this course.

If successful, a crowd of participants could have the potential to develop richer content than any single entity. In addition, getting teachers involved in resource creation provides a means for teachers to learn both from PER literature and from each other, by reading research papers, collaborating, critiquing each others' work, and reading critiques of their own work. Usage data can help drive both selection of the best resources, and provide feedback to the community on what does and does not work.

Community Approach

Maker Physics

Goals

Build a community of physics instructors and researchers trained in creation and usage of PER-based resources

Develop their comfort level with MOOC-style content.

Encourage creation of high-quality physics resources

Create a crowd-sourced course in physics based on PER.

Approach

cMOOC/xMOOC course for physics instructors

Group instructors into peer groups, with each group responsible for 1 week of an introductory mechanics course.

Each week, cover a bit of PER. Instructors practice by applying those areas to their weeks.

Pilot

Ran over March

Intentionally small set of participants

Short course (4 weeks)

What Worked

Two working groups developed community style interactions

Over 50 educational resources

Lessons for Full-Length Course

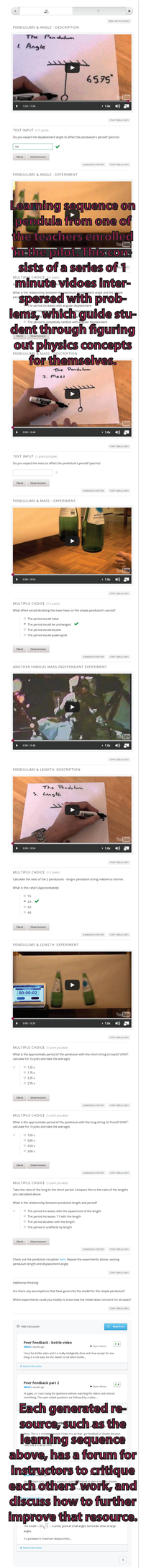
Develop better social technology to build more course-wide community

Focus more on developing shared vocabulary between different areas of education research

Smoother on-ramp at the beginning of course and clearer communications

Next Steps

Developing full course (maker-physics.org)
Good venue to publicize/apply your PER
Want to play? Let us know: pmitros@edx.org



The Physics at Scale Team (All contributed equally)

Piotr Mitros is Chief Scientist at edX, and a co-founder of the preceeding MITx effort. He lead the development of the initial version of the edX platform, with a vision as a tool to bring communities together to create shared courses based on research-backed pedagogy.

David Pritchard heads the RELATE group at MIT, one of the leading PER groups in the nation, which currently focuses on using big data to understand learning. He a long-standing interest in developing students, and has mentored 3 Nobel Lauretes.

David Cormier is an educational activist, researcher, and online community advocate. He is an early MOOC pioneer (and indeed, coined the term MOOC back in 2008). Dave's work has focused on how coming to know is at once intensely individual and embedded in a community