A new wrinkle in online education

An experimental online course gives some students scheduling freedom.

Jennifer Chu, MIT News Office

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Jasmine Chan's course schedule this semester would suggest that the MIT sophomore is more than a little overbooked.

The online version of 2.002 offers video lectures searchable by keyword, and organized as a tree of basic concepts that branch into related subtopics.

IMAGE: CHRISTINE DANILOFF/MIT

Chan, a mechanical engineering major, is taking two classes that meet at exactly the same time. Despite this apparent scheduling snafu, she hasn't missed a single lecture in either course — and her approach to juggling the conflicting courses may represent the future of ambitious academic scheduling.

Chan is one of 11 students this semester who are participating in i2.002, a new online version of 2.002 (Mechanics and Materials II), a core requirement in mechanical engineering. The online course features videotaped lectures from 2.002, as well as recitations and a discussion forum that are similar to elements of edX, MIT's OpenCourseWare, and other massive open online course (MOOC) platforms.

What may set i2.002 apart is its ease of searching: Search a key word or concept, and a video will start at exactly the moment in a lecture when that concept is introduced.

"It's like Googling your class," says Ken Kamrin, the Class of 1956 Career Development Assistant Professor of Mechanical Engineering. "It's a clickable, searchable index of videos … something that might be considered as part of the next generation of textbooks."

"These are exciting times for online education," says Pedro Reis, the Esther and Harold E. Edgerton Assistant Professor of Civil and Environmental Engineering and Mechanical Engineering. "There's huge momentum at the moment for developing technology, through edX and other MOOC platforms, to deploy to a very large number of students. We're saying, 'Let's take that approach and apply it to benefit our own students.'"

Together, Kamrin and Reis have developed, and are currently offering, the online course to MIT students, like Chan, who may otherwise have a scheduling conflict. Students can watch lectures on their own time. The instructors require only that these students attend regular lab sections and in-class exams.

"The whole push here is residential education, improved by the Internet," Kamrin says. "We are now in a position where students who can't take the class for logistical reasons can now take the class."

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The semionline course is an experiment sponsored by MIT's Office of Educational Innovation and Technology (OEIT), the Office of Digital Learning, the Department of Mechanical Engineering, and the School of Engineering. Kamrin and Reis are also collaborating with OEIT's Brandon Muramatsu in the incorporation of new technologies into their project.

In 2012, Reis and Kamrin videotaped lectures and recitations from 2.002 and tracked the points at which new topics were introduced. The team then organized the videos, creating a tree of clickable topics and subtopics. A student can watch lectures in sequence, or search a topic and watch related videos along a particular topic's "branch."

"I like how many resources there are on the website," says Chan, who often will watch video lectures from the comfort of her room. "It's presented incredibly well."

If a student has a question about a problem set, the student can post it to an online discussion forum moderated by teaching assistants, or consult a new feature in the web course: an "online homework tutor" in which TAs post whiteboard-like videos, talking through the concepts in a problem set as they work through the beginnings of a solution. The videos are meant to simulate the kind of help typically offered during office hours.

From Kamrin's perspective, the tutor videos may also address a growing problem in MOOCs. When a student posts a question to a course's discussion forum, the first to provide a correct solution is often not the course TA, but another student. This works, Kamrin says, but only up to a point: The more difficult the course material, the less likely it is that another student will provide a correct answer. But as online courses attract tens of thousands of students at a time, it's virtually impossible for TAs to address every unanswered question, creating a situation that Kamrin says is not "scalable."

"Let's suppose we get to the point where we want to be able to take higher-level classes, and get a full college education, of MIT quality, online," Kamrin says. "This is going to be that stick in the spokes that makes it really difficult to put higher-level classes online. We're trying something now [the online homework tutor] to try to combat this problem."

The hope, Kamrin says, is that the tools developed for i2.002 may one day be used for edX and other MOOC platforms. He and Reis, with the help of OEIT, have been adding features to i2.002 as part of an evolving experiment in student learning.

The instructors presented the first iteration of the course last year as a completely online offering, offered concurrently with the on-campus class. Students who took the course were studying abroad, or had a scheduling conflict, and took the course — lectures, labs, problem sets (p-sets) and exams — entirely online.

In addition to video lectures, students watched videotaped lab experiments, and used portable scanners to first scan and then email p-sets and lab reports to instructors for grading. For exams, students worked out their answers in front of a computer, as TAs proctored them via a web-based videoconferencing platform.

That first year, Reis says, was a "proof of concept" showing that advanced MIT courses can successfully be presented online.

"Then we thought, 'Let's bring it closer to home and make it useful for students on campus,'" Reis says. "It was a progression in this small-scale experiment, which allows us to identify features that can ultimately feed back to large-scale offerings like edX and other MOOCs platforms. These experiments can work in reverse as well."

So far, the online experiment seems to indicate the more resources students have available to them, both online and in the classroom, the better. For example, one student may learn best in the lecture hall, while another may prefer to go straight to a p-set, referring to specific points in a video lecture if she is confused.

"Students have a toolbox of different mechanisms of learning, and each student is going to grab a particular tool that they feel most comfortable with," Reis says, adding that "[i2.002] provides yet another set of tools for students."

Although Reis and Kamrin consider i2.002 a work in progress, the material on which it is based — the core principles of mechanics and materials — has been refined over several decades of teaching at MIT. Various instructors, including professors Lallit Anand, Mary Boyce and David Parks, have shaped the course's content and organization. The cumulative knowledge in how best to present the course was a big help to Reis and Kamrin when they set out to develop this online-teaching experiment.

Since there are many other MIT courses with similarly long teaching histories, the team sees i2.002 as a blueprint for moving other courses online.

"Now this online framework can be applied to other classes," Reis says. "That's what we hope stays as a legacy of our experiment."

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