

# MOOC U.

**Does the rise of the “massive open online course” spell the end of the university as we know it? Through its academic and financial partnership with Coursera, Penn has professors in the fray, skin in the game, and a front-row view of higher education’s next big frontier.**

**By Trey Popp**

**NOT** far into his celebrated class on Greek and Roman mythology, Peter Struck suddenly started talking very, very quickly.

It was during his second lecture. Picking up where he’d left off the week before—a bravura word-by-word translation of the first 10 lines of *The Odyssey*—the youthful Penn classicist mused on Homer’s opening description of Telemachus as a whiny layabout resigned to blaming the gods for his bad luck.

“Achilles was off conquering whole swatches of territory at this age,” Struck was saying. “Twenty is plenty old enough to step up and get things done!”

Then, as he launched into Telemachus’s remedial education in how to work up some righteous anger, Struck began jabbering like an auction crier on a sugar high.

It only worked in Safari. Firefox wouldn’t let me do it. I clicked a plus sign at the bottom of the screen and Struck instantly accelerated his pace by 25 percent. I hit the plus sign again. Struck sped up to a 1.5x clip. It seemed like a miracle. If I could power through the rest of the lecture just a little faster, I’d be able to knock out the weekly quiz before my kids came home clamoring for sandwiches. I might get the rest of the weekend to myself—and my Lego partners—after all.

I cranked it up another notch. Struck was really flying now. Telemachus is in Pylos, he’s in Sparta, he’s hearing from Nestor and Menelaus, he’s getting bewitched by Helen, nudged by Athena disguised as Mentor, everyone’s telling him what Orestes had to do to avenge Agamemnon—

And that’s when my brain almost boiled right out my ears. I hit the minus sign. This Coursera thing was clearly going to take some getting used to.

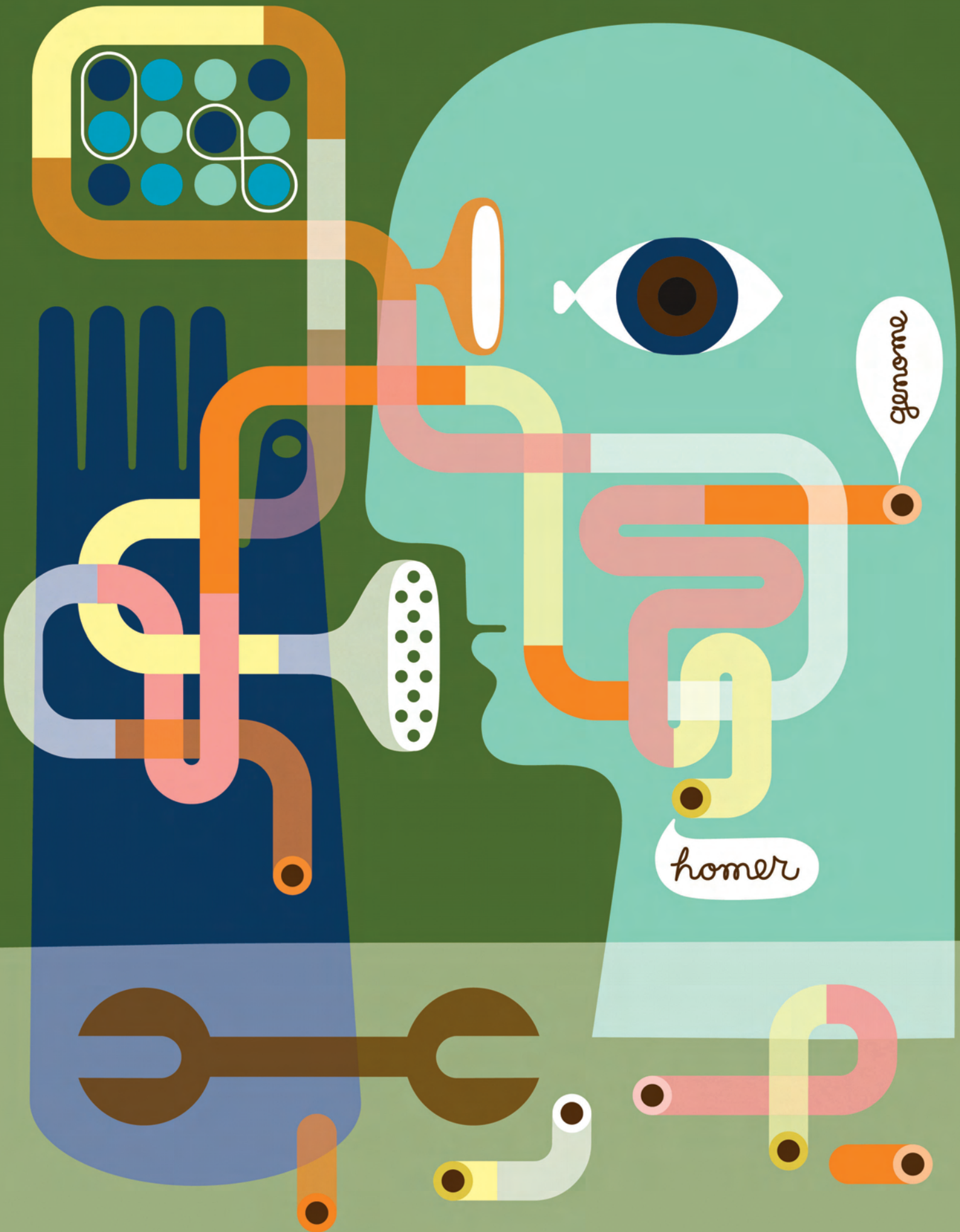
**As you’ve probably heard, we are living in the age of the MOOC.** In the last year, “massive open online courses” have spread through the higher-education landscape like kudzu on a Carolina roadside. Among the several providers that have gained early prominence, Coursera stands out as a particularly fast-growing enterprise. Founded by two Stanford professors in April 2012, the for-profit online education platform attracted more than a million users in its first four months—a faster start than either Facebook or Twitter, according to *The New York Times*.

Penn accounts for a significant portion of that growth. So far the University has offered 19 courses on the platform—more than any of Coursera’s 32 other academic partners aside from Stanford, which has also offered 19. Penn’s MOOCs range

from “Corporate Finance,” by Franklin Allen, the Nippon Life Professor of Finance and Economics, to “Experimental Genome Science,” by pharmacology professor John Hogenesch and assistant professor of genetics John Isaac Murray. And the University is expanding its offerings. (See sidebar on p.61 for Penn’s current Coursera catalog.)

Penn also has a financial stake in Coursera. Three months after the company launched—with \$16 million in venture-capital funding and initial academic partnerships with Stanford, Penn, Princeton, and the University of Michigan—Penn became an equity partner by making a joint investment with Caltech of \$3.7 million. (As of press time, Coursera had attracted a total of \$22 million in equity funding.)

What the rise of the MOOC portends for higher education is an open question. Coursera has been enrolling tens of thousands of students in single classes (all of which, so far, have been offered for free). They live everywhere from Kansas to Kazakhstan, and are turning to MOOCs to get everything from casual intellectual enrichment to actual college credits. Coursera co-founder Daphne Koller aims to offer “most of the full university curriculum”—which she pegs at about 5,000 courses—within three to five years.



genome

homer

“I hope that in 10 years,” she adds, “we will look back and say, ‘Boy, I can’t believe that the most predominant method of teaching our students was to shove them into an auditorium for an hour and a half twice a week.’”

Koller, along with her co-founder Andrew Ng and a great many other people, believes that MOOCs will radically change the world of higher education.

“The question is,” as Penn Provost Vincent Price puts it, “How?”

## REBOOT THE MISSION

“We are in the business of creating and disseminating knowledge,” says Edward Rock L’83, the director of Open Course Initiatives at Penn. “That’s what we do. We do it on campus, teaching students and doing research. We disseminate it in journal articles, we disseminate our research in books, and we disseminate our research in conferences all around the world. We have a few satellite campuses. And the Internet is a place of knowledge. So to be there—to be a presence on the Internet and disseminate the knowledge that we’ve created through the Internet—isn’t some tangential kind of activity. It’s core to our mission.”

Rock, the Saul A. Fox Distinguished Professor of Business Law, is the University’s designated deep thinker on all matters MOOC. Last year he was tapped as a senior advisor to Price and President Amy Gutmann on the issue.

Part of the motivation for Penn’s embrace of MOOCs is altruistic. But while administrators trumpet Coursera as a way for Penn to spread enlightenment, the University’s self-interested hopes for Coursera are more varied and interesting.

“What Coursera has made possible,” says Rock, “by virtue of the hype, if you will—the glamor, the potential of teaching hundreds of thousands of students—is it has jump-started a conversation about technology in the classroom at Penn that we’ve been trying to get going for a long time.”

Like a growing number of educators, Rock and Price believe that the traditional approach to both teaching and assessing students is outdated.

“This is an opportunity,” says Price, “for the faculty to grapple more seriously with that whole range of technological opportunities—some of them not

yet developed—to think about the way they inform not just delivering course material, but assessing student learning, and doing it on a broad scale and in more efficient ways.”

One of their fondest hopes is that the MOOC format holds the key to “flipping the classroom.” This idea dates back to the 1990s, but gained a fervent following around the time an MIT grad named Salman Khan started tutoring his niece in math over the Internet. When Khan started uploading his instructional videos on YouTube in 2006, their popularity and apparent effectiveness sparked widespread enthusiasm for the notion of “flipping” the conventional balance between classroom lectures and homework. Perhaps high-school teachers could take advantage of Khan’s knack for YouTube teaching by assigning his tutorials (or others like them) as homework, and using class time to help students apply the concepts to problem sets.

Khan left his job as a hedge fund analyst in 2009 to devote himself to Khan Academy, a non-profit educational organization that currently offers 3,900 “micro lectures” on its YouTube channel, which has racked up over 230 million views.

Price thinks MOOCs hold the same potential for college classrooms.

“If you have well-developed technologies to provide that didactic component,” he says, “it actually frees you up to do more of the intense, smaller-scale, what’s often called ‘high-touch’ kind of teaching. And for places like Penn, I think that’s likely where the value-added will be.”

Karl Ulrich, the CIBC Endowed Professor of Entrepreneurship and e-Commerce, is already on that path. He teaches a handful of classes on product design, management, and innovation at Wharton, and a Coursera class titled “Design: Creation of Artifacts in Society.”

“I believe my Coursera videos are more effective educationally than the same content delivered live,” he says. So he’s been using them at Wharton. “I typically assign a module comprised of a handful of short videos and ask my students to complete a challenging assignment based on that material. They do this before our class meeting. We then use our class time for an experience that can only be delivered with a group of 60 people sharing the same time and location.” For example,

he recently ran a competition in which teams of students produced product prototypes, and then simulated a market in which purchasing decisions were made and profits computed.

“For some years now,” Price adds, “students entering institutions like Penn have grown up in a media environment where many of these tools seem second-nature to them. And they’re puzzled as to why their faculty members aren’t using them.”

## PEDAGOGY AND PROFITS

University officials decided to partner with Coursera for several reasons—not the least of which is that the company’s founders reached out to Penn before anyone else did. Another factor, Rock and Price say, was Penn’s lack of expertise in online education.

Free, high-quality, online collegiate classes are not a brand new invention. MIT has been putting entire courses on the Web since 2002, and now offers, at no charge, more than 2,100 classes encompassing “virtually the entire curriculum” of the university on its Open CourseWare (OCW) website. More recently, MIT teamed up with Harvard to found edX, a non-profit MOOC platform that currently offers 24 courses produced by one of six participating colleges.

“MIT, to their credit, did much to advance those technologies, and launched in many respects the Open Course movement,” Price says. “But that investment in the technology *per se* is what led them down that road. Our *lack* of investment in this technology was what permitted us to focus on what I think matters, which is the content and the pedagogy, and to leave the technology to Coursera.”

In Rock’s view, “There’s a really optimal division of labor with a for-profit venture-capital company taking care of, and taking the risk of, developing the platform—something that Penn has no comparative advantage at internally—and the universities doing what they’re best at, which is producing high-quality instruction.”

It’s also attractive that, as both an academic partner and an equity investor, Penn has the potential to cover the costs of producing these courses—which run to about \$50,000 a pop (consisting primarily of stipends for professors and teaching assistants, along with the cost of videography)—



with a double cut of Coursera's profits, should profits materialize.

(Penn has not disclosed the details of its agreement with Coursera. According to the company, academic partner institutions will keep between 6 and 15 percent of revenues from classes taught by their professors, plus 20 percent of the profits. Penn has also not disclosed how much of this revenue will flow to individual professors; Rock says the formula is modeled on the University's patent policy.)

"I think of this largely as a set of investments I'm willing to make as an educator," says Price. "They're necessary investments, and I would make them in any event. But the idea that we might defray some of those expenses makes the proposition that much more interesting."

Coursera's venture-capital backers, of course, are betting on—and will no doubt push for—profits well beyond that modest expectation. Which makes some Penn faculty members uneasy.

"Penn always goes where the money is," remarks John Puckett, a professor in the Graduate School of Education who is currently working on a history of the University since World War II. "Coursera seems to be another way of providing non-traditional instruction in a way that's going to make money for the institution, because we're one of the anchor institutions of American capitalism.

"For all the pabulum about pristine academic values," he adds, "they sometimes play a second fiddle. The question is, where does the slippery slope become a mudslide?"

Price appears to be keeping Puckett's question in the front of his mind, and notes that Penn has a nonexclusive agreement with Coursera. "We put our energy into this partnership," he says. "It makes sense to play this out in a way that benefits both Coursera and Penn. But if at any point the company moves in a trajectory that's not consistent with our mission, there's really nothing lost by that. And to some extent one could imagine a scenario where our investment in that company proves to have been a wise investment in a financial sense, even if we part ways and move in very different directions."

In the meantime, as Rock puts it, "What we're doing, in an incredibly cost-effective way, is jumpstarting the integration of technology into teaching on campus."

## SMALL-SCREEN SCHOLARS

As it happens, some Penn faculty members are old hands when it comes to Internet teaching. Peter Struck has been doing it for 10 years. He got his start in a broom closet on Market Street.

"My bread-and-butter course has always been this mythology class," Struck said in the fall, shortly before his Coursera debut. "I know that course best. So I decided to try that in an online format. In the early days, it felt a little bit like doing a TV show. It felt like you were on cable access. It was just me and my TA, and we had a camera, and a person behind the camera, and we were in a broom closet at the old College of General Studies office—literally a broom closet.

**"I think down the line you're going to have instructors who re-mix content that's prepared by potentially one, two, or three different instructors—or more—and create trajectories that make sense," says Coursera founder Daphne Koller.**

"We sat next to each other, and I would talk. My TA would monitor a chat room. And we had an 800 number and people would call in—so we had a call-in section of the program, where we would chat back and forth, like a sort of Johnny Carson/Ed McMahon setup."

As Struck remembers it, the interactive element of that first experiment—back when most Americans accessed the World Wide Web via dial-up connections—was "not all that robust."

It got better with the next advance in webware, which coupled lectures with a stronger online-forum component. But for Struck, that also counted as a drawback.

"At first I wondered, is this really right to have students basically passing notes while I'm talking?" he recalls.

"*Multitasking* is a euphemism for *being distracted*," he continues. "So it made me think that what I was accomplishing in this online forum was hampered by the very nature of the delivery mechanism."

Coursera and its competitors, by harnessing vastly expanded bandwidth and elements of social networking, are pushing online instruction into new territory. Lectures are typically broken into short video segments (the mythology class usually featured 10 per week) and served "on demand." The image and sound quality is on par with Netflix, professors can use tools like greenscreens and computer animations, and the online forums are more sophisticated.

"The students ask questions, give their comments, and then they're 'liked' or not by the class," Struck explains. "And the ones that are liked most get bumped up to the top. So you wind up with an ongoing referendum on the most salient issues ... It gives you this huge pool of

information to draw from to see what's working and what isn't."

Still, before his course launched, Struck had no real idea how crowd-sourced commenting from some 40,000 students would actually play out.

Neither did I, until I tuned into the first of what would become a series of "screen-side chats" hosted by the professor and his teaching assistants. These supplemental video segments—filmed, unlike the main video lectures, while the course was in progress—were largely dedicated to discussing particularly interesting comment threads generated by the online forums.

One student had posted a comment referencing a study of Homer's color descriptions by William Gladstone—who was more famous for his four stints as British prime minister in the 19th century. Gladstone, who studied classics at Oxford, noted in a scholarly volume that the word *blue* never appears in *The Iliad* or *The Odyssey*. Yet this student had come

across that word in Robert Fagles' English translation, in a description of waves at the end of Book 2.

Struck and his teaching assistants took up the query. After discussing how the ancient Greeks perceived and talked about colors—noting, for instance, their linguistic predilection for deriving color-related terms from material objects—they delved into the original Greek text.

The word Homer used at this junction is *porphyreos*.

"A famous dye in antiquity is linked to this term," Struck remarked. "A purple dye—a very dark color coming from sea-shells connected with the Phoenicians. And this purple color, a very rich and very expensive kind of dye, is often connected with extreme wealth."

To which one of his assistants added: "Think about all the shells that would have to be mined for just a little bit of purple dye."

It is hard to imagine such a well-informed (if esoteric) question arising in a typical undergraduate discussion section. And this was one of countless comments, in this course and others, that seemed to demonstrate the value of gigantic class sizes—particularly when they encompass students of all ages and origins.

For Al Filreis, the Kelly Professor of English and another web-wise faculty member, channeling this dynamic was the whole point of giving Coursera a whirl.

"Is this phenomenon of the MOOC, which is really not all that different from what we've had before, is it different from Open CourseWare?" he asked me in January. "It seems to me that we are in danger of creating this sexy, hyped-up mode that's not different from OCW. And if that's the case, then why don't we just put it online? We don't need a platform for it."

He designed his Coursera course, "Modern and Contemporary American Poetry," to answer that question.

"I wanted to test the hypothesis that these courses could actually be somewhat like humanities courses ought to be, in my opinion, which is, characterized by interaction, questions being asked and answered, and discussion rather than lecture. So ModPo was intended not to be teacher-centered teaching, but learner-centered learning."

It was filmed in the Kelly Writers House, at a table where Filreis either led a seminar

discussion with half a dozen Penn students, or delegated one of them to lead it. Filreis and those teaching assistants participated heavily in Coursera's online forums, and hosted seven live webcasts in which they interacted with distant learners.

In the first one, Filreis issued a spontaneous and impassioned defense of "over-reading," an activity whose indispensability to decoding modern poetry may explain why so many people avoid poems.

"When I go and buy a car," he began, abruptly adding that he only buys used ones, "I go and I ask a lot of questions. And the salesperson never says to me, 'I think you're over-reading the situation.' No, I am kicking those tires! I am looking under that hood! I am not going to drive that car away without over-reading! *And no one thinks I'm over-reading.* I'm a consumer!"

"When I fell in love with my wife-to-be," he continued, "I over-read the situation. I really did. I didn't skim the surface. I didn't say, 'Well this is not something I should interpret very carefully, I'm just going to go with my feelings.' No! That's not a good idea!"

"And I want to put poetry up there with used cars and marriage. I want poetry to be that important. I want you to take it *seriously!* I want you to over-read it!"

For the next two months, people did—hitting the online discussion boards to the tune of almost 100,000 posts and nearly one million page views, numbers that continued to climb even after the class had ended. For Filreis, the experience served as proof of concept—at least the concept that a professor willing to do "twice" the work of a traditional class in a MOOC's first iteration, and "exactly the same" amount in subsequent ones, can accomplish a lot.

"The MOOC has the chance to be a community of learners who work with each other, and create a sense that they're doing it together," he says. "That's the revolution—but it hasn't been utilized. Partly because the people who really pushed the MOOCs in the first place are from STEM disciplines [science, technology, engineering, and math], particularly engineering, where you can write a quiz that appropriately tests comprehension and ability."

The mythology and poetry classes featured computer-graded quizzes—Filreis calls his "silly"—but also peer-graded

essays. I actually found the latter element to be surprisingly valuable, since the process of grading five other students' work forced me to master the material to a greater degree than if I'd only had to write my own. It also seemed to produce pretty reliable evaluations. After the course, I asked Struck to grade one of my peer's papers and (unbeknown to him) one of my own. He scored the first almost exactly as I had, and reckoned that my paper merited an A-minus, which was more or less what my Coursera peers thought.

"There is a set of assumptions that haven't been explored," Filreis adds. "One is that that the pedagogy is lecture. That's wrong! And the assumption also is that to teach a MOOC you have to give up contact with students. That's wrong, too. Then there's an assumption that these are automated—you put it in the can and push the start button and the course will teach itself. That's wrong also."

While I was taking Greek and Roman Mythology, Rochelle Rabin C'74 was taking "Listening to World Music" from Penn music professor Carol Muller. She experienced the power of crowd-scale participation again and again.

"When we studied Tuvan throat music, one of the issues was that while the Soviet Union ruled over Tuva, the Tuvans had to suppress their indigenous customs," she recalls. "There was a guy in the class who had grown up in that area, who was able to post about what it was like living there under the Soviet Union!"

"The fact that people from all around the world were part of the class," she adds, "was as much a part of the learning process as anything that the professor brought in."

My experience was different, perhaps because I spent less time surfing the class comment boards. Partly that was because it was challenging enough for a working parent of small children just to get through the lectures—even at 1.25x speed, where I eventually found my groove. But it also seemed that for every commenter who enriched Struck's lecture about the cult of Apollo with a Thucydides citation, there were two more just casting around for fellow "neo-Pagan/Wiccans." I preferred to rely on Struck's ability to curate a more reliably enlightening discussion in his screenside chats.

That seems to have been an invigorating challenge for Struck. "Conversations

in [traditional] class tend to be more targeted,” he says. “They tend to be funneled down avenues down which a lecturer and my TAs steer it. Which gives it a chance to go a little deeper, but it’s not as creative on the students’ part.

“The discussion on the forums was much more multivalent,” he adds. “I mean, there were hundreds of interesting threads to follow from people who were engaging with the material ... The creativity of a huge crowd-sourced group was apparent—their ability to come up with new ideas, and vote them up or down.

“When I started off,” Struck concludes, “I had a mixture of excitement at the newness of it all, and a little bit of skepticism as to whether it would be at all possible in a forum like this to do the things I really care about. And that skepticism, that’s melting away. There’s enough that’s proving for me that, for those who follow along with the course, we can get a lot of substantive things done in this format.”

That’s a matter of some consequence, because Greek and Roman Mythology is now being offered for college credit—only not by Penn.

## THE GREAT UNBUNDLING

Last October, Antioch University, in Los Angeles, announced that it would begin granting college credit through Coursera. To pilot its program, it chose two courses produced by Penn: Struck’s mythology class and Filreis’s poetry class.

When the University entered into partnership with Coursera, says Price, “We made it clear that we were not in it to offer credit-bearing courses. Over the long term that may change—if it’s abundantly clear to us that this is a vehicle for providing an educational experience that is, in every respect, credit-worthy and Penn-worthy in that sense. At the moment it’s not clear that that’s the case, for a variety of reasons.”

For Penn, those reasons include worries about Internet-enabled identity fraud and cheating, and uncertainty about just how academically comparable a virtual class is to a traditional one. But other institutions may overcome such qualms more quickly. (Or already have; the University of Washington has offered credit for a Coursera class in a “hybrid model” involving supplemental instructors, and while

# Penn’s Coursera Catalog

## SCIENCE AND MEDICINE

### Basic Behavioral Neurology

Roy Hamilton, Assistant Professor of Neurology

### Experimental Genome Science

John Hogenesch, Professor of Pharmacology

John Isaac Murray, Assistant Professor of Genetics

### Fundamentals of Pharmacology

Emma Meagher, Associate Professor of Medicine

### Vaccines

Paul A. Offit, Maurice R. Hilleman Professor of Vaccinology and Professor of Pediatrics

### Cardiac Arrest, Hypothermia, and Resuscitation Science

Benjamin Abella, Assistant Professor of Emergency Medicine

Emergency Medicine

### “Pay Attention!!”:

### ADHD Through the Lifespan

Anthony L. Rostain, Professor of Psychiatry

### Neuroethics

Jonathan D. Moreno, David and Lyn Silfen University Professor

### Health Policy and Affordable Care Act

Ezekiel J. Emanuel, Diane v.S. Levy and Robert M. Levy University Professor; Vice Provost for Global Initiatives

Global Initiatives

### Rationing and Allocating Scarce

### Medical Resources

Ezekiel J. Emanuel

### Networked Life

Michael Kearns, Professor of Computer and Information Science

Information Science

Information Science

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## ECONOMICS AND BUSINESS

### Principles of Microeconomics

Rebecca Stein, Senior Lecturer of Economics;

Director of the Microeconomic Principles Program

### An Introduction to Operations Management

Christian Terwiesch, Andrew M. Heller

Professor; Senior Fellow at the Leonard Davis

Institute for Health Economics

### Corporate Finance

Franklin Allen, Nippon Life Professor of Finance and

Economics

### Gamification

Kevin Werbach, Associate Professor of Legal

Studies and Business Ethics

### Design: Creation of Artifacts in Society

Karl T. Ulrich, Vice Dean of Innovation at

Wharton; CIBC Professor of Entrepreneurship and

e-Commerce

## MATH

### Calculus: Single Variable

Robert Ghrist, Andrea Mitchell Penn Integrates

Knowledge Professor in Mathematics and

Electrical/Systems Engineering

## HUMANITIES

### Modern & Contemporary American Poetry

Al Filreis, Kelly Professor of English; Faculty

Director of the Kelly Writers House; Director of

the Center for Programs in Contemporary Writing

### Greek and Roman Mythology

Peter Struck, Associate Professor of Classical

Studies; Director of Benjamin Franklin Scholars

### Listening to World Music

Carol Muller, Professor of Music

I was reporting this story Penn was working out at least one other licensing deal with another university.)

When I spoke with Daphne Koller in January, it happened to be the day after Coursera got its “first revenue.” It came from individual students purchasing a premium option entailing identity-verification, which would enable them to earn a special certificate upon successful completion of a course.

Koller and Ng have a lot of ideas about how to make money. That’s one. Another is allowing job recruiters to purchase access to high-performing Coursera students. A third is selling ads on the site. But perhaps most interesting—particularly as it pertains to Penn—are licensing fees paid by institutions who want to use Coursera materials, whether they award credit or not.

The idea of this happening on a large scale seemed a little far-fetched to me when my Coursera experience was limited to Greek and Roman Mythology—especially when I ducked into one of Struck’s live lectures this spring. I had enjoyed his online delivery. Grabbing an eight-minute lecture segment here and a 12-minute segment there was a fun way to break up my day. It was like LOLCat slideshows, only without the brain-cell death. But attending a full 50-minute performance in Stiteler Hall reminded me of the signal luxury of a residential university, which is the chance to sink into deep communion with ideas and people who enlarge them, free from all the



distractions that inevitably pinged my inbox and buzzed my phone when I watched the same material online. The difference between Struck in pixels and Struck in person was the difference between TV and live theater. Surely it would be the same for any truly good professor.

Then I started taking single-variable calculus with Robert Ghrist.

It is fair to say that Ghrist, the Andrea Mitchell University Professor, represents Penn's best hope for a Coursera blockbuster. His lectures are built on nifty, cartoon-style animations that have a hand-drawn feel. More importantly, the first week's worth overcame long odds to make the concept of Taylor Series lucid to a scribbler who hasn't encountered a sigma sign, much less taken a derivative, in 20 years.

In February, Ghrist's course was approved for college credit by the American Council on Education, which oversees the granting of "academic credit for formal courses and examinations taken outside traditional degree programs." Calculus students who pay \$99 for Coursera's Signature Track, and pass an "online proctored exam" for an additional \$79, may now earn credit at one of some 2,000 universities and colleges that consider (but are not required to honor) ACE's recommendations.

Rock thinks the excellence of Ghrist's MOOC doesn't detract from the value of—and the premium students are willing to pay for—taking the class from him in person. But even if it turns out that his Coursera class undercuts his traditional one, so what?

"The best kind of challenge that the University has is figuring out how best to take advantage of face-to-face residential instruction," Rock says. "And if we can't show that the single-variable calculus course that we offer at the University of Pennsylvania is better by a significant degree than the Coursera course that you can take online for \$99 or whatever, then we shouldn't be teaching single-variable calculus. We should say take it some—take it before you get here.

"We don't teach Algebra II anymore," he continues. "The curriculum changes over time ... And if it turns out that the whole first year of college, all of these introductory courses, is done more cheaply online, we could become a three-year university, and it really wouldn't disrupt us. We would

just increase the size of the class. It could be revenue-neutral. I don't think that's going to happen. But it could."

Karl Ulrich feels like it's starting to happen already.

"Many of my own students at Penn have taken MOOCs," he notes. "Some have even asked if I can give them independent study credit at Penn for MOOCs taken elsewhere. For their academic education, students will gravitate to the educational mechanisms they find most attractive, and increasingly those mechanisms will not be Penn classrooms. As an institution we can take advantage of new modes of instruction, integrating them with the other elements of the Penn experience, which I am convinced students will continue to value. Therefore, the emergence of MOOCs and other novel educational mechanisms represent as much of an opportunity as a threat for us."

That's a heady notion. Yet it was only when I watched Ghrist's seven-minute "bonus lecture" on how a geometric series and a binomial series could be applied to solve a particular problem in electrostatics that I realized that Coursera is on the cusp of doing something far more radical.

The nitty-gritty of that particular piece of math is unimportant. Except, of course, to any professor who needs to teach it—and realizes that Ghrist probably does a better job in a shorter amount of time. It was easy to imagine, say, a robotics professor licensing just that tiny bit of Ghrist's class—and then maybe grabbing another fragment from Coursera's electrical engineering class, and so on—and weaving them into a course of his own design.

When I mentioned this idea to Koller, she was way ahead of me.

"I think down the line you're going to have instructors who re-mix content that's prepared by potentially one, two, or three different instructors—or more—and create trajectories that make sense," she said, sketching a future in which the professor becomes a sort of DJ. "That is what it's about to be an instructor, I think. It's a curation process."

If so, Coursera's pedagogic model, which unbundles lectures into still smaller parts, may threaten the very idea of the course as the fundamental unit of a college education.

"Unbundling is a good thing," Koller says, "because it allows you to extract units from courses that are of value in and of themselves, and provide them for students.

"At the same time," she goes on, "I think there is a sense about courses—and more broadly about degrees—that the whole is bigger than the sum of the parts ... and students are better served, shall we say, by having access to larger units and being forced to take larger units."

Price has thought about this, too.

"If you unbundle things like the course, and then you start to imagine unbundling things like degree programs, et cetera, it starts to look as though it permits a radical reconceptualization of an undergraduate degree program," he says. "How quickly that develops is unclear in my mind, and the exact trajectory that it might follow is also unclear.

"I could imagine a world," he muses, "in which they reconceptualize the system to be more like a tutorial system where a student comes in and, in close consultation with faculty, identifies a subject area and is qualified for advanced study, making use of a variety of unbundled educational experiences, and then is taken through a research enterprise."

After thinking for a moment, Price remarks, "The credit unit was invented to serve particular purposes. It continues to serve valuable purposes. I don't see it going out of use any time soon. On the other hand, it *is* an invention."

On the issue of other institutions awarding credit for Penn-produced Coursera classes—or materials, if unbundling is indeed the future—Rock is agnostic. He compares MOOCs to textbooks.

"When somebody buys Brealey, Myers, and Allen's *Corporate Finance* textbook for their finance course," he says, referring to a volume co-authored by Wharton's Franklin Allen, "we don't tell them what kind of grades on the final exam are required in order for them to give credit for the course. That's their business."

Does he fear that Penn could be giving away the keys to its kingdom, the way newspapers did, to their apparent financial doom, in the web's early days?

No more than any professor who's ever written a book.

"Paul Samuelson wrote the leading economics textbook that dominated the market for 30 years, okay," Rock says.

“Samuelson taught at MIT. One could take Samuelson on economics at any university in America, including really inexpensive universities. Do you think that that reduced the attractiveness of MIT versus the competition, or do you think it increased the attractiveness of MIT? My guess is it increased the attractiveness ... because it came with the guy.”

Ulrich takes that logic a step further.

“Universities like Penn deliver at least four benefits to students,” he observes. “They confer alumni status, which carries with it prestige and a signal of quality to employment markets. They create a social network among individuals likely to be powerful in the future. They provide an engaging environment in which to make the transition into adulthood. And they provide an academic education.

“My sense is that for most students, the academic education is of substantially less value than the other elements.

“Elite universities are among the oldest institutions in the world,” he adds. “They appear to be very resilient institutions, rivaling religions for longevity. I believe a key reason for their success is that institutional prestige is very hard to replicate and takes decades to develop. For this reason, I am confident that the top handful of universities in the world will continue to be successful for decades.”

Ulrich isn't alone in distinguishing between the outlook for the “top handful of universities” and the prospects of all the rest. Last year Sebastian Thrun, founder of the MOOC platform Udacity, predicted in *Wired* magazine that 50 years from now there will only be 10 institutions of higher learning in the world.

Extreme forecasts are always the most titillating, but there's no getting around the enormous potential of MOOCs to disrupt the business of higher education.

“The big disruption will not be to the elite universities themselves,” Ulrich reckons. “Rather, I believe that the institutions whose primary benefit to students is education—such as community colleges—will need to adapt quickly to the availability of excellent content via the web.

“It's easy to imagine how they might do that, [by] employing instructors who serve more as mentors and facilitators than as lecturers,” he adds. And “if that approach proves highly effective, afford-

able, and attractive to students, then it will move ‘up market’ to the middle tier of institutions.”

It's also easy to imagine how MOOCs could imperil those institutions—and the students they serve. After all, using MOOCs to amp up face-to-face instruction is not the only option. A more tempting one, in an era of cash-starved state universities and community colleges, might be to let MOOCs simply replace all that good stuff.

That possibility can't be discounted. Then again, neither can the fact that for a lot of people—particularly in the developing world—MOOCs aren't a replacement at all. They are the difference between no college and at least a taste of it. And even a taste can be incredibly empowering.

While I was taking Greek and Roman Mythology, so was an autistic 17-year-old named Daniel Bergmann. Amazingly, considering that he communicates by typing letters one at a time, and relied on his father's physical ability to cut and paste sentences as he crafted the first essays he had ever attempted, Bergmann was simultaneously taking Filreis's poetry class.

“I can't yet sit still in a classroom so ModPo was my first real course ever,” Bergmann wrote in a personal letter to Filreis. “During the course I had to keep pace with the class, which is unheard-of in special ed ... I started to dream about a life in an academic setting where I might someday be of use to others as so many people have been of use to me. The effect is that I feel dramatically less isolated. Your notion that digital learning need not be isolating is very right where I am concerned.

“The specifics of your course were no less transforming,” he went on. “My father asked me the other day whether ModPo had had an effect on my openness and I was astonished to realize it had. My whole intellectual life as I've started to emerge from the misty darkness of autism has been an adventure in beauty housed in form and structure ... Structured art was what I needed to develop my mind, but you showed me a larger world. In special ed they love to talk about the least restrictive environment a child can function in and you have taught me to function in a greatly expanded artistic one.”

Meanwhile, halfway around the world, a 22-year-old computer-science student

named Askhat Murzabayev turned to Coursera for a class that didn't exist in his native Kazakhstan. As reported by NPR, he took Stanford's Machine Learning course, and parlayed his completion certificate into a job offer from Twitter, where he is now a product manager based in Almaty.

As Koller told me in January, one of the biggest surprises for her and Ng has been “the extent to which the impact we felt we were having wasn't just about providing education to tens of thousands of students, but the direct and immediate impact that you have on the lives of a few hundreds of students—in the sense that it completely transformed their lives to have access to the educational experience.”

At Penn, Price echoes that sentiment.

“My fondest hope is that this produces an elevation in the quality of undergraduate education,” he says. “It stands to improve the quality of secondary education [as well], because it circulates collegiate material, puts it in the hands of secondary-school faculties and bright secondary-school students.”

Yet an anxiety tempers that optimism, and it is to the University's credit that its chief academic officer pays heed to both things.

“My biggest fear, frankly, is not a fear connected to Penn at all,” he says. “It's a fear that thinking right now about higher education, and especially public higher education, is driven by logics of efficiencies, concerns about the spiraling costs of education, et cetera. And that, too rapidly, these [MOOCs] will be seen as ways of bending the cost curve. And that efficiencies, real or imagined, will become a device for withdrawal of support from high-quality education, and replacement of that experience with something that's perhaps adequate, but not outstanding. I'm very, very concerned with the misuse of these technologies in a way that is viewed as a cheap way out.

“There is no cheap way out of educating a population,” Price adds. “It is the best public investment that any society can possibly make. And this country has benefited from critical moments in time where wise public leaders recognized that and made those investments, and they built fabulous institutions of higher learning.”

Those institutions have new company. And the next critical moment in the history of higher education might just be the present one. ♦