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Online Higher Education: Beyond the Hype Cycle[†]

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When two Silicon Valley start-ups, Coursera and Udacity, embarked in 2012 on a bold effort to supply college-level courses for free over the Internet to learners worldwide—regardless of whether they were enrolled in a traditional college or university—the notion of the Massively Open Online Course (MOOC) captured the nation's attention. The Harvard- and MIT-based non-profit edX quickly joined the field. Reporters and analysts debated not so much whether MOOCs would transform the landscape of higher education, but only how quickly they would do so—and how many existing universities, if any, would survive the onslaught.

But while the leading MOOC firms remain in business, they have had their struggles, as start-ups often do. Rather than posing an imminent threat to traditional universities, MOOCs now seem like an example of what the consulting firm Gartner (n.d.) calls the "hype cycle," which follows a five-step process of initial trigger, inflated expectations, and trough of disillusionment, before reaching the more productive, final stages of "slope of enlightenment" and "plateau of productivity," when the technology's broad applicability leads to widespread mainstream adoption. In the case of MOOCs, the inflated expectations include predictions that

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MOOCs will make quality higher education globally available at near-zero marginal cost and with little need for many currently employed faculty members.

One challenge facing MOOCs and other forms of instruction intended for use outside institutional frameworks is the need for users to exert considerable self-discipline to stay with a program that is undertaken individually. MOOCs in particular have very low completion rates. Banerjee and Duflo (2014) documented this point in an imaginative way. The authors offered a MOOC on global poverty, and they set a registration deadline that they didn't in fact enforce. The lack of enforcement produced a kind of accidental regression discontinuity analysis that allowed a comparison of results between those who made the deadline and those who missed it. They found that those who made the deadline, even by a day or two, did better on grades and completion than those who missed it. Interpreting the failure to register on time as a measure of self-discipline, the authors conclude that the "noncognitive" capacity for self-control was significant in accounting for success in online learning.

Although MOOCs are an interesting experiment with a role to play in the future of higher education, they are in fact a surprisingly small part of the online higher education scene, given the attention they have received. We believe that online education, at least online education that begins to take full advantage of the interactivity offered by the web, is still in its infancy (Bowen 2013). Thus, we begin by sketching out the several faces of online learning—asynchronous, partially asynchronous, the flipped classroom, and others—as well as how the use of online education differs across the spectrum of higher education. We then turn to some of the main issues posed by the growth of online education, which are how it will affect cost and convenience, how it will affect student learning, and how it will affect the role of faculty and administrators. We argue that the process by which online education spreads through higher education is likely to be slower than many commenters expect. Furthermore, while we hope that online education will bring substantial benefits, there is also the possibility that it could lead to less-attractive outcomes. This could happen if legislators use the existence of online education as an excuse for sharp cuts in higher education budgets that lead to lower-quality education for many students, at the same time that richer, more-selective schools are using online education as one more weapon in the arms race dynamic that is driving costs higher.

The Current Status of Online Learning

In evaluating statistics about online education, it's important to recognize that "college" has become a capacious term in the United States, encompassing essentially any form of education or training high school graduates receive, from studying late Victorian poetry to learning to drive a truck. Moreover, what is described as "online education" involves many different uses of technology to facilitate learning.

During the last decade, estimates of the prevalence of online education have often drawn from the annual studies of the Babson Survey Research Group, which

Table 1
Student Participation in Online Courses by Type and Selectivity of Institution, 2013

	All courses online	*Some courses online*	*No courses online*
Type of institution			
Total	11%	15%	75%
Public, 4-years	6%	17%	77%
Private, not-for-profit, 4-years	10%	8%	82%
Public, 2-years	10%	18%	72%
Private for-profit	34%	6%	60%
Carnegie classification			
Community college	10%	18%	72%
4-year, public, non-research institutions	8%	17%	75%
Public research universities	4%	17%	80%
Private not-for-profit research universities	2%	5%	93%
Liberal arts colleges	0%	2%	98%
For-profit institutions	34%	6%	60%

Source: US Department of Education, NCES, Integrated Postsecondary Education Data System (IPEDS)
Notes: The column "All courses online" shows the percentage of undergraduate students exclusively enrolled in distance education courses as defined in IPEDS. The column "Some courses online" shows the percentages of undergraduate students with some but not all of their enrollment in distance education courses. And the column "No courses online" shows the share of undergraduate students who are not enrolled in any distance education course. "Community college" is defined as all public institutions in Carnegie's Associates category, and "4-year, public, non-research institutions" are defined as 4-year or above public institutions not classified as "Doctorate" nor as "Associate" by Carnegie. "Public research universities" are all public institutions in Carnegie's Doctorate classification, and "Private not-for-profit research universities" are all those in Carnegie's Doctorate classification that are private not-for-profit. "Liberal arts colleges" correspond to all those private not-for-profit institutions in Carnegie's "Baccalaureate Colleges—Arts & Sciences" classification. The sample is restricted to Title IV eligible institutions; branches are not included.

regularly surveys chief academic officers at a large number of schools: for example, the 2014 data includes responses from 2,800 higher education institutions. By these estimates, about one-third of all students enrolled in college in a given year take at least one course in which 80 percent or more of the material is provided online (Allen and Seaman 2015). The US Department of Education recently began to conduct its own survey of online education as part of its Integrated Post-Secondary Education Data System (IPEDS), with full coverage of the roughly 4,900 US institutions of higher education. As shown in Table 1, IPEDS data indicates that as of 2013, about 26 percent of all students took at least one course that was entirely online, and about 11 percent received all of their education online. Although the IPEDS data is drawn from a larger sample, the Babson data remains useful because it asks a broader set of questions about attitudes and trends regarding aspects of online education.

The federal IPEDS data provides information on online course-taking in different parts of the higher education system. At liberal arts colleges and private not-for-profit research universities, the use of online education is minimal. There is somewhat

greater use at public research universities. At less-prestigious and less-selective institutions, including the "non-research" public universities and community colleges, there is greater use of online instruction. And the greatest use, by a considerable margin, is in for-profit institutions. Deming, Golden, Katz, and Yuchtman (2015) show that use of online instruction is particularly prevalent in for-profit colleges that operate as chains, in contrast to stand-alone or mom-and-pop institutions, suggesting that economies of scale are important to the economics of online learning. In general, use of online learning appears to be inversely proportional to prestige and selectivity, a point to which we will return below.

Online courses employ a variety of formats. Most existing online courses for undergraduates are offered "asynchronously," meaning that students individually determine when they interact with the online material. Even with fully online asynchronous courses, the amount of interaction between students and the course's computer technology varies substantially. At one end of the spectrum, there is no interactivity: Austin Community College, for example, offers a number of courses which entirely consist of recorded lectures broadcast online and through cable television (Austin Community College District 2015; Lack 2013). At the other end of the spectrum, in certain MOOCs in advanced computer programming, students submit computer applications they have designed and receive immediate machine-generated debugging feedback that pushes the application to extremes as a way of pointing out potential weaknesses. In such cases, the feedback is intense and immediate.

There is growing interest in "blended" or "hybrid" courses that combine face-to-face instruction with digitized online instruction. In some respects, almost every course taught today is a hybrid and incorporates at least some online component. For example, instructors routinely distribute readings and assignments electronically. Many encourage their students to view videos and other supplementary materials online. Students often submit papers and problem sets electronically and receive feedback on their assignments in the same format. Email has displaced traditional office hours at many institutions. While students may not be formally enrolled in "online courses," the influence of digital content in the academy is ubiquitous. One of the most popular methods of exploiting digital learning is the idea of "flipping the classroom." In a flipped classroom, lectures are recorded and viewed by students asynchronously. The class time that is freed up from the lecture is then used for more intense, interactive exercises and discussion. In theory, the flipped classroom allows more class time to be devoted to more-active learning. We describe the cost implications of flipped classrooms later in this essay.

Although it may seem natural to assume that online course delivery (especially in asynchronous mode) is best-suited to subjects where there are objectively right and wrong answers, in fact the range of online courses and even fully online degrees available is quite wide. Penn State University, for example, offers fully online introductory courses in subjects that include anthropology, comparative literature, economics, history, philosophy, psychology, and sociology (Penn State World Campus n.d.; Lack 2013).

A significant growth area for online learning is in professional education at the graduate level. It may seem counterintuitive that online instruction could thrive in areas like teacher preparation or nursing, where live interaction with students or patients appears to be central. Yet some of the largest programs in the country rely heavily on online instruction and are frequently offered with no residency requirements.[1] Two factors seem vital to the effectiveness of such programs. First, the programs typically require either arrangements with local schools and hospitals to cooperate in providing clinical experience of documented quality for participants in the program, or else brief visits to campus are required for that purpose. Second, synchronous online discussion sessions frequently play an important role in instruction in these programs.

We lack rich descriptive data about the extent of the use of online instruction of these varying kinds in different subject matters and different segments of the higher education system. This lack of data is partly explained by the rapid speed of change, but it also reflects the fact that the study of instructional methods in higher education has long been neglected among both scholars and administrators.

We noted earlier that more-selective and prestigious colleges and universities make less use of fully online courses than other institutions do. What explains this pattern of adoption? A natural explanation is that more-selective institutions compete on the basis of personal service, prestige, and brand while less-selective places are offering something closer to a commodity product (Brewer, Gates, and Goldman 2001; Zemsky 2009). Consumers cannot judge the quality of an education by inspection—it is a classic example of an "experience" good (Nelson 1970)—so symbolic indicators like the degree of selectivity, the quality of the facilities, and the difficulty of admission are emphasized. For institutions that are more selective and wish to present themselves that way, pedagogical innovation may be risky, especially if it appears to trade off the opportunity for intimate personal interaction with faculty against a technology that may appear to "cheapen" the product. Ironically, the highest-end institutions may be reluctant to adopt online learning unless they can demonstrate that it is actually *more* expensive than existing methods—a point to which we will return. These considerations weigh less heavily at less-selective institutions, whose main selling point is their ability to deliver a credential that has a demonstrable value in the marketplace. It is at the less-selective institutions that innovations in online education that can lower cost, expand availability, and/or increase convenience of access have a good chance of succeeding, at least in the near term. (If it is the case that more-traditional training is more effective than online training—the evidence to date is inconclusive—in the long run, the online strategy could come into question: employers would eventually notice a productivity

[1] See, for example, "Master of Arts in Teaching," USC Rossier Online http://rossieronline.usc.edu/academics/master-of-arts-in-teaching-program/ (accessed August 25, 2015) and "College of Nursing," Medical University of South Carolina, http://academicdepartments.musc.edu/nursing/academics/masters/msn_faq.htm (accessed August 25, 2015).

difference between traditionally trained and online-trained employees. However, this would be a slow-working corrective mechanism at best.)

Cost and Convenience

What lies behind the rapid growth in online education over the last decade, from about 10 percent of students taking at least one online course in 2002 to 33 percent in 2012 (as measured in the Allen and Seaman 2014 data)? The two most obvious explanations involve cost and convenience. The Internet, at least in its asynchronous use, affords delivery of instructional material that scales.

It is worth noting that the Internet is not the first, nor the second, instructional technology that offered the promise of vast scale at low cost. Berland (1992), citing a popular commentator named Waldeman Kaempffert writing in 1924, reported that "there were visions of radio producing 'a super radio orchestra' and 'a super radio university' wherein 'every home has the potentiality of becoming an extension of Carnegie Hall or Harvard University.'" Craig (2000) reports that "the enthusiasm for radio education during the early days of broadcasting was palpable. Many universities set up broadcast stations as part of their extension programs and in order to provide their engineering and journalism students with experience in radio. By 1925 there were 128 educational stations across the country, mostly run by tertiary institutions" (p. 2831). The enthusiasm didn't last—by 1931 the number of educational stations was down to 49, most low-powered (p. 2839). This was in part the result of cumbersome regulation, perhaps induced by commercial interests; but the student self-control problem, similar to that observed by Banerjee and Duflo (2014), likely played a role as well. As NBC representative Janice Waller observed, "Even those listeners who clamored for educational programs, Waller found, secretly preferred to listen to comedians such as Jack Benny. These "intellectually dishonest" people "want to appear very highbrow before for their friends . . . but down inside, and within the confines of their own homes, they are, frankly, bored if forced to listen to the majority of educational programs" (as quoted in Craig 2000, pp. 2865–66).

The excitement in the late 1950s about educational television outshone even the earlier enthusiasm for radio. An article by Schwarzwalder (1959, pp. 181–182) has an eerily familiar ring: "Educational Television can extend teaching to thousands, hundreds of thousands and, potentially, even millions. . . . As Professor Siepman wrote some weeks ago in *The New York Times,* 'with impressive regularity the results come in. Those taught by television seem to do at least as well as those taught in the conventional way.' . . . The implications of these facts to a beleaguered democracy desperately in need of more education for more of its people are immense. We shall ignore these implications at our national peril." Schwartzman goes on to claim that any subject, including physics, manual skills, and the arts can be taught by television, and even cites experiments that show "that the discussion technique can be adapted to television."

Clearly neither radio nor television has fulfilled its early promise (hype?) as a tool for college instruction. Yet even in the Internet age, similar approaches survive.

Thus, a minimal and inexpensive form of online learning is the rebroadcast of taped live lectures. At the University of Florida, for example, the "Principles of Microeconomics" course uses this approach: otherwise, the course enrollment of 1,500 students would substantially exceed the size of the largest lecture hall on campus (Lack 2013; Gabriel 2010). Such one-way transmission of information uses the Internet as a means of delivering video, but with the advantage that students can stop, rewind, replay, and fast forward (but not ask questions or receive feedback online). Some MOOCs take (more or less) this form, providing a series of mini-lectures, sometimes interrupted by brief quizzes to provide an incentive for students to keep looking at the screen.

Asynchronous online courses are attractive to institutions because of their low marginal cost and their potential to expand markets substantially by offering credit-bearing courses to students in distant locations. Of course, "distance learning" itself is anything but new. Queen Victoria in 1858 authorized the University of London to offer degrees through its International Programmes to students throughout the world who could not reside at universities. For example, Nelson Mandela studied law under the university's International Programmes while in prison.[2] Countless students have benefited from these and other correspondence programs, with degrees offered through proctored examinations.[3] With the arrival of online education, such courses have become core products at a number of for-profit colleges and universities including, for example, the University of Phoenix and Capella University. There has also been considerable entry to this market from some public and private nonprofit universities. Arizona State University has recently used an advertising campaign to help expand its role in this market, with more than 70 degree programs offered entirely online. Southern New Hampshire University has risen from a relatively obscure small, private nonprofit institution to become a major player nationally in fully online degree programs.

Asynchronous online courses are an appealing substitute for correspondence courses delivered by physical mail. Moreover, the ability to market courses online may change the grounds of competition for place-based public universities substantially, with potentially far-reaching effects on quality and price. Such courses may also offer opportunity to improve time-to-degree in large institutions. A common problem in large public universities is that students are unable to enroll in gateway subjects needed to complete their degree due to limited enrollment. Online courses may be a means to improve speed or rates of completion at large institutions, although we are not aware of any hard evidence on this point.

[2] See University of London, International Programmes, "Timeline." http://www.londoninternational.ac.uk/our-global-reputation/our-history/timeline/ (accessed August 25, 2015).

[3] The Open University, established in the United Kingdom in 1966, today has a student enrollment of over 200,000. Over the years, it has used a variety of distance learning technologies to reach its students including radio, TV, and online learning.

However, the key difference in potential effectiveness between Internet technology and educational TV or radio is not just a more-convenient distribution channel, but the former's capacity for two-way interaction between student and instructor (or virtual instructor), and interactions among students. (Internet technology, as noted earlier, also has the advantage of allowing students to start, stop, and rewind video content, something that traditional educational radio and TV did not.) Instructional systems that provide automated feedback to students based on their progress can enable self-paced designs that permit faster progress for more adept or industrious students.[4] This opens the possibility of so-called "adaptive learning" systems, in which not only the pace but also the content and pedagogy of lessons might adjust automatically in response to evidence about a student's comprehension revealed by her interaction with the software. In principle, sufficiently advanced versions of such technologies could reproduce at least some of the kinds of sensitive give-and-take that skilled teachers and responsive students produce together.

Computer-adaptive techniques are now in wide use for examinations, including the Graduate Record Examinations supplied by the Educational Testing Service and the Common Core state-level examinations at the K-12 level developed by the Smarter-Balanced Consortium. But designing computer-adaptive instruction appears to be a much harder problem than designing examinations. Examinations simply involve sampling from within a given educational domain, a task that is easy to improve on with relatively simple rules about what multiple choice or short answer question to ask next. Instruction involves working with students to help them gain competence over a particular domain of knowledge or skills, which involves the very difficult challenge of diagnosing the reasons for their mistakes. Intensive work on the instructional challenge has been undertaken at Carnegie Mellon University and other places, but sophisticated computer-adaptive instruction is not currently in widespread use in online courses.

Richly interactive online instruction is obviously much more expensive than Internet-delivered television. The development costs for Carnegie Mellon's sophisticated but far from fully computer-adaptive courses in statistics and other fields have been estimated at about $1 million each (Parry 2009). Although future technical developments will reduce the costs of providing a course of a fixed level of quality over time, those future technical developments will also encourage the provision of additional features. Universities can invest in improving the production values of such television programs at the margin in ways that range from multiple camera angles to the incorporation of sophisticated graphics

[4] Self-paced instruction of course preceded the Internet. As one example, in the late 1950s, a company called Science Research Associates introduced a color-coded system of reading cards that was widely used as a supplement in elementary schools. This popular innovation helped create the fortune that SRA's founder Lyle Spencer used to endow the Spencer Foundation, where one of the authors of this article now works. Recently the original SRA reader system has been digitized and is still sold (SRA Reading Laboratory 2015; *Wikipedia* entry on "Science Research Associates," last modified February 3, 2015, https://en.wikipedia.org/wiki/Science_Research_Associates).

and live location video. Many interactive courses could also conceivably benefit from regular updating based on recent events or scholarship, although we note that currently, it is quite cumbersome to update most online courses. While an instructor in a traditionally taught course can easily drop new material into the syllabus or even an individual class, modifying an online course usually requires reshooting video, editing existing content, modifying software, and so on. These changes cannot be done quickly or in real time. They often require coordination of multiple parties including the instructor, instructional designer, camera operators, editors, web designers, and software engineers. Our point is that while online courses offer the potential for constant modification and updates, realizing this potential may in fact be expensive, leading to less-frequent updates than for traditionally taught subjects.

Highly sophisticated and therefore expensive online courses are likely to be financially feasible only when offered at a scale far beyond that of the individual university. Those who foresee the widespread adoption of adaptive learning technology often underestimate the cost of producing it. Stanford President John Hennessey, in a recent lecture to the American Council of Education, estimated that the cost of producing a first-rate highly interactive digital course to be in the millions of dollars (Jaschik 2015). Few individual institutions have the resources to make such investments. Furthermore, while demand may be substantial enough to support such investments for basic introductory courses in fields that easily lend themselves to such instruction, it is unlikely that anyone will invest in the creation of such courses for upper-level courses unless they can be adopted at scale.

It's also important to remember that any effects of online education on costs will occur as part of the overall system of US higher education. Selective institutions of higher education have long known how to make education cheaper. It involves larger classes, less student–faculty contact, less-intensive hands-on learning, fewer curricular options, and less in the way of student services and amenities. Some of the features that make elite colleges expensive may well be essential to the learning experience, but others pretty transparently are not and are still well-loved. In our time as presidents of Macalester and Tufts (and previous time as senior administrators at Williams and MIT), not once did we have a student or their parents ask us to do any of the above and lower the price. If anything, people always wanted more.

To put it bluntly, selective institutions of higher education actually compete to be among the least cost-effective providers of educational services. As anyone knows who has taken a prospective student on a college tour, elite colleges routinely advertise small classes, frequent student-faculty contact, and lots of opportunities for hands-on learning. Similarly, colleges compete by offering a vast array of curricular options: multiple majors and minors, again with faculty support. Curricular entropy adds to cost by committing institutions to offer a diverse array of courses over time, even when demand for certain courses or majors dwindles. This approach clearly appeals to students choosing these schools, to the parents who are typically footing the bill for a substantial share of the cost, and to faculty choosing where to work. Many of the most selective institutions are also among the best endowed. Wealthy

colleges can in fact gain competitive advantage by raising expectations for how resource-intensive a "good" college should be.

Indeed, there is a real chance that at least in selective higher education, technology will actually be used to raise rather than lower cost. There are obvious ways to use online materials to complement rather than to substitute for in-person instruction. Flipping the classroom, as we will explain further, is one. Instructors can also import highly produced video material—either purchased or homemade—to complement their classes, and there could easily emerge a market in modular lessons aimed at allowing students to extend material farther or to get a second take on a difficult set of concepts. If individual faculty members are authorized to make these choices, and universities agree to subsidize expensive choices, costs seem likely to rise. With no reduction in faculty input, but an enhancement in other resources, the worry of parents that technology is undermining their children's experience is quelled even as faculty are assured they are not losing either their autonomy or their jobs.

While the absolute number of highest-prestige institutions of education is of course small, they cast a long shadow as market leaders and as institutions of origin for many faculty at less-prestigious places. If online technology stimulates higher costs at the most selective institutions, it will set expectations for how higher education will function elsewhere.

While flipping the classroom and using time previously allocated to lecture for more-intensive student-faculty interaction may improve instruction (a topic discussed in the next section), it offers little promise of actually reducing cost. Lectures are relatively cheap. Smaller courses that focus on more discussion-oriented teaching require lots of space and lots of instructors and much more intense student–instructor interaction. Moreover, in the typical flipped classroom, faculty are substituted for graduate instructors, further increasing costs. Finally, the early returns from experiments at Harvard suggest that students at that institution are not wild about the flipped classroom. They find that they spend considerably more time viewing the recorded lecture (and responding to questions about their comprehension) than simply sitting passively through a live lecture. This may be due to the fact that students are being asked to take more responsibility for their learning in a format that is still unfamiliar, or it may be attributable to poor course design.[5]

Many observers envision that the savings in large lecture courses will come from replacing the live lecturer with an online version of that person. But most of the cost of large lecture courses comes from staffing discussion sections with graduate students and obtaining classrooms for the sections and, in science and engineering, substantial lab space as well. Real savings would come from finding a way to replace the discussion sections with some version of interactive sessions run by technology. Sophisticated courses like those developed by Carnegie Mellon

[5] Faculty are also still learning how to teach in this new format. Students report redundancy between material covered online, and that covered in discussion section (Derek Bok Center for Teaching and Learning 2014).

University in the Open Learning Initiative have the ambition to eliminate or reduce the need for discussion sections. Because section teaching relies so heavily on the presence of graduate students, undergraduate education at research-oriented institutions effectively subsidizes graduate education. Indeed, we believe this subsidy may cause many institutions to inflate the size of their graduate programs, resulting in the overproduction of PhDs in some fields. Shrink the number of teaching assistants, and many departments will struggle to support as many graduate students. Of course, we can easily imagine the complaints from our colleagues if online technology becomes a mechanism to reduce graduate student enrollment.

Changes in Student Outcomes and Pedagogy

What do we know about the educational effectiveness of online instruction in all its varieties compared to traditional methods? Not much. Thorough surveys of this literature find very few examples of well-designed experiments and quasi-experiments, and these generally do not find statistically significant differences in student outcomes between online or hybrid courses and traditional courses.[6] Similarly null findings emerge from a small number of regression-based studies with reasonably good statistical controls on comparative student quality and other variables (Means, Toyama, Murphy, Bakia, and Jones 2009; Bell and Federman 2013).

The fact that existing studies have not yielded decisive "victories" for traditional forms of education is surely a source of disquiet, if not alarm, for many faculty defenders of traditional practice. Indeed, based on the fact that a number of these studies have not so far generated clear winners and losers, it is tempting to conclude that online, hybrid, and traditional courses yield essentially the same outcomes in most circumstances. This conclusion would be overreaching. More plausibly, the evidence suggests that pedagogy is multidimensional in such a way that it cannot be reduced to "online" and "offline." As we have seen, instruction with a significant online component takes place in a wide variety of settings and subject matters, and the variation in the ways that "traditional" instruction is delivered is also great. There is also a wide range of learning outcomes that may be of interest. Tests that assess recall of facts or computational skill may yield quite different results from ones that assess conceptual grasp or problem-solving ability.

[6] In one of the strongest studies, Bowen, Chingos, Lack, and Nygren (2014) contrast traditional and hybrid versions of a statistics class in a randomized controlled trial and find no significant differences in learning outcomes, with small standard errors and reason to believe there would be cost savings from widespread use of the hybrid method. Several experimental and quasi-experimental studies have found small negative effects of hybrid versus traditional instruction in various contexts (for example, see Joyce, Crockett, Jaeger, Altindag, and O'Connell 2014, Kwak, Menezes, and Sherwood 2015, and Olitsky and Cosgrove 2014, as reported in Wu 2015.) These findings say little about fully online instruction nor about likely outcomes in courses with different subject matters. Figlio, Rush, and Yin (2010) undertook a randomized controlled trial comparing traditional and fully online microeconomics classes and found modest evidence that students in the "live" course learned more.

Ultimately, there are limits to what can be learned from piling up longer lists of A to B comparisons between online and traditional versions of the same course particularly when the definitions of "online" and "traditional" vary from one example to the next. (This is not to say that we cannot learn from such comparisons, only that we have to be careful about generalizations.) What we really lack is an adequate understanding of what makes for effective instruction in particular settings, with students who have particular characteristics, with effectiveness judged by the achievement of well-defined and valued outcomes. The Pittsburgh Science of Learning Center, a joint effort of Carnegie Mellon University and the University of Pittsburgh, is an important locale for such work.

Obviously, experimenting with various approaches to online learning will and should continue in parallel with more theoretical research; equally obviously, universities will continue to act even in the absence of strong evidence. After all, universities have been quite willing to offer traditional instruction in various formats for centuries with remarkably little attention to comparative educational effectiveness!

Institutions of higher education have had centuries to perfect traditional chalk-and-talk pedagogy. It seems unlikely that great gains in the speed or effectiveness of education remain to be had with this approach. Whatever one believes about the effectiveness of online education today, it is likely to get better—and probably dramatically better—over time.

Shifts in the Role of College and University Faculty

Traditionally, college and university teachers are accorded nearly complete autonomy in how they conduct their classes: indeed, we have sometimes heard assertions that academic freedom should protect faculty from any demand for information about how they teach. However, the growth of online education seems likely to shift this historical pattern in ways that could give greater power to administrators.

One perhaps ironic byproduct of the interest in online learning is that administrators and scholars are beginning to ask more questions about actual instructional practices, including "traditional" approaches, and how we can assess their quality and effectiveness. Also, online education allows administrators to "peer over the shoulder" of instructors to monitor not just what is being taught, but a range of other metrics: for example, how long it takes an instructor to respond to student questions, the turn-around time for assignments, and instant breakdowns of data on how different groups of students perform in a given class.

The use of technology to import classes from other institutions—highly desirable in theory as a way to achieve economies of scale in producing high-quality online instruction—raises thorny issues of its own. While college and university faculty are not reluctant to employ a text authored by someone else, they are reluctant to be perceived as little more than facilitators of someone else's course (Bacow, Bowen, Guthrie, Lack, and Long 2012). Thus, faculty may resist the wholesale importing of lectures by well-known scholars from other institutions. For example, in 2013,

the philosophy department at San Jose State University rebelled against efforts to import Harvard philosopher Michael Sandel's well-regarded course on "Justice" (Hartnett 2013). By contrast, in 2014 Yale agreed to import Harvard's most popular course: "Introduction to Computer Science" (Bernhard 2014). Yale students will watch the Harvard lectures online and will be taught in sections by Yale faculty and graduate students, whose efforts will be coordinated with colleagues from Harvard. However, this second example is likely to be atypical. We suspect that computer scientists are outliers in their openness to digital learning and are likely to remain so for a good while.

Unlike written materials (including textbooks) that can be mashed up, reordered, and supplemented, most online courses are not currently produced in formats that lend themselves to customization. By contrast, those who are attracted to teaching MOOCs are often seeking a larger audience for their particular approach to the material. As a result, they often are not interested in reducing their integrated approach to the material into a series of short modules that can be reordered or customized by others. To do so would lose the integrity of the whole that they seek to convey. Until digital content is designed in a more flexible way, faculty are likely to be slow to adopt it, because they cannot incorporate it easily into their personal conception of how a particular body of material should be taught.

Also, at least some faculty fear that technology may weaken their relationships with their students (Bacow, Bowen, Guthrie, Lack, and Long 2012). Many value these relationships, and fear that they would isolate themselves from students by embedding their course in a digital environment—even if we reach the point where highly sophisticated and responsive robots provide really excellent instruction. Many students also enjoy face-to-face interaction with their professors, at least at places where such interaction is common and expected.

Finally, we note that widespread adoption of online learning will require the resolution of a number of potentially divisive intellectual property issues that will often pit faculty against administration. Standard practice on most campuses is that faculty own the copyright for their course materials and lectures. For example, even though a textbook may have been produced using substantial institutional resources, the copyright is owned by its author. Institutions are unlikely to make the substantial investments needed to create high-quality interactive online courses if they are unable to recover their costs. Similarly, faculty are unlikely to invest the time necessary to produce this content—which many report to be substantially in excess of what is required to teach a conventional course—if they are not going to be compensated for their efforts. Clearly, a revenue sharing model is in order, but we know of no conventions yet established governing the relative rights of faculty and sponsoring institution to the revenue generated from online learning.

Could Coursera, Udacity, edX, and others fill this gap? At least so far, their offerings are not especially close to an adaptive learning technology with the high production values that would impress a typical college student in the second decade of the 21st century. The original business model for MOOCs (whether offered by for-profit or nonprofit ventures) was predicated on the possibility of generating

profitable revenue streams from courses offered free online outside the framework of existing colleges and universities, a strategy that has not panned out so far. Alternative options would be for MOOCs to market their wares to existing universities or for universities themselves to develop cross-institutional arrangements that would permit sharing development costs. Griffiths, Chingos, Mulhern, and Spies (2014) report findings from a set of studies imbedding elements of MOOCs into the offerings of a university system. Again, these alternatives require that colleges and universities solve a set of quite difficult economic and governance problems.

Textbook publishers are also entering the market for online content. Many modern textbooks already contain some digital content, whether it is a CD-ROM with supplementary materials or access to a website that curates the same. Furthermore, textbook publishers have access to production capacity and distribution channels that many academic institutions lack. Time will tell whether textbook publishers succeed in providing online content on their own without the brand identity provided through partnership with a sponsoring academic institution.[7]

Similarly, because digital learning technologies make it possible for faculty to "teach" elsewhere without being physically present, we can foresee challenges to conventional conflict-of-interest and conflict-of-commitment policies. For example, can a faculty member employed at one institution produce an online version of his or her course and sell it for adoption at a competitor school? At present, institutions are happy to have their faculty's textbooks adopted elsewhere. How will they feel if textbooks are ultimately replaced by digital course packs with embedded exercises and lectures from their own faculty?

We also note the potential for conflict over control of future versions of online courses. While an author may control the production of future editions of a textbook, should a sponsoring institution be able to modify an online course without the permission of the faculty member who appears on screen? What if the faculty member is no longer employed by the institution? No longer alive? Similarly, if the faculty member decamps to another institution, can that faculty member take the course along to the new institution? Can a faculty member who is moving between institutions reproduce a course from the first institution, at least in some form, and then have that course compete with the former institution? Again, these issues and others will need to be resolved before institutions and their faculty are willing to make the necessary investments to produce the highest-quality interactive and updated online content that could truly disrupt conventional forms of instruction. These issues raise thorny legal and governance challenges where progress will be hard won and, we suspect, not quick (Bowen and Tobin 2015).

[7] For an example of a sophisticated attempt to enter this market, see Pearson's efforts to market MyLabs, a series of interactive online modules for teaching a full range of subjects. See "My Lab™ & Mastering™," http://www.pearsonmylabandmastering.com/northamerica/errors/index.html, accessed August 25, 2015.

Summing Up: Dystopian and Optimistic Possibilities

Online education offers the tantalizing possibility of comparable learning outcomes at potentially lower cost. Some commentators like Clayton Christiansen predict that online education will be a dramatically disruptive technology (for example, Christiansen and Horn 2011). For example, Christiansen has written that 15 years from now, a new class of institutions, or extra-institutional provision of cheap high-quality education, will drive half the universities in the country out of business.

We are skeptical of such extreme predictions. We have suggested that a range of issues must be addressed before online education is likely to threaten the traditional structure of higher education. It will take some time before the technical problems of achieving high-quality interactive instruction at scale are solved, partly because it is not at all clear who will make the big investments necessary to do so. A large range of institutional and practical obstacles will stand in the way of rapid substitution of cost-saving technology-mediated education for traditional modes of instruction at selective colleges and universities

Like all professors who seek to study higher education, we are handicapped by being deeply experienced in the kinds of places where we have studied and worked, and often deeply ignorant of the vast heterogeneity of the other parts of the so-called "system" of higher education. Nonetheless, we offer some thoughts about potential futures for online classes in different kinds of higher education institutions.

Broad-access unselective institutions are already among the largest users of online instruction. These institutions are responsible for the education of many students—at least half of all those enrolled in postsecondary education—and they disproportionately educate lower-income students and students of color. Enabling technological advances to support improvement in the educational success of these institutions at manageable cost is an important goal, arguably the most important goal for using technology to improve American higher education. (Of course, the implications of these technologies for global learning would be potentially gigantic.) There is especially high potential for online education to cater to the large number of nontraditional students, which includes adult learners and those who have a very high opportunity cost of attending college whether at the undergraduate or graduate level. For this group of students, asynchronous online learning can be a godsend. Opportunities surely exist for technology to penetrate this market further, and quality is likely to improve as faculty and others figure out how to take better advantage of new educational technology. As the technology improves and as more institutions adopt it, more of these students are likely to receive all or at least some of their education online.

Yet this great opportunity is accompanied by considerable risk. It is all too easy to envision legislators who see a chance to cut state-level or national-level spending that supports higher education by imposing cheap and ineffective online instruction on institutions whose students lack the voice and political influence to demand quality. It's equally easy to imagine for-profit institutions proffering online courses in a way that takes advantage of populations with little experience with college in a marketplace where reliable information is scarce.

What about the large number of institutions with a medium level of selectivity? These institutions already deliver the first two years of undergraduate education relatively cheaply in very large lecture classes, often with support of brigades of teaching assistants. As we have previously noted, technology has the capacity to reduce costs here not so much by replacing live with online lectures as by reducing the demand for section teaching, with consequent reduction in the demand for graduate student teaching assistants and graduate enrollment (which would be a disruptive but perhaps not a bad thing). It remains to be seen whether online education in the form of interactive pedagogy (as opposed to the use of video clips and machine-based testing) will penetrate the upper-division courses in these schools, because of the large and differentiated number of such courses and their relatively small enrollments. Also, not every subject is equally amenable to online instruction, so entire disciplines may be relatively untouched for the foreseeable future by the development of more-advanced educational technology.

For the most selective institutions of higher education—less than 5 percent of enrollments but a vastly larger percentage of both popular and academic attention—some of these investments in technology-enhanced learning experience may provide benefits that outweigh their costs. Yet for those, like us, who think the elite colleges already spend more than can be justified on educational grounds, the idea of technology as a cost enhancer is unwelcome. One route toward heading off this potential trend is to recognize the collective action problem that underlies it. In the topsy-turvy world of prestige competition, raising spending relative to the existing norm can be a winning competitive strategy. But when all elite institutions raise spending together, the arms race may well result in welfare loss and political damage compared to a world where colleges jointly exercise restraint. Any selective college or university that makes a bold move to economize by using online instruction to substitute for faculty in some measure, risks harming its reputation. However, if a group of institutions move in a coordinated and carefully designed way to explore such possibilities, both cooperating with each other to share development costs and emphasizing that they will guard against reductions in quality, such a group might be seen as innovators rather than cheapskates. Coordinated activity like this requires some level of trust among the institutions involved and raises a risk of violating antitrust policy. After all, back in 1992, MIT and a number of other colleges were sued by the US Department of Justice for alleged price fixing because of efforts to coordinate the determination of need in granting of financial aid awards. (Other institutions settled with the Justice Department and signed consent decrees, while MIT litigated the issue and ultimately prevailed on appeal, as reported in Bangs 1994.) But as William Bowen (1992) argued persuasively in his legal brief and testimony in that case, coordination among nonprofit institutions can at times be justified on public policy grounds.[8]

[8] In his testimony, Bowen (1992) noted that before he closed a Slavic languages program at Princeton, he called colleagues at Columbia and Yale to make sure they were enthusiastic about their programs, thereby ensuring that such an educational program would not disappear from the land. Bowen argued that this type of cooperation should be allowed among nonprofits.

Finally, for those who believe that brilliantly produced online courses taught by a handful of the very best faculty in the world will eliminate the demand for live versions of the same courses, we note the continuing vibrant and growing market for live concerts, theatrical productions, and sporting events. Cheap digital downloads of music have not eliminated the demand for live concerts, nor has the availability of live sports on TV (often with better viewing angles, instant replay, and simplified access to bathroom facilities) eliminated the demand for tickets to live sporting events. Even more puzzling to technology fans, a rising proportion of live-theater shows on Broadway display a kind of technological regression by adopting the plots of expensively produced movies seen by millions to recycle them with extremely labor-intensive live reproductions. If anything, the increased availability of digital programming may have even stimulated demand for the live experience. For example, Michael Sandel's popular Harvard course, "Justice," is now available in multiple formats, including as a PBS series and in an online version. These formats have not reduced the demand for Sandel's live lectures. To the contrary. Sandel has lectured to tens of thousands of fans in soccer stadiums in Asia largely because he is known there through his earlier digital presence (Cheng 2014).

While online education is here to stay, so are traditional bricks and mortar colleges and universities. Excepting only the Roman Catholic Church, universities are the longest-lived institutions in Western society. Having survived such disruptive innovations as the printing press, radio, and television, we suspect that universities will survive this most recent disruption as well. They will adapt and change in response to this new technology as they have adapted and changed in the past to other pressures.

However, it is possible to envision both dystopian and optimistic possibilities. If technology is used in broad-access institutions to drive cost down without regard to quality, and at the same time is used in elite higher education to further increase the cost and restrict the availability of the "best" education, we will wind up with a society both more unequal and less-productive than it could be. If the new digital technology is used in broad-access institutions to extend education to a wider population and in top-level institutions to reduce the cost and expand the availability of exceptionally good education to more of those who can benefit from it, we can view the future with more optimism. The eventual outcome will be determined not by the irresistible force of technology alone, but also by the exercise of judgment by citizens and by educational, business, and political leaders.

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