**Can Online Education Technology
Improve Excellence and Access at Berkeley?**

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March 2, 2012

Online higher education has moved from the margin to the mainstream. The Sloan Foundation estimates that more 30% of all enrolled college students, some six million people, participated in on-line learning at accredited U.S. colleges and universities in 2011 and that the U.S. market for online higher education grew 12-14 percent annually between 2004-2009.[1] The European Commission estimates worldwide revenues from online education at approximately $50 billion.[2] Tellingly, Sloan's annual surveys also indicate that faculty support for online education remains low and has not increased in eight years.

Many faculty members still associate online higher education with second-rate courses delivered by third-rate institutions, despite growing efforts by education startups to transform education with technologies that make learning more personalized, social, accessible, and measurable. Some observers, like Clayton Christenson, predict that many of these online education technologies represent for higher education the kind of "disruptive" innovation that has undermined the position of incumbents in other industries.

Given the high level of ambient noise surrounding debates involving investors, educators, entrepreneurs, established vendors, students, and policymakers, it is not surprising that campus discussions about online education often zoom past each other. The ecosystem of specialized online education providers and initiatives is complex, decentralized, international, and constantly changing.[3]

The problem is aggravated by our lack of a shared vocabulary or frame of reference. Online education is protean; there are as many different models for online teaching as for traditional teaching, even among educators using similar technologies to organize and deliver content. We know little about how students learn online, what tools work best for different types of content, and when the technology is not a good substitute for physical presence. The lack of high quality scholarly research on online teaching and learning means that discussions are often dominated by the hyperbole of private sector vendors and academic entrepreneurs, on one hand, and by the anxieties and ambivalence of many faculty about the new technologies, on the other.

On the Berkeley campus this confusion is heightened further by the belief, often not fully articulated, that online tools enable us to meet our three strategic goals of excellence, access, and revenue. The introduction of online education, by itself, achieves none of these goals. With focused campus leadership and investment however, it can contribute significantly to all three.

1. Excellence

Early evidence suggests that education provided online produces equivalent, if not better, learning outcomes than education provided in a classroom and that online tools can allow students to engage more actively.[4] Of course educational excellence requires more than technology, but increasingly technology opens up new opportunities for improving teaching and learning outcomes. Internet-based tools enable regular, precise, and personalized feedback to students and instructors that is difficult to achieve off-line. Software with built-in "continuous formative assessment" (quizzes) allows instructors to gauge individual student progress and customize assignments. Adaptive online learning systems personalize course content based on individual student competencies and/or learning styles. Since the

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[1] Sloan Foundation "Going the Distance: Online Education in the United States, 2011" available at http://www.onlinelearningsurvey.com/reports/goingthedistance.pdf

[2] European Commission, Communication from the Commission: E-Learning. 2000.

[3] Mapping this ecosystem is well beyond the scope of this paper, but a map would include a variety of private educational service vendors, private and open source Learning Management Systems providers, for-profit and not-for profit online universities and community colleges, the online initiatives of established public and private universities and colleges, and hundreds of start-ups providing specialized tools and services (adaptive learning, assessment, video platforms, social media and collaboration tools, etc.),

[4] A comprehensive review of research to date finds that hybrid models that mix online and face-to-face teaching outperform each of these alternatives alone. US Department of Education "Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies" Revised Sept 2010. The volume of research on online education is growing fast, but it focuses primarily on the technology (rather than on the deeper questions about learning in different contexts) and is often out-of-date because the pace of innovation is so rapid.

systems can measure every click a student makes, it is possible to collect massive amounts of data to analyze performance and outcomes at all levels—and to learn from and improve them. As these assessment tools evolve they should also inform broader research questions about the most effective models for online teaching and learning.

Most of the highest quality online courses to date have been in math, science, engineering, and other fields where knowledge is procedural and sequential, and learning is largely individualized. Increasingly, however, the integration of social media and high quality multi-viewer video into teaching platforms enables the creation of learning communities through seminars, study sessions and office hours, games and simulations, and other forms of peer learning and interaction previously possible only in face-to-face settings. This opens new possibilities for online teaching in the humanities, for example, where interaction is required because knowledge is contextual, conceptual, and concerned with values as well as facts.

The availability of first-rate educational content online is also changing the conventional classroom. It has contributed to discussions of the "flipped" or "inverted" classroom, where students review articles and lectures on their own and the instructor devotes class time to insuring that students master the concepts through work in small groups, labs and projects.[5] As videos of first-rate lectures become freely available university faculty will be no more likely to deliver every lecture in a course than to write the assigned textbook or articles.[6] Educators at elite institutions are even predicting the demise of the lecture in higher education.[7] In short we are witnessing a sea change in thinking about university teaching, one that is inspired least in part by new educational technologies.

2. Access

Online education technologies enable us to transcend the limitations of a physical campus. We will be able, if we choose, to reach tens of thousands of outstanding students who live far from Berkeley or who elect to combine study with work and family responsibilities. By expanding access this way we should attract a far more diverse student body. Achieving this requires attention to admission standards, test integrity, academic honesty, identity security, and intellectual property rights. None of these issues appear insurmountable.

The experience of Stanford's Massively Open Online Courses (MOOC) confirms that online education from elite institutions has the potential to attract huge numbers of students from countries around the world.[8] A Brookings study estimates that by 2015 the number of Asian middle-class consumers will equal the number in Europe and North America; if present trends hold, in less than a decade two billion Asians will live middle class households with Internet access.[9] The potential for Berkeley is enormous: as technology enables us to select, teach, and credential tens of thousands of outstanding students, a global

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[5] http://mindshift.kqed.org/2011/09/the-flipped-classroom-defined/ See also the example of large enrollment introductory astronomy classes "Using Research to Bring Interactive Learning Strategies into General Education Mega-Courses" *AACU Peer Review,* Summer 2011, v. 13, n. 3.

[6] The trend towards specialization of teaching functions is not new. In elite universities not many generations ago, faculty in many disciplines produced all of the written material used in their courses, in addition to delivering every lecture. Today this seems unimaginable, but it is likely that university faculty will not spend as much time lecturing in the future.

[7] Harvard physics professor Eric Mazur calls for the end of the lecture for pedagogical (not technological) reasons. However his logic parallels that used in discussions of the "flipped" classroom. See Craig Lambert, "Twilight of the Lecture" April-May 2012 *Harvard Magazine* http://harvardmagazine.com/2012/03/twilight-of-the-lecture

[8] Some 160,000 students enrolled in the Artificial Intelligence class taught by Peter Norvig and Sebastian Thrun in Fall 2012. See http://new.livestream.com/accounts/50648/events/698/videos/112950.

[9] Homi Kharas "The New Global Middle Class: A Cross Over from West to East" The Brookings Institution, March 2010 http://bit.ly/aGIawT. The OECD forecasts that by 2030 the global middle class could total 4.9 billion, with some two-thirds living in emerging economies. *Perspectives on Global Development 2012 – Social Cohesion in a Shifting World* http://bit.ly/vfDZMt

brand that represents high academic standards will strengthen our ability to meet the surging domestic and global demand for outstanding higher education.

3. Revenue

Demand for higher education is increasing, particularly among working professionals and their employers, who recognize the importance of continuing, or lifelong, learning. As a result, professional certificate programs continue to expand, even with limited marketing. The experience of Berkeley Extension and of the Haas Executive Education programs suggests that during the next decade, professional certificate programs can become an important source of revenue. With care we should also be able to offer professional degrees online at scale without compromising student or education quality.

These revenue opportunities are not lost on others. We can expect private businesses, new education institutions, as well as our longstanding peers to seek to use online technology to meet this demand. As traditional credentials from elite universities come under economic pressure, we will either use online technologies to grow revenue, improve quality, and expand access or we will watch others do so.

Online education highlights the natural and constructive tension between our goals of educational excellence, access, and financial sustainability. Berkeley has the opportunity to play a leadership role in online education in coming years and decades; our ability to do so will depend in large part on our ability to manage these tensions productively to support campus-wide learning and innovation, rather than allowing them to slow or hinder progress.

The rest of this paper is structured in four sections, beginning with a short overview of online technologies and teaching. Part two briefly summarizes the online initiatives currently underway on the Berkeley campus. Part three suggests principles for a campus online education strategy, proposing that it contribute to a wider campus focus on teaching and learning. The final section recommends specific steps for campus leadership to guide the development of this strategy in what are still the early days of this technology.

The spirit of this brief is to identify and frame issues in order to provoke and focus a productive leadership discussion. It is not a fully researched guide to any specific course of action.

I. Defining Online Education: Technology and Teaching

The technology for online education is a fast evolving bundle of software and web-based tools that leverage the power of the Internet to provide access to text, audio, visual, and video content as well as research collections, any time and from any location that is connected. These tools continue to evolve—and we can anticipate ongoing innovation in most aspects of educational technology, from content to delivery to assessment, in coming years. For example, publishers of a new generation of electronic textbooks like Inkling, and tools like iBook Author that make it easy to build rich media-based online textbooks, will continue to transform the educational content industry. The integration of social media into "distance learning" allows instructors to leverage the power of social interaction in learning. Technologies that automate grading, track student performance, and adapt to individual learning styles should increase the reach and the effectiveness of online education. And the integration of features from online gaming promise to grow the appeal of online education as well as deepen student engagement.

The technologies for online education can be divided into four broad categories. They support administration of programs, manage course content, facilitate online course delivery, and help evaluate online courses and programs.

- *Administer Programs.* Most colleges and universities use integrated student information management systems—the educational counterpart to corporate enterprise resource planning systems (ERP) that support the functioning of complex business operations. These are essentially administrative tools used to track student data (from registration and grades to course enrollment) and while they are an important part of the infrastructure for online education, they are not treated here as educational technologies.

- *Manage Content.* Learning content management systems are repositories for the storage, indexing, and management of use and reuse of digital educational material such as courses, syllabi, content modules, textbooks, journal articles, videos, websites, and collections.[10] These repositories each contain tens of thousands of courses and articles and are accessed online by millions of teachers. Some of this content is peer-reviewed; virtually all of it is free. With iTunes University, Apple has created the largest online repository of university lectures—another form of online free, open educational content.

- *Deliver Courses.* Web-based technologies can be used to deliver courses in traditional classrooms and/or online, and they support a range of course formats. Online courses can be delivered asynchronously or they can require synchronous engagement of instructors and students, or a combination. They can also be offered completely online or in blended (sometimes referred to as hybrid) formats. Blended courses or programs integrate online with face-to-face instruction. Each of these formats has strengths and weaknesses; selection depends on the content, goals and target student body for a course.

  Large-scale live courses, once recorded, are likely to be made available as self-paced offerings. The Massively Open Online Courses (MOOC) offered by Stanford and MITx both post videos of classroom lectures, online problem sets, and machine graded quizzes and exams. Once automated, they can enroll unlimited numbers of students. High quality open courses with brief lectures and frequent practice exercises has demonstrated clear value in gateway math, science, language, accounting, and computer science courses where subject boundaries are well defined, developed in logical sequence, and easily testable. Millions of students around the world use resources like Khan Academy to supplement traditional courses, as continuing education, and remedially to fill specific knowledge gaps.[11]

  Learning Management Systems (LMS) have been in use in classrooms and online education for more than a decade. They began as little more than a student facing web-based repository for materials such calendar, syllabus, readings, and other content for a specific class. LMS have evolved to allow instructors to manage a class and to exchange information with students in the class; typically they allow for different roles, users, and courses, and they provide enrollment information, a pathway through course materials, video as well as text-based content, student messaging and notifications, tools for quizzes, exercises, collaboration, and so forth. There are large corporate vendors such as Blackboard and Desire2Learn, start ups like Instructure, and two major open source LMS initiatives from Moodle and Sakai. The competition in this space is based on factors such as ease of use, accessibility, openness, security, scalability, flexibility, and a variety of specific features such as mobile access, cloud-based hosting, and so forth. In general successful features are quickly adopted by others so that (like spreadsheets or word processors) the features of LMS are likely to converge, although the underlying architectures will not.

  Today most LMS offer features that enable students to interact with one another and with instructors via email or instant messaging. These systems are also increasingly integrating a variety of asynchronous social media tools (such as wikis, threaded discussion forums, and shared bookmarks) and some offer multi-view video to support real-time (synchronous) seminars, discussion sections, group projects, and tutoring.[12] Reflecting their origin as a corporate training tool, early generation LMS have counter-intuitive, clunky interfaces that turn off faculty and students accustomed to more user-friendly social

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[10] Academic content, along with tools for developing and delivering the content, is increasingly available in free, open source repositories such as the Hewlett Foundation's Open Educational Resources Initiative, Carnegie-Mellon's Open Learning Initiative, and MIT's OpenCourseWare (OCW), along with a range of discipline specific repositories.

[11] The Khan Academy website reports 125,942,478 "lessons delivered" as of 3/1/12. Even if that is the number of unique log-ins to the website the scale is remarkable. www.khanacademy.org

[12] Howard Rheingold, a leading proponent of interactive and participatory learning, has developed customized learning systems to support "learner-centered" education. His Social Media Classroom includes not only traditional course content in text, audio, and video formats, but also social media tools (wikis, RSS feeds, mind mapping, twitter, chat) as well as ample space for student-generated content (such as forum discussions, blog entries, and shared bookmarks). See http://socialmediaclassroom.com/index.php/resources.

media. With greater attention to usability and design, the systems have the potential to provide creative learning space and be embraced—rather than simply tolerated as a delivery device.[13]

The LMS attracts disproportionate attention today because new features are regularly introduced. As the feature sets stabilize, we can expect the buzz to die down and the technology to recede into the background, as with educational technologies in the past.

- *Evaluate Results.* Evaluation and assessment are standard tools for improving education. When used as part of a well-designed research agenda, they have the potential to transform our understanding (and the practice) of teaching and learning. Web-based assessments can be integrated into the instructional process to provide continuous feedback to students and instructors—and in greater detail than in a conventional classroom. Problem sets, quizzes and exams are easy to implement and automate online. Sophisticated analytics can also be applied to online discussions and assignments for formative assessment of the extent to which students understand and can articulate ideas or concepts. Ideally assessments provide feedback to help students become better learners, to help teachers improve their teaching and courses, and to institutions seeking to improve the overall curriculum.

   Medicine demonstrates how measurement can improve quality. Until recently physicians based their clinical decisions on their own training, reading, and experience. As institutions analyzed decades of medical outcomes data it became clear that some approaches to treating health problems were superior, and that many physicians were unfamiliar with the state-of-the-art. "Evidence-based medicine" has produced measurable improvements in clinical outcomes for institutions like Kaiser where physicians routinely review and modify their approach based on outcomes. Evaluation and assessment data could have similar effects on higher education. Universities that become adept at capturing outcomes data and modifying their practices accordingly should be able to gain a competitive advantage.

Educational tools and technologies will continue to improve; nevertheless teachers, not technology, will determine the quality of education in the foreseeable future. While the observers who forecast far-reaching transformations in higher education may be correct, is far too early to say precisely what this will mean for how we teach and how our students learn.

We know that developing and teaching online courses today can be demanding. Posting a course on the web literally (and visibly) exposes its underlying structure and logic. As a result, designing an online course requires thoughtful and explicit consideration of pedagogy and its relationship to content. A good online course maps goals and learning objectives to a sequence of clusters, or modules, of content and activities, defines a clear pathway (or pathways) through the material, and provides tools to measure understanding and/or mastery at each stage, as well as at the end. We may believe that this is simply good practice, but the unfortunate truth is that pedagogy is often overlooked in university classrooms.

Online course development is also normally a team process. Until the tools get easier to use, developing an online course will require expertise—beyond knowledge of course content—that most faculty members lack, ranging from course and instructional design to technical production to graphics and media.[14] Faculty members also report that teaching online can be both more rewarding and more time consuming than in a conventional classroom because of the frequent interactions with students between sessions, and the high

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[13] To fully engage digitally savvy youth, for example, online programs should be designed to be available on mobile devices such as phones and tablets.

[14] Instructional designers know, for example, that practices that are acceptable in a conventional classroom often need to be retooled for an online environment. Full length lectures, for example, can work because the physical and social presence of the instructor allows for interaction; once recorded, a lecture becomes a static "talking head" lacking context or opportunities for engagement. Experienced online teachers today recommend short 5-10 min videos to capture important ideas—but not full length lectures.

cost of making mistakes on line.[15] This suggests that the campus will need to provide non-trivial support for faculty and units that seek to experiment with online and hybrid courses and programs.

II. Current Online Education Initiatives at Berkeley

A variety of experiments in online education are currently underway at Berkeley. These initiatives reflect our diverse range of units and educational programs, as well as local trade offs between goals of increasing excellence, broadening access, and/or financial sustainability. Experimentation by our peers and competitors also continues to shape the ways campus units are responding to the opportunity to provide education online.

While each of these experiments is producing local learning, the later sections of the paper suggest that campus consider mechanisms for learning collectively from these now largely independent initiatives.

UC Berkeley Extension. Berkeley Extension began testing and deploying elements of online learning in 1996 and remains the only campus unit with significant experience in online education. Today it offers 165 online courses, as well as 10 professional certificate programs and 2 specialized courses of study online. This includes a mix of self-paced and scheduled format classes using the Blackboard Angel LMS. In 2010 Berkeley Extension online served some 6,000 students and generated $7 million, or 20% of its top line revenue.

Instructors for Extension's courses work with specialized instructional designers to develop the course, and with instructional technologists to build the class. Their classes provide customized modules of multimedia content (text, audio, visuals, and short videos). They encourage "student learning communities" by facilitating peer-to-peer interaction and team projects; they insure interaction between students and instructors through individual feedback, discussions, and virtual office hours. They have also built in ongoing and final assessments for both students and instructors. http://extension.berkeley.edu/online/presentation/

Extension developed the content and provides the technology (LMS) for 8 of the online courses offered by Summer Sessions; it currently supports 1,600 students in that program. Extension also provides funding, marketing, content development, program delivery, instructional design, and the technology for the on campus/on line Masters in Public Health (OOMPH) and the Masters of Advanced Studies in Integrated Circuit Design (MAS-IC). Extension is also experimenting with a pilot online business essentials certificate for engineers in India.

UC Office of the President. UC Online Education, or UCOE, is an ambitious system-wide project with two goals: (1.) to expand access to undergraduate courses for current UC students as well as students who are unable to gain admission or be physically present on campus, and (2.) to generate significant new revenues for the system. The UC Online Instruction Pilot funded was launched in 2011 and funded faculty from the general education campuses to develop 24 large gateway lower division courses for online delivery. The first course was offered for UC matriculated students in spring 2012; the remainder should be launched for UC students in fall 2012 and to non-matriculated students a year later. The courses represent a wide range of different subjects, types of content, uses of technology, and pedagogical approaches.

These courses will use a Common Learning Environment (CoLE) based on a Sakai 3 LMS with Berkeley's Educational Technology Services (ETS) serving as the "general contractor" for the technology platform. In the coming years ETS plans to provide a high level of interactivity to support "student-centered learning" and to integrate a variety of proprietary and open source widgets, including tools that facilitate data collection for evaluation and assessment. A second wave of about 8 courses will be funded shortly. The educational evaluation center at UC Santa Barbara has been tasked with evaluation of the new courses and the overall program. Marketing and student services are being outsourced to Blackboard, and UC Merced will serve as the registrar for UCOE. http://onlineeducation.universityofcalifornia.edu/

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[15] A blog post by the chair of Computer Science at Stanford, Jennifer Widom, who offered a free, online Introduction to Databases course provides a sobering look at the work involved in developing and offering an online class, as well as a sense of the exhilaration of reaching thousands of students. http://infolab.stanford.edu/~widom/SigmodBlog/

The division of labor between UCOE and campus departments is clear: UCOE pays for course development, developer royalties, and course updating, it also provides instructional design advice and development support, maintains the learning environment, and recruits and supports non-matriculated students. Individual faculty and departments are responsible for developing the online courses, teaching them as part of the regular curriculum as well as on a revenue-generating basis for non-matriculated students, and use the online courses without restriction.

Progress on this initiative has been speedy, given the difficulties of coordinating administrative functions and collaborating across nine campuses with widely varied instructional and technology support. Nevertheless there has already been tremendous amount of learning among the faculty, departments, technologists, instructional designers, and administrators involved with this project. These lessons should be valuable for experiments on the campuses.

Summer Session. Summer session offers a growing number of online classes, developed and supported by Extension, with the same fee structure as regular summer session classes. For summer 2012 the program offers 12 online courses in fields ranging from African American Studies, Art, and Astronomy to Chemistry, Psychology and Statistics. All but one of the courses is offered fully online. The Organic Chemistry Laboratory is the only hybrid course: lectures, including safety and equipment instruction, are provided online, but the labs are held on campus in the evening. http://summer.berkeley.edu/courses/online

School of Public Health. The School of Public Health has just introduced Berkeley's first on campus/online professional degree, the OOMPH, in collaboration with Berkeley Extension. The program is intended to help meet the severe shortage of trained public health professionals in the state and is aimed mainly working professionals without the current training. This 7 semester long degree is a hybrid: most of the content (85%) is offered online, but students are required to complete 3 one-week campus visits to complete the program. SPH is using the UC Berkeley Extension platform with an initial class of 12 online students who will earn a full masters degree in 2014. Public Health has priced tuition for the online degree at a premium relative to the identical campus-based degree ($42k/year v. $36k/year, including supplemental professional tuition). The program aims for steady state enrollment of 214 students by 2016 when it should break even financially http://onlinemph.berkeley.edu/

Electrical Engineering and Computer Science. EECS plans to launch the MAS-IC through Extension in fall 2012. The two-year fully remote graduate program is targeted at working professionals and will eventually enroll some 120-180 students annually. While the coursework is completely asynchronous, there will be opportunities for real time interaction with faculty and GSIs during live office hours and discussion sections. Tuition will be approximately $50k/year.

A handful of computer science faculty members plan to, or already do, offer free online courses using the platform developed for Coursera (Daphne Kohler and Andrew Ng's startup). Armando Fox and David Patterson, for example, are offering a class on Software as a Service and Jitendra Malik is offering a class on Computer Vision https://www.coursera.org/. In addition, computer science faculty members Pieter Abeel and Dawn Song are leading development of a new open source course platform.

The Haas School of Business. The Haas School has proposed forming an independent entity (either private for-profit or non-profit) to build a state-of-the-art platform for delivery of top quality, premium-priced professional degrees, including their planned hybrid MBA (a combination of online and on campus.) They are currently partnering with outside vendors to develop two core courses. They envision 600 students in the program with tuition comparable to its other self-supporting degree programs, the Evening and Weekend MBA and the Berkeley-Columbia Executive MBA.

School of Information. The School of Information is planning to introduce an online (or hybrid) certificate and/or degree program in Information and Data Science to meet the growing demand for data-savvy professionals. The faculty will select a partner and technology platform this spring after conversations with both Berkeley Extension and a private-sector vendor. While the latter takes at least 50% of the revenues, it has the capacity to provide global marketing and to scale a program quickly using its proprietary platform and instructional development capabilities.

Graduate School of Education. The Graduate School of Education is collaborating with the High Tech group of charter schools in San Diego to develop up to four online courses in the area of school leadership, including a course on "creating new schools." The courses would be used to support practicing educators and school leaders, potentially in the context of revenue-generating certificate and credential programs. GSE also plans to develop a global education course that could be offered as part of the undergraduate minor and linked to opportunities for international experience; the course could also be adapted to serve non-degree students. Participating faculty are discussing possible technology partners and platforms.

Professional School Online Pilot Consortium. Supported by the generosity of donors Susan and Steve Chamberlain, alums of the Education and Business Schools respectively, a group of campus professional school has been meeting regularly since summer 2011 to discuss shared interests in online education. The Chamberlains' $1 million matching gift has been divided between the five participating schools (Business, Education, Public Health, Information, and EECS) to support each unit's pilots in course and program development and to provide the opportunity to learn from one another and from the outside experience about online education. The Consortium has built links with both Extension and ETS, and has hosted a "Getting Smart" series of talks and demonstrations by firms and individuals involved in various aspects of online education.

Other Online Education Activities. There are other classes being offered online at Berkeley, e.g. Phil Stark's statistics class, which uses the "knowledge architect" (LMS) developed by Silicon Valley-based Onsophic to deliver personalized content and provide assessment and learning analytics.

ETS offers a monthly lunchtime discussion of social and new media that can be used to enhance teaching and learning. The monthly faculty buzz roundtable, led by an instructor and an instructional designer, focuses on new teaching approaches, best practices, learning activities, and resources for specific supportive technologies. ETS also offers faculty support the Awakening the Digital Imagination Seminar on New Media: http://ets.berkeley.edu/new-media-seminar and the Teaching Enrichment Program (TEP): http://ets.berkeley.edu/article/ets-teaching-enrichment-program-tep. With support from ETS, Prof. Jane Hammonds of College Writing redesigned a traditional course into a hybrid writing class.

Berkeley has provided Open Educational resources since 2001 by capturing and making videos of courses and public lectures freely available. The campus was one of the first universities to contribute to iTunes University and today our content is available on several YouTube channels.

III. A Campus Strategy for Online Education Technology

Managing a large complex campus like Berkeley has been likened to piloting an aircraft carrier. Campus leaders have only blunt instruments for steering. One approach is to establish administrative rules that standardize processes and/or technology. Done well, such rules reduce costs and complexity and insure consistency, but often at the expense of initiative and flexibility. The alternative is to provide incentives and funding in support of local experimentation. Decentralized experimentation can appear messy and wasteful, but with systematic oversight can contribute to learning about, and even to, the kind of innovation that differentiates.

Do central campus standards make sense for online education? There are some contexts in which standardization of technology and practices make sense.

- *A standard technology platform is important if educational content can get locked in.* Campus or system wide standards would make sense if there were no way to transfer content between technology platforms. Fortunately, major learning management systems adhere to a standard for packaging and transferring educational content. This means that educational platforms do not lock in users based on content formats (users may become locked in by virtue of habit, as occurs with desktop operating systems even when underlying files can be moved across platforms). No platform migration is ever painless—but schools do successfully change platforms all the time.

- *Standards are important if online platforms and tools have network effects.* One person's decision to use a telephone or Twitter makes it more attractive for others to adopt the same technologies. These benefits increase with the size of the networks. When fax technology came out, campus leaders did not debate for long whether to experiment with a new standard or adopt the existing one. But education, whether online or in class, does not have network effects; my decision to enroll in a class with a particular LMS does not make it more attractive for you to do so. It is valuable to have classmates, ideally talented classmates, but these benefits are not related to the technology or to the size of the network.

- *We need standards if moving first matters.* If an early technology mover, either universities that adopt early or software vendors that achieve early success, can shut out later ones, we would need to respond as a unified campus. But absent loyalty effects, network effects, or platform lock-in risk, the main benefit to first-movers is that they get smart faster. There is little evidence that standards confer an advantage in this situation at all.

- *We need standards if online education poses a serious threat to Berkeley.* Plainly if the university is threatened, our response should be unified. Do online education technologies pose a fundamental threat? Commentators, and even faculty, often assert that online technologies are undermining higher education, or that Berkeley is going to fall behind in online education if we don't invest immediately in a common approach. While most of these fears are inchoate and unfocused, there two arguments worth considering closely.

  The first suggests that the rise of free online courses poses a threat. But at closer look, these courses pose no more threat than public libraries, some of which are used by motivated citizens to become quite well educated. Berkeley is not likely to be threatened by free online courses, even if top-tier universities put an enormous amount of teaching material online. Universities are high fixed cost organizations; they cannot give away degrees to people who contribute nothing to these costs. Universities are quite likely, however, to use free online courses as a marketing tool and a social contribution. This seems like a good idea, if one that seems likely to wear thin.

  The second concern is that new forms of credentialing will undermine the value of degrees from top universities. Udacity and MITx, for example, offer high quality courses for free and will soon score and certify students. Understanding whether there is a fundamental threat from rival credentials is subtle. Many years ago, the New Yorker put the case starkly:

  > Social scientists distinguish between…treatment effects and selection effects. The Marine Corps, for instance, is largely a treatment-effect institution. It doesn't have an enormous admissions office, grading applicants along four separate dimensions of toughness and intelligence. It's confident that the experience of undergoing Marine Corps basic training will turn you into a formidable soldier. A modeling agency, by contrast, is a selection-effect institution. You don't become beautiful by signing up with an agency. You get signed up by an agency because you're beautiful.[16]

  Top-tier universities depend heavily on selection effects; we produce top graduates by accepting the best applicants. These effects are of course not entirely removed from treatment; these students must complete courses and meet other requirements in order to receive their degree. But it is clearly true that Berkeley, like our peers, selects students who will be successful from large pools of applicants and arms them with the necessary tools and social relationships.

  Might online education undermine the reputation that Berkeley has developed over many generations? Arguably the creation of hundreds and perhaps thousands of new degrees and certifications will serve to increase, not decrease, the power of a well-known and long-respected degree. So long as Berkeley continues to admit top students and attract leading faculty, the threats we face will not come primarily from online education.

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[16] Malcolm Gladwell http://www.newyorker.com/archive/2005/10/10/051010crat_atlarge#ixzz1m1dBctur

Online education is a very broad category that will eventually touch every Berkeley classroom. Learning about online education should be an important campus goal, and we will learn more and learn faster by funding experiments than by standardizing. While the new tools have the potential to improve teaching quality this is not likely to be a speedy process; the pace of learning will depend less on the existence of a shared technology platform than on changing faculty attitudes, our ability to relieve institutional constraints, and investments in faculty and course development as well as research on online education.

Our goal should be to encourage faculty and units to start sooner, experiment more, and learn faster. This argues for providing campus support for diverse online educational initiatives and against premature standardization. As the preceding section illustrates, this experimentation is already well underway. Several Berkeley faculty members are developing undergraduate courses on the UCOE Common Learning Environment (CoLE). Some units (the Information School and Haas) may form technology and marketing partnerships with private vendors. Others (Public Health and EECS), are using the Extension Angel LMS; while Extension is also exploring the possibility of partnering with UCOE to upgrade the CoLE. Some EECS faculty members are developing their own open source course platform, while others are offering courses through Stanford's Coursera. UCOE is contributing to development of the Sakai 3 open source platform, but is subcontracting marketing and student services to a private vendor.

Will we ever need standards? Yes, and many technology standards will evolve naturally. At the point that the campus decides to invest heavily in online learning (and customizing its own LMS, training large numbers of faculty, expanding support for online course design and production, and developing a large portfolio of online courses) the scale advantages of a single standard will outweigh the learning advantages of experimentation. At that time, which may be only a few years away, it will be important to revisit the question of campus standards.

IV. Recommendations for Campus Leadership

The forgoing view suggests that Berkeley can encourage experimentation and learning in online education with the goal of increasing access and excellence, and over time, generate new revenue. *The single most important step to support this vision is the creation of a small, high quality Office of Online Education to encourage and monitor experiments in online education, fund research on teaching and learning alongside systematic assessment of outcomes, and build the foundation for a large scale commitment to online education.*

To improve academic excellence, this office would invest in high quality research on online teaching and learning, and in a coordinated and rigorous program to measure educational outcomes, enabling the campus to systematically improve the design and delivery of online and hybrid courses. The office would be responsible for educating the campus on what constitutes excellence in online education, and serve as a clearinghouse for information about online teaching and learning—both on campus and elsewhere. It would publicize the Berkeley brand by offering free, high quality, online lectures to the public designed and marketed to attract top applicants. And it would work with programs to ensure that online degree programs maintain admissions and graduation standards that are equal to or higher than classroom programs.

To expand access and generate revenue, this office would support University Extension as an online learning incubator, especially for professional certificate and degree programs, and expand ETS programs that support faculty in online course and instructional design. It would assist professional schools and other units to develop high quality revenue-generating online offerings. It would also work to remove the substantial administrative hurdles that currently impede these efforts—and that could prevent online education from becoming an important source of revenue over the next decade. Finally, it would ensure that online degree programs be financially self-supporting by restricting tuition discounts.

This office would need to be sufficiently well resourced ($3-5 million/year) to serve as a respected, high quality, source of information and research on online education, to support the development of new online or hybrid courses and programs across campus, and to facilitate systematic assessment and learning about what works and doesn't in online education. Without a solid budget and stature that commands respect of campus units, the office would risk being marginalized and/or seen as irrelevant; in that case, it would not be worth the effort.

Specifically, the Office of Online Education would undertake the following:

1. *Provide seed funds to support development of high quality and theoretically informed research on online teaching and learning.*

    There is substantial external funding available for research on online education from the federal government, the MacArthur Foundation, and other institutions. This office would provide seed funding to support pre-proposal workshops and the development of research proposals to support serious, high quality research on access, quality, and innovation in online teaching and learning. This research could draw on assessment data collected from units already pursuing online or hybrid courses and degree programs; and would ideally be multidisciplinary, bringing together scholars from units such as Education, Information, Engineering, and other programs involved in online education.[17] The Berkeley faculty has the intellectual diversity and quality to make a substantial contribution to research in this area.

2. *Use consistent outcomes measurements to steadily improve learning and teaching outcomes.*

    Assessment and refinement are powerful tools for improving the quality of online teaching and leaning. By building ongoing, systematic assessment and evaluation tools into online, or hybrid, classes, and by learning quickly from the feedback, an instructor can transform a course that works adequately to one that excels. With appropriate analytical tools, teachers and students alike can start to identify patterns in the relationship between particular instructional tools and techniques and outcomes—and to continue to modify the tools and techniques to improve outcomes.

    The Center would spearhead development of consistent measurements of course quality and learning outcomes, and ensure that the data is paired with analysis and changes in teaching. Devoting ourselves to early and rigorous quality measurements can, over time, create a powerful differentiating advantage, especially in professional education.[18] This would be even more powerful if paired with serious, first-rate research on the subject.

3. *Offer well-produced, free online courses as a public service that builds the Berkeley brand.*

    A well-produced and marketed (think TED Talk) "Best of Berkeley" online lecture series, updated regularly, would be a wonderful public service and outstanding public relations for the campus. This would expand on the already successful campus contributions to iTunes University and our YouTube channels. It would be a great way to honor our most capable scholars and teachers, and it would force us to develop online content with very high production and education values, which would likely spill over into other educational content we produce.[19] Neither MIT nor Stanford has focused on the production quality of their open courseware so it may represent a chance to leapfrog our peers.

4. *Uphold admission and graduation standards in part by investing in marketing.*

    An important goal of the Office of Online Education would be to build faculty support and strengthen our academic brand by ensuring that all online course admissions and degree programs adhere to the same or higher admissions and performance standards as their on-campus counterparts. This will require significant investment in faculty and course development. Without an explicit and measurable commitment to quality, faculty suspicion that online education will undermine the Berkeley brand will gain credibility.

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[17] Some promising areas for research are listed in the Appendix at the end of this document.

[18] An interesting analogy is Harvard Business School, which devoted itself early on to an instructional technology: discussion-based learning using the case method of teaching. They invested heavily in course material (cases), instructor development, and quality measurement to support this commitment. Agree with the value of case method or not, the thorough, consistent implementation of an educational technology and the measurement of results to enable faculty to continually improve is instructive as we contemplate expanding online teaching and programs.

[19] Effective online lectures are highly produced and take a lot of work. For a humorous look at what goes into an effective TED talk, see http://goo.gl/4rkqH .

In order to build online degree programs that have a measurable revenue impact, the campus must invest in the marketing necessary to ensure that the world's highest achievers look to Berkeley for online education. The cost of attracting top students to an online Berkeley program can easily rival the cost of teaching them. Although some units may be capable of scaling up high quality marketing programs, others will be well served by campus-wide capabilities or by partnerships with firms that have demonstrated an ability to reach talented professionals around the world. Most of the marketing spent attracting students to online programs will, of course, help build campus programs as well.

5. *Use University Extension as an incubator for online education.*

    University Extension has a valuable role to play as a laboratory for online learning, particularly if it can be encouraged to think outside of the box and experiment with new technologies and approaches. The campus should offer support for development of an integrated and highly interactive next generation online learning management system, creation of new self-financing professional certificate and degree programs, and a production center for developing online courses. Extension should devote particular attention to professional degree programs and undergraduate gateway courses that, far more than doctoral programs, are likely early beneficiaries of online education technologies.

    We should encourage University Extension to explore a rich combination of certifications in partnership with professional schools and L&S departments. Because the faculty approval and teaching requirements of non-degree programs are significantly lower than for degree programs, Extension is free to experiment with different certificates, to grow those that work, and modify the rest. This has several benefits beyond the undeniable value of revenue. Professional schools can design certificate programs offered by Extension to serve as a feeder program for more selective online degree programs. They can use Extension as a natural testing and learning environment for new courses and subject areas. And we prevent other universities from using credible, attractive online certificate programs to build a sufficient online presence to challenge Berkeley degree programs directly.

6. *Encourage professional schools to establish full-tuition, online degrees.*

    Several professional schools have either launched or are developing plans for online degree programs. This is because the students in most professional schools can finance master's degrees from the increased earnings the degree permits (including business, law, information, public policy, and public health.) In these cases Berkeley can use high quality online programs to address an immediate, compelling, and in many cases global need. The substantial investment required launching a new online program means that these degrees are not likely to produce net revenue for the campus for at least five years. Over time, however, online education has the potential to become a significant revenue source.

    Can we use online education technology to double the size of our professional degree programs without compromising quality? Since online education allows us to serve a global market, we may be able to do so – but not quickly. Bringing online learning programs to scale requires investment in course design, instructor development, marketing and technology. The campus should ensure that programs with potential to grow significant revenues can make these investments by offering a mix of no (or low) interest loans to programs, and incentives, including course release or summer salary for faculty willing to develop hybrid and online courses.

7. *Work with campus to eliminate the obstacles that hinder online degree initiatives.*

    The hurdles that slow down campus approval of online education initiatives are widely discussed and need not be repeated in detail here. *It is critical to remove them if units are to generate revenues from online degrees.* We need to move with deliberate urgency and, at a minimum, make sure that we do not stand on our own air hose. Even initiatives that propose to duplicate existing degrees face lengthy reviews by several Academic Senate committees and by the system wide Senate committee. They also face complex

negotiations with campus administrative units that "own" part of the process, including the Registrar's office, IS&T, and Summer Sessions.[20]

We need to dramatically streamline this approval process. Academic Senate approvals would ideally be a one-stop process with compressed turnaround times and parallel, rather than sequential, reviews. Units like business and law have in the past addressed many of the issues that arise with new self-supporting degree programs (e.g. registration, grades, access to student systems, etc.) with one-off solutions. This is not feasible for most other campus units. Online degree programs should enjoy access to campus services, rather than be treated like secondary citizens.[21]

Last, but not least, it is not clear why the campus "tax" for self-supporting degree programs offered on line is the same as that for programs provided on campus, given that the former use fewer campus resources. It makes even less sense that units must pay not only the 15% overhead to campus but also an additional 7% to summer sessions if programs are offered during the summer. Given the expense of developing new online programs, it might sense to reduce or eliminate the campus overhead at least until the programs break even.

V. Concluding Thoughts

Technology disruption is rarely linear. This is clear to anyone who works in the book publishing, recorded music, or film industry. Education is much more than interactive media -- but as it moves online, it is not a lot more. It is possible that as higher education goes online, its competitive dynamics will come to resemble other forms of digital media. To the extent that this is true, Berkeley will face challenges that we need to anticipate now. Consider the digital transformation of books, movies, and music. In each case:

- *Content was disaggregated and mashed.* Just as albums are now sold as songs, ringtones, and clips, educational content is unlikely to remain entirely within current disciplines or courses. As technology makes it easier to recombine and repurpose courseware, it may become possible for two students to complete the same course without confronting the same content in the same sequence or manner. We should expect that learning and certification will not be limited to degree programs, or even courses.

- *Engagement became social.* Digital movies have benefitted Hollywood much less than YouTube and Netflix. It should not surprise us to see more learning become self-motivated, socially certified, and delivered outside of mainstream institutions. Startups like the Khan Academy and others on the way may well increase the demand for formal education, but they could also substitute for it just as many of the needs once filled by campus fraternities or alumni associations are now available in social networks.

- *Value shifted from content creators to aggregators.* Book publishers and music labels have learned that aggregators of content (Amazon and iTunes) hold a lot of cards. Will universities that efficiently aggregate and distribute high quality educational content regardless of its origin become powerful players in online education? Or will universities, like film studios, attempt to remain relevant by offering exclusive, premium-priced, high-quality, proprietary content protected through careful

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[20] Academic Senate committees on campus include COCI, Graduate Council, Educational Policy, Budget and Interdepartmental Relations, and at the Office of the President, CCGA. Other administrative units "own" part of the process including the Registrar's office and IS&T. The system wide CCGA approval could even be waived if a program has full approval at the campus level. The CCGA could assume a role in insuring program quality by reviewing programs once outcomes and evaluation data become available.

[21] While the OOMP degree was launched in January, Dean Wu reports several major issues remain unaddressed, including the ability to do "summer admissions," the lack of financial aid, ambiguity regarding instructor IP rights, the inability to compensate instructors, the requirement of revenue sharing with summer sessions, the amount returned to central campus (especially by smaller units), and the desire to use the Jazzee system hosted by Graduate Division.

online distribution and syndication? Top universities are betting on the Hollywood model, which is obviously under sustained attack.

- *Prices fell as comparison-shopping became easier.* It appears that the revenue optimal price for eBooks is between $2 and $5, depending on the author and in some cases the publisher. For songs it is between $1-$2. Record labels and publishers have been forced to seek entirely different business models to monetize their content. If the market for digital content and media cannot sustain premium prices, universities are betting that the market for a premium credential can. At the moment, this appears to be a safe bet – but there are plenty of reasons to believe that a generation hence, it will not be.

New technologies always begin by "paving the goat path." In online education we are barely past the stage of putting lectures on line and automating what we do in the conventional classroom. If online education follows other media it will look very different in 5-10 years. This means that the serious competition in online higher education is still in the future. We should neither waste this time nor assume that we are ready to bring a better offering to scale until we have built a deeper understanding of online course design and development, production, teaching and assessment. We should encourage interested faculty from across campus to explore hybrid and online education, and provide means for learning from these experiences. We need a period of testing new solutions and defining new advantages.

Over the next five to ten years, online education technology will pull Berkeley and our peers into unknown territory. It is a situation that calls simultaneously for vigilance, caution, and bold exploration. Mild paranoia may even be rational. The past president of an Ivy League university recently summarized the dilemma facing universities. Following a discussion of changes in higher education, including some of the threats discussed here, he cautioned that: "things often take longer to happen than you think they will -- and then happen faster than you thought they could."

Appendix. Some Promising Areas for Research on Online Education[22]

- *Learner Engagement and Motivation*: Where and how do students learn most? Can learners on their own achieve learning objectives from participatory tools that are made freely available to them? What factors besides instructor and course requirements motivate students? What role do blogs, wikis, social bookmarking, and other participatory tools play in learning?

- *Online Learning as a Social Process:* To what extent can the adoption of social media transform higher education from a primarily individual-centered to a more social and interactive learning process? What kind of tools and applications work best? How can we assess this?

- *Personalization and Adaptive Learning:* A major promise of the technology is the ability to customize curriculum based on student performance and learning styles. Regular online quizzes can be used for real-time assessment and feedback to both students and instructors. This allows iterative learning and adaptation. How well are these experiments working thus far? What could be done to improve these outcomes? How can the most sophisticated analytics and informatics be harnessed for assessment? What will the next generation of backend analytics allow?

- *Technology Design and Usability:* We have much to learn about how to design educational software and tools that are easy to use, low cost, and effective. Design should be informed by understanding of the learning process as well as by principles of human-computer interaction and usability. How can these tools be used to lower the barriers to participation and interaction? How can rapid feedback to students as well as teachers help improve learning? What support do students need in order to be able to take full advantage of new tools, online spaces, and opportunities to learn outside of formal classrooms?

- *Institutional Barriers and Possibilities:* Although many faculty members see the promise of technology and online learning, many do not and fear it or dismiss it out of hand. In this transitional era, as we stand with one foot in an old age and the other in the future, it is important to address faculty's concerns about the efficacy and ethics of the online movement through research that asks questions about how access is distributed. How do the new tools affect access to learning and knowledge for a diverse student population? What forms of learning require face-to-face interaction and access to material objects, and which live more naturally online?

- *Information Science & Education:* An information design model for education provides many advantages. We will have the potential to gather and analyze large amounts of data gathered by institutions and the learning management system. This data can be accessed real-time and used to adapt the program and accelerate our learning about what works and doesn't. For example, what are early warning signs of student loss of interest? What interventions can be given to students at risk of exiting the system?