TIAA-CREF Institute

From Disruption to Design

How Technology Can Help Transform Higher Education

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Executive Summary

Technology is ushering in a new era for education, student success, and financial sustainability for both institutions and students. In particular, new models of online learning in tandem with growing analytics provide powerful new opportunities for institutional leaders to use technology to improve both educational and financial outcomes. The industry must closely examine the most promising new models and technologies to understand more fully how institutions and students can successfully adopt them.

Key Take-Aways

- Technology is paving the way for many online learning innovations, including MOOCs, simulations, and games. Students want greater use of technology.
- Analytics is a growing area for innovation in higher education, improving student decision making, pathways to degrees, and early alerts/interventions to improve student success.
- New business models are emerging predicated on IT to make better use of time, faculty, and other resources.
- For IT to lead to innovation and financial sustainability, institutions must go beyond using IT as a delivery channel and use it to change the learning experience and catalyze radically different models.

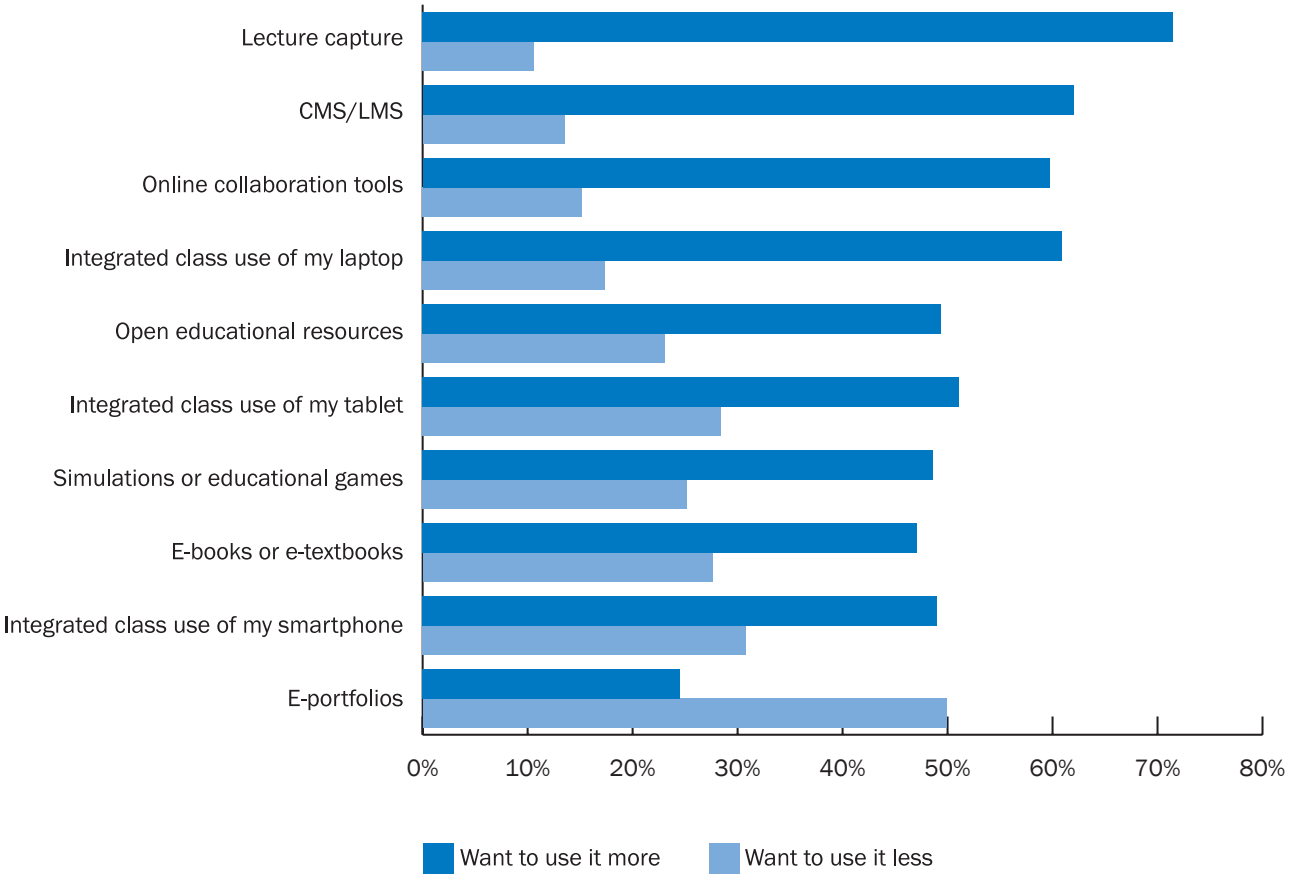
Information technology is often called a disruptor, but it is also a powerful element of design. Technology enables us to do more, know more, and achieve more thanks to anytime, anywhere access to information and social interactions. Higher education already serves millions of students very well, but IT could transform the industry and improve the lives of millions of more students. Why is that? Because online learning can be tailored to individuals—to the format, time frame, and content most appropriate for their learning goals and hectic schedules. Technology can engage students and allow them to chart a personal pathway for their education that would have been impossible even five years ago. For colleges and universities, technology holds another promise: the feasibility of new business models to cope with escalating costs, decreased funding, and increased regulation and oversight.

Engagement

Students are eager for institutions to apply technology innovations to courses and teaching methods, whether through gaming, online learning, simulations, or simply using smartphones and tablets (see Figure 1). Students in private bachelor's institutions are less interested in adopting these technologies than other students; yet, even in the most traditional colleges, 40–50% of students want more technology incorporated into their education, and 62% say they learn best in classes with some online components.

Students are eager for this new technology because they firmly believe in technology's power to improve their educational pursuits. Three out of four undergraduate students agree or strongly agree that technology helps them achieve their academic outcomes and that technology better prepares them for future educational plans.[1]

Figure 1: Students' Preferences for Their Instructors' Use of Technology



A majority of students (61%) also agree that by the time they graduate, the technology they have used in their courses will have adequately prepared them for the workplace.

This enthusiasm logically generates greater engagement among students, and better engagement is associated with gains in academic, personal, and social development. Immersive learning experiences (e.g., through augmented reality, simulations, and other tools) move beyond "teaching information" to helping students develop the valuable skill of "transfer"—being able to take what they know and apply it to a new area.

Gaming is the perfect example of how technology can transform education through engagement. Games use elements such as feedback, rewards, badges, or competitions to motivate students and accelerate learning. Games can catalyze intense concentration, effort, time-on-task, and achievement, and make it easy for students to track their progress with scores and progress bars. Almost half of students would like their instructors to incorporate more games into their courses, but only 5–6% of institutions expect to offer gaming by the end of 2014.

There are exceptions, however. For example, the University of Washington's Center for Game Science developed The FoldIt simulation of model protein folding. The community is invited to help solve protein folding problems that even computational science has difficulty addressing. In 2011, a decade-old AIDS enzyme puzzle was solved within days by gamers.[2]

Another gaming example is LearningEdge, which offers simulations of complex systems such as renewable resources, clean energy, and commodity pricing; students can connect the dots between their decisions and inevitable consequences. As students role-play as senior managers in different industries, they explore the risks of climate change, negotiating international agreements to reduce greenhouse gases, for example.[3]

Beyond gaming, technology can improve engagement by connecting students to other students, faculty, advisors, and the larger community through a variety of IT channels (e.g., network, social media, and collaboration tools). This technology network includes databases, archives, tools, and other scholarly resources. Data collected and analyzed from these interactions allow institutions to provide feedback to students.[4]

For example, remote web-based science labs (RWSLs) allow students to see the science behind the experiments, talk with peers, and gain a better understanding of concepts. Experiencing what real high-tech equipment is like, students benefit from that kind of real-time technical support. Consider, for example, the North American Network of Science Labs Online (NANSLO), a consortium that helps members develop and deploy modularized courseware. NANSLO web-based labs are learner-centered and immersive, using software, video, and robotics for the science studies.[5]

Students also learn by doing research using digital tools. For instance, in the Digital History Project students compile historic artifacts and share them with others in a "harvest." History Harvest brings value to learners as well as the community. At each "harvest," community members share

The Need for Faculty Engagement

The transformative promise of information technology cannot be realized without faculty engagement and leadership. More than 80% of CIOs agree that faculty influence their institution's choice of e-learning technologies,[24] and lack of faculty interest may be the largest barrier to implementing online learning. The most common reason institutions cite for not offering online learning is lack of faculty interest (36%). In the same study, more than 75% of institutions reported lack of faculty expertise as a moderate or major concern; it was the largest concern about e-learning. A separate study benchmarking early adopters of personalized learning pathways notes that faculty buy-in is a major concern.[25]

Most institutions have facilities and services to support faculty with instructional technology. At least 75% of colleges and universities provide the following:[26]

- Designated instructional technology center available to all faculty
- Special grants or awards for innovative use of instructional technology
- Instructional designers to help faculty develop courses and course materials
- A faculty teaching/excellence center that provides expertise on IT

Fortunately for the immediate future of online learning, faculty engagement is increasing: More than 80% of CIOs report that faculty are becoming more interested in e-learning.

personal letters, photographs, objects, and stories, and they explore the significance and meaning of their materials. This collaborative, team-oriented effort connects student learners, scholars, and the community.[6] The project's creators are leveraging digital technology to democratize and open American history.

Personalized Pathways

Students have different abilities, preparation, goals, and learning styles. No one system fits all students. Technology makes it easier to personalize the learning experience, and students across all institutions are showing interest in personalized pathways to assist their educational planning. One-third of undergraduates expressed strong interest in course recommendation engines, and an additional 43% were moderately interested. Even more students were strongly (40%) or moderately (48%) interested in institutional alerts for new or different academic resources.

Some examples of personalized pathways include:

- *Education planning*. These services help students select courses and move efficiently through their program of study. The goal is often to improve "time-to-degree" by helping students make better-informed choices. That may mean more efficiently earning a degree at a student's current institution, or planning the transfer of credits to earn a degree at another college or university. Education planning systems can improve the use of advisor time and reduce errors. Planning tools often include mechanisms for tracking student progress.

- *Advising and coaching systems*. These systems help students identify the support they need and link them to resources. Tools can help students develop personal action plans, along with reminders and tracking mechanisms. Case-management tools can help advisors, faculty, and others share necessary actions, observations, etc.

- *Alerts*. Systems can identify at-risk students and trigger interventions. Data from a variety of sources (grades, course management systems, etc.) can feed predictive algorithms, resulting in alerts that can be sent to faculty, advisors, or students. The alerts serve as an early-warning system to help students know when their course success may be at risk.

- *Dashboards*. Analytics in a dashboard format allow faculty to quickly spot patterns of success or disengagement in student populations. They can also provide students visibility into their own behaviors and how they are linked to learning outcomes. Dashboards also allow institutions to see which students are "on track" to graduate and which might be running into difficulty.

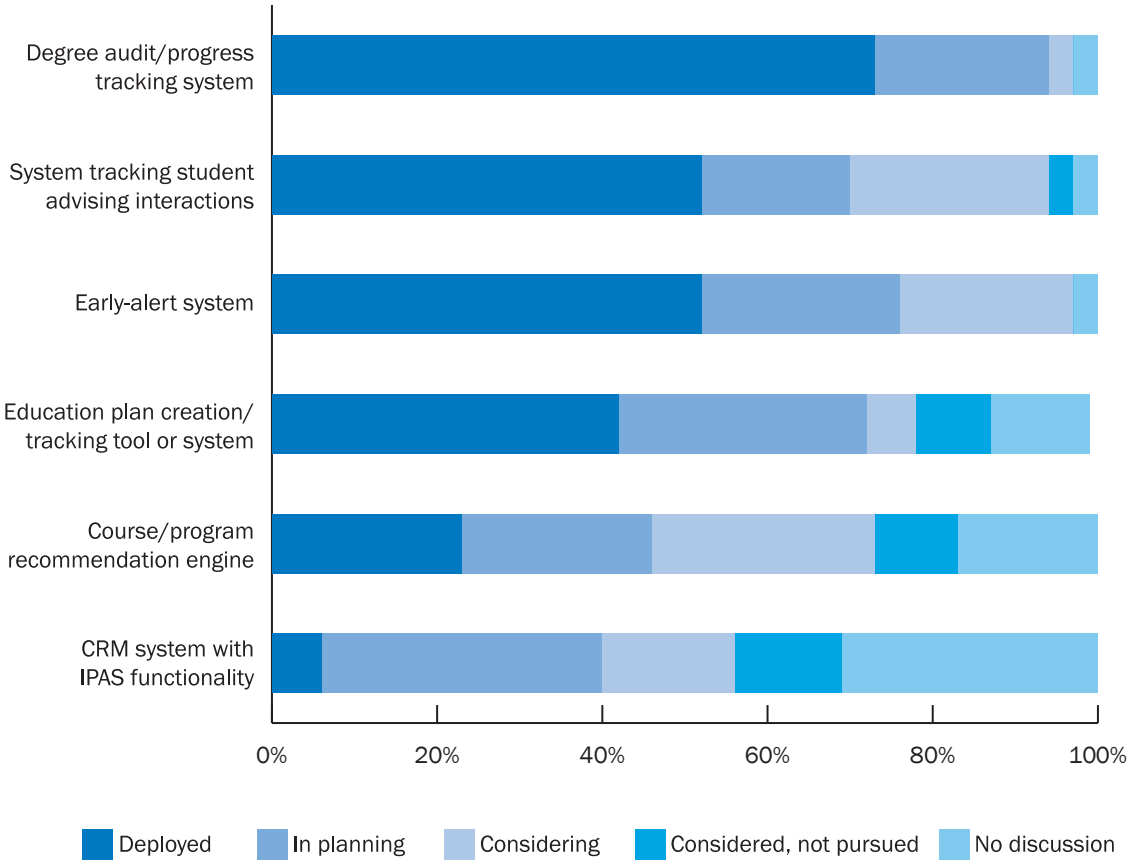
These self-paced, personalized curricula have proven more efficient than a one-size-fits-all approach. For example, the Degree Compass system at Austin Peay State University analyzes hundreds of thousands of student grades—as well as each student's personal academic achievement, requirements for the current program of study, and graduation requirements—to make personalized recommendations for courses that meet degree completion requirements and in which the student is likely to succeed (receive an A, B, or C grade). There has been a steady increase in the proportion of A, B, or C grades between fall 2010 and fall 2012 of almost 5 standard deviations. Effects have been especially pronounced (7.7 standard deviations) for Pell Grant recipients who follow Degree Compass recommendations.[7]

Elsewhere, Sinclair Community College's Student Success Plan (SSP) software suite provides students with a pathway to their academic goals. The software components (case management, early alerts, action plans, reference guides for referrals, student self-help tools, and My Academic Plan (MAP)) help students, advisors, and student-support professionals through to program completion. Each student is given an individualized, clear, and coherent pathway to degree completion. The intent is to "assure that students take the right course, in the right sequence, for the right purpose." The system helps prevent course selection confusion and degree misdirection, and it demystifies many issues, saving both the student and the institution time and money.[8] The system has administrative advantages, as well, such as anticipating future staffing/course scheduling needs.

Meanwhile, Arizona State University's eAdvisor program offers online advising and personalized student support. The system informs students about degree requirements and intervenes when a student is off track. Online academic support tools are also offered. Students are provided with progress reports and connections to advisors. From 2000 to 2010, ASU's freshmen retention improved from 73% to 84% and the six-year graduation rate from 47% to 59%. Initially, only 22% of students were on the correct course path for their majors; it is now 95%.[9]

Colleges and universities are also experimenting with different "alert" tactics and behavioral "nudges" to urge students to greater performance, engagement, and retention using text messages on mobile phones (mobile and smartphone ownership is approximately 95% for people between the ages of 18 and 29). In a pilot at the University of Washington–Tacoma, students in the Persistence Plus math pilot received an average grade of 2.42 compared to 1.71 among the control cohort. Course completion rates were 85%, compared to 73% for the control group. For an economics course, the average grades were 2.95 compared to 2.59; course completion rates were 83% and 64%, respectively.[10]

Figure 2: Deployment of Personalized Pathways Technologies Among Early Adopters



Use of personalized pathways in any form remains limited to about one-third of colleges and universities.[11] In a 2012 study, just 28% of institutions saw analytics as a major, institution-wide priority, and an additional 41% saw it as a priority for specific departments.[12] But sentiment may be changing. Study respondents predicted that analytics would be more important (86%) or just as important (14%) by 2014; nevertheless, analytic technologies will be in place in fewer than 50% of institutions by the end of 2014. Figure 2 shows the distribution of personalized pathways among the early institutional adopters of such technologies.

Alternative Business Models

In the commercial world, the Internet has created new business models for the likes of eBay, Amazon.com, and Netflix. Now new models are emerging in higher education as well. These include competency-based programs, and sometimes include credit for coursework taken outside the institution. The point is that the path from course to credit is changing to offer alternatives to the traditional model.

This kind of creative use of technology may relieve some of the tuition burden on students and help institutions run their own operations more cost efficiently.

As Bill Bowen, president emeritus of Princeton University, puts it:

> Our greatest opportunity to raise productivity lies in an imaginative rethinking of how to schedule courses, how to make more efficient use of fixed plant, and how to facilitate the flow of students through what should be viewed as an 'educational system,' not a static set of programs and rigid scheduling conventions. The real trick is to use technology to both raise completion rates and reduce time-to-degree.[13]

Several alternative business models are emerging:

- *Prior learning assessment* (PLA) is the evaluation and assessment of an individual's life learning for college credit, certification, or advanced standing toward further education or training. While PLA has long been used to certify learning accomplished in the workplace or military, it is now being used to certify learning from MOOCs. It shifts the financial model because the students no longer pay for course or seat time, rather, they pay for a test to validate what they already know.

- *Competency-based education* (CBE) uses defined learning objectives and measurable outcomes, allowing students to advance toward a degree based on demonstrated mastery of learning. Much of the learning is done independently through online or blended models. Competency models are designed to replace time-based models. What students learn outside the classroom can be used to build competency, whether the learning is from individual study or the workplace. CBE aligns with the trend of focusing on outputs rather than inputs.

- *Shifting roles*. Institutions are disaggregating faculty roles, separating course development from mentoring, tutoring, and assessment. Many of these disaggregated roles are performed by faculty at a distance, who may be paid at different rates based on roles. The distributed workforce allows the institution to avoid costs for facilities; the faculty interacts with students and peers online. In addition, institutions outsource a variety of functions to third party providers, such as student support services, tutoring, recruiting, etc. These services may be available at a lower cost than if done by campus personnel, and provide greater flexibility to scale up (or down) services, based on demand. These role shifts can alter the institution's costs, potentially improving long-term sustainability.

- *Badges.* Any organization or community can issue badges backed by its own seal of approval. Learners and badge earners collect badges from different sources and display them on their résumés, websites, social networking profiles, job sites, etc. By displaying evidence of skills and achievements that traditional degrees and transcripts often leave out, badges may lead to jobs, community recognition, and new learning opportunities. Some firms report they hire based on badges rather than traditional degrees. The Open Badge Initiative, for example, uses the Open Badge Infrastructure (OBI) to support badge issuers and badge displayers, while also providing a repository for badge collection and management for each learner. It also includes the Badge Backpacks, which are personal badge repositories for each learner.[14]

A few examples of new business models that are being put into practice include:

Northern Arizona University's Personalized Learning Initiative is a competency-based approach to a bachelor's degree. Students are pretested to ensure proper placement and awarded credits for prior learning. Students may achieve goals more quickly and cost-effectively by earning credit for prior learning. A flat annual fee of $5,000 and no restrictions on credit accumulation incents students to complete their degree. There are no additional charges for books or fees. NAU is currently pursuing accreditation for the program.[15]

Southern New Hampshire University's College for America Program is a self-paced, online, competency-based Associate of Arts degree program. Learning is organized by an individualized Knowledge Map that acknowledges what students already know, reflects what employers need, and aligns with student goals. Students develop evidence to demonstrate mastery, documenting progress in the Knowledge Map. Students are assigned a coach and accountability partner, but there are no faculty in the traditional sense. The program launched in 2013 with a general studies degree, priced at approximately $2,500 per year.[16] The first graduate completed his Associate's degree in three months at a cost of $1,250.

Kentucky Technical and Community College System's Direct to Degree (D2D) is a series of 81 sequenced, learning-on-demand online course modules culminating in an associate's degree. The program is designed in block-style format; students focus on one course at a time. The program uses a monthly subscription model, providing a financial incentive for efficient completion. To be effective, D2D will require financial aid that is not dependent on the traditional semester-based financial aid and award. Students in a competency-based program need grants and loans that mimic their progress, not a college calendar. The program is seeking accreditation to open in fall 2014.[17]

StraighterLine courses are offered on a subscription basis ($99/month, $349/semester, $899/year), individually or bundled. Courses are self-paced and have defined start/stop dates. Credits can transfer through the American Council on Education's (ACE's) credit system to other higher education institutions. A pilot program allows students to take courses with StraighterLine and transfer them to Western Governors University.

Funding Technology Investment

Despite technology's clear benefit to schools and students, affordability is a widespread concern. Almost 60% of institutions reported lack of funding for analytics initiatives. Today only 9% of the IT budget is being spent on transformative initiatives, with the remaining budget devoted to ongoing operations (76%) and growth (15%). The teaching and learning mission will have to share that transformative budget: administrative computing accounts for 53% of the IT budget, and the teaching and learning mission accounts for 39%.[18]

MOOC or Not?

MOOCs have been receiving a great deal of attention, but the financial model for MOOCs is unclear. In MOOCs, lectures are typically "canned," quizzes and testing are automated, and student participation is voluntary. They attain large scale by reducing instructor contact with individual students; students rely on self-organized study and discussion groups. The technologies include high-quality indexed video; data capture and analytics; and delivery platforms that combine the qualities of social networking sites with content delivery, discussion, and grading functions.[22]

Online learning is still much more popular than MOOCs.[23] In fact, a surprisingly low proportion of undergraduate students (26%) are aware of MOOCs, and even fewer (3%) have taken one. An unclear business model was the most common deterrent (54%) for institutions that have chosen not to offer MOOCs (see figures 3 and 4). One approach that shows promise is to use MOOCs to "flip the classroom," which means sharing background or lecture material online, then using face-to-face time for discussion and problem solving. Some institutions are using lectures from outside sources, such as Khan Academy or MOOCs, as a part of how they flip the classroom.

Figure 3: Reasons for Offering MOOCs

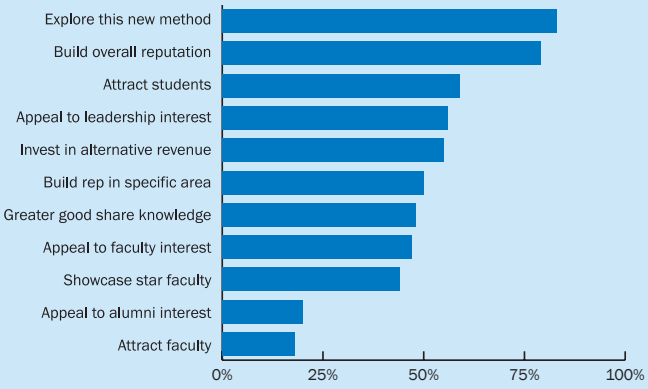
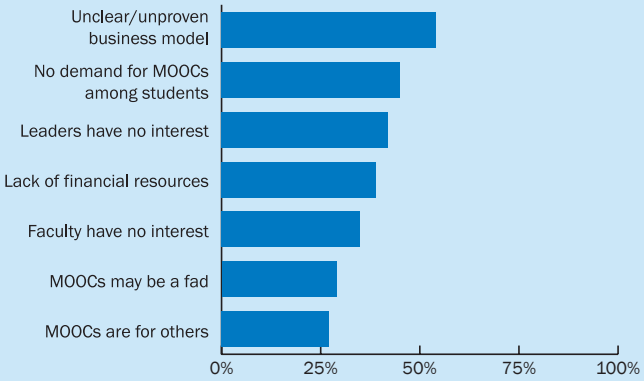


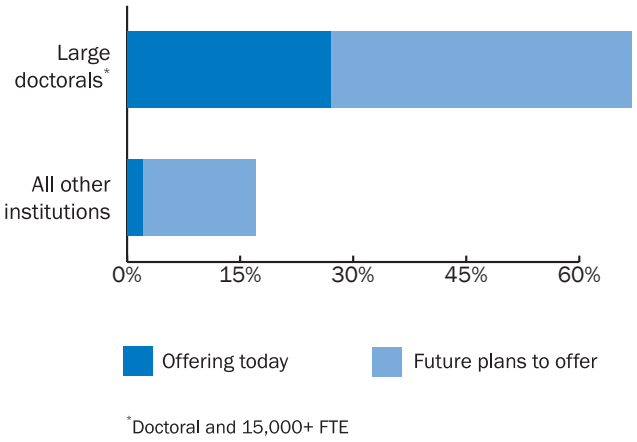
Figure 4: Reasons for Not Offering MOOCs



A clear technology strategy is the best guarantee for technology funding. Some strategies include:

- *Technology as a value differentiator*. Doctoral institutions are most likely to experiment with instructional technologies for pedagogy; they are most likely of all institutional types to incorporate games and simulations.
- *Technology to facilitate completion*. Early-alert systems that identify students who are academically at risk are most likely to be deployed at community colleges (36%), private bachelor's (38%), and master's (37%) institutions. Doctoral institutions (27%) and public master's institutions (29%) are least likely to have deployed them broadly.[19]
- *Technology to reduce costs*. Public institutions are more likely to deploy technologies that help reduce students' costs, specifically e-textbooks, e-books, and, particularly, online courses. Public institutions are also more likely to deploy technology to reduce institutional costs (54%) than private institutions (23%).
- *Reputational reinforcement*. Technology is being deliberately used—or avoided—to reinforce institutional brands. Private bachelor's institutions, most associated with traditional campus-based, faculty-intensive education, are least likely to offer online courses.[20] MOOCs, which can help extend the brand of both institutions and faculty, are almost exclusively a phenomenon of large doctoral institutions and are likely to remain so (see Figure 5).

Figure 5: Plans to Offer MOOCs



Conclusion

Technology holds exciting promise for education, but academia must always look beyond the tool—which can be intimidating to some and seductive to others—and focus on the goals of student outcomes and institutional efficiency. With this mindset, technology need not be disruptive, but rather a way to design the education of the future.[21]

Research Questions

To make the most of technology in education, we need to rethink the use of technology in the educational process.

Groups like the TIAA-CREF Institute, EDUCAUSE, and others can foster innovation and financial sustainability in higher education by exploring questions such as:

- Can a more efficient online delivery model avoid institutional costs and increase student retention through accelerated, self-paced degree completion?
- How might competency-based models and accelerated completion impact student costs, as well as institutional expenses and revenues?
- What type and frequency of student support increases the rate of student success? Educational pathway programs? Tutoring? Mentoring? Nudges? What is the return on investment (ROI) of these systems for students and institutions?
- What emerging technologies might have a significant impact on educational productivity and student success? Could tools like diagnostics, unobtrusive assessment, or animated pedagogical agents extend faculty and advisor time and skill? Could these tools ensure more students have deeper skills and greater transfer of knowledge to new situations?

EDUCAUSE

EDUCAUSE is a nonprofit association and the foremost community of IT leaders and professionals committed to advancing higher education. EDUCAUSE programs and services are focused on analysis, advocacy, community building, professional development, and knowledge creation because IT plays a transformative role in higher education. EDUCAUSE supports those who lead, manage, and use information technology through a comprehensive range of resources and activities.

1 All data about students and technology are based on the *2013 ECAR Study of Undergraduate Students and Information Technology* (Louisville, CO: EDUCAUSE Center for Analysis and Research, September 2013), available from http://www.educause.edu/ecar.

2 See http://vimeo.com/57394084.

3 See https://mitsloan.mit.edu/LearningEdge/.

4 Diana Oblinger, "Higher Education in the Connected Age," *EDUCAUSE Review*, April 1, 2013, http://www.educause.edu/ero/article/higher-education-connected-age.

5 See http://nextgenlearning.org/grantee/western-interstate-commission-higher-education-wiche.

6 See http://historyharvest.unl.edu/.

7 See http://www.apsu.edu/academic-affairs/degree-compass-and-my-future.

8 Russell Little and Michael F. Burns, "If You MAP the Way, They Will Follow," *EDUCAUSE Review Online*, August 5, 2013, http://www.educause.edu/ero/article/if-you-map-way-they-will-follow.

9 "New Initiatives Advance ASU's Effort to Enhance Student Success," ASUchallenges, blog entry October 13, 2011, http://www.asuchallenges.com/blog/new-initiatives-advance-asu039s-efforts-enhance-student-success.

10. Jill Frankfort, Kenneth Salim, Colleen Carmean, and Tracey Haynie, "Analytics, Nudges, and Persistence," *EDUCAUSE Review Online*, July 18, 2012, http://www.educause.edu/ero/article/analytics-nudges-and-learner-persistence.

11. Ronald Yanosky, "ECAR's IPAS Benchmarking Study: A First Look," presentation at the 2013 EDUCAUSE Annual Conference, Anaheim, California, October 2013.

12. Jacqueline Bichsel, "Analytics in Higher Education: Benefits, Barriers, Progress, and Recommendations" (Louisville, CO: EDUCAUSE Center for Applied Research, August 2012), available from http://www.educause.edu/ecar.

13. William G. Bowen, "The Potential for Online Learning: Promises and Pitfalls," *EDUCAUSE Review* (September/October 2013), http://www.educause.edu/ero/article/potential-online-learning-promises-and-pitfalls.

14. Erin Knight and Carla Casilli. "Mozilla Open Badges." In: *Game Changers: Education and Information Technology*. 2012. http://net.educause.edu/ir/library/pdf/pub7203cs6.pdf

15. Frederick M. Hurst, "Northern Arizona University's Personalized Learning," *EDUCAUSE Review Online*, September 4, 2013, http://www.educause.edu/ero/article/northern-arizona-universitys-personalized-learning.

16. See http://www.snhu.edu/ and http://nextgenlearning.org/grantee/southern-new-hampshire-university.

17. See http://www.kctcs.edu and http://nextgenlearning.org/grantee/kentucky-community-and-technical-college-system; also James E. Selbe and Sandy Cook, "Direct2Degree: College One Course at a Time," *EDUCAUSE Review Online*, August 5, 2013, http://www.educause.edu/ero/article/direct2degree-college-one-course-time.

18. IT spending on teaching and learning (39% of IT budget) encompasses more than educational technology services (11% of IT budget). Examples of IT spending on teaching and learning beyond educational technology services include student information systems and associated IT infrastructure. The remaining 8% of the IT budget (beyond administration and teaching and learning) is devoted to research (4%) and other areas that were difficult to classify (4%).

19. Ronald Yanosky, "ECAR's IPAS Benchmarking Study: A First Look," presentation at the 2013 EDUCAUSE Annual Conference, Anaheim, California, October 2013.

20. Preliminary results from the EDUCAUSE 2013 Core Data Survey.

21. Diana Oblinger, "Disrupted or Designed?" *EDUCAUSE Review* (July/August 2013), http://www.educause.edu/ero/article/disrupted-or-designed.

22. "What Campus Leaders Need to Know about MOOCs," An EDUCAUSE Executive Briefing, 2013, http://www.educause.edu/library/resources/what-campus-leaders-need-know-about-moocs.

23. Susan Grajek, Jacqueline Bichsel, and Eden Dahlstrom. "What MOOCs mean to today's students and institutions." ECAR Research Bulletin, October 7, 2013. http://www.educause.edu/library/resources/what-moocs-mean-today%E2%80%99s-students-and-institutions.

24. Jacqueline Bichsel, *The State of E-Learning in Higher Education: An Eye toward Growth and Increased Access*, Louisville, CO: EDUCAUSE Center for Applied Research, June 2013, available from http://www.educause.edu/ecar.

25. Ronald Yanosky, "ECAR's IPAS Benchmarking Study: A First Look," presentation at the 2013 EDUCAUSE Annual Conference, Anaheim, California, October 2013.

26. 2013 EDUCAUSE Core Data survey: http://www.educause.edu/sites/default/files/library/presentations/E13/SESS133/CDSResults_131010_corrected.pdf.