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Technology-Enhanced Education at Public Flagship Universities:

Opportunities and Challenges

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Ithaka S+R is a strategic consulting and research service provided by ITHAKA, a not-for-profit organization dedicated to helping the academic community use digital technologies to preserve the scholarly record and to advance research and teaching in sustainable ways. Ithaka S+R focuses on the transformation of scholarship and teaching in an online environment, with the goal of identifying the critical issues facing our community and acting as a catalyst for change. JSTOR, a research and learning platform, and Portico, a digital preservation service, are also part of ITHAKA.

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Executive Summary

Technology has changed both the possibilities for higher education and our expectations concerning it, and it would be surprising to find any college or university in the United States not thinking about the implications of technology-enhanced education for its own campus. With funding from Lumina Foundation, Ithaka S+R visited ten institutions from the Public Flagships Network (PFN) between late October 2013 and March 2014 to interview academic administrators, directors of online learning, chief financial officers, career services staff, and department chairs in order to understand their perspectives on budgets and business models, student consumption of higher education, and technology-enhanced education. We talked to 214 individuals in this process. The Public Flagships Network is a recently established consortium of 17 large public universities that are interested in better informing current policy discussions centered on opportunities for educational innovation, discovering new business models, and communicating the value of America's great public research universities. Members of PFN are keenly aware of the changes taking place in higher education, and they are committed to leading the transformation. To that end, PFN encouraged this study to better understand the current environment.

Overall, we encountered a lot of excitement about technology-enhanced education and some highly innovative practices, tempered by real limitations. Administrators have pinned great hopes on technology as one solution to tightening budgets, recognizing that more work needs to be done to develop coherent, university-wide plans to leverage technology to "bend the cost curve." Faculty, meanwhile, endorse the idea of improving student learning, and many have developed sophisticated, technology-enhanced courses. At the same time, there is palpable trepidation about the prospect of losing instructional autonomy.

Administrators are facing financial, legislative, and academic pressures to increase access to higher education and make it more affordable. The publicity surrounding MOOCs (massive open online courses), adaptive technologies, and hybrid courses has pointed to the potential for technological tools to address some of these pressures, but there are significant barriers to adopting these tools and considerable uncertainty about their impact. Administrators feel tremendous pressure to maintain and, ideally, enhance the competitive position of their institutions in terms of faculty talent and the quality of their programs. Some see potential in the new technologies for not only improving productivity, but also enhancing students' learning experiences. Public flagship institutions, by definition, serve multiple missions and audiences. Increasing, often vocal, demands are coming from all directions, and responding to those demands generally means that already constrained budgets are simply being spread thinner and

thinner. Technology may provide relief to some of these competing pressures, but only if there is a coherent organizational strategy for doing so.

Financial officers report that they have nearly exhausted the possibilities for streamlining operations, consolidating functions, and achieving efficiencies. Some universities are using a Responsibility-Centered Management model as a tool to push budget decisions to the college or departmental level, and all believe that better financial outcomes will require more creative solutions. Technology is seen as one of the possible tools. Administrators are hoping that technology-enhanced education might improve time-to-degree and completion rates, provide relief for space constraints, improve student learning, and fulfill their institution's outreach mission. However, the universities we visited have not yet fundamentally re-engineered the production function for teaching and learning in order to achieve those aims, and many faculty remain unconvinced about the potential for technology-enhanced education to do so. The formation of a Public Flagship Network is a significant step in acknowledging the need to work in new ways.

Even while administrators are responding to these pressures to change, students' patterns of consuming higher education are also changing. In increasing numbers, students arrive on the public flagship campus with a significant number of Advanced Placement and dual credits earned while attending high school, or with transfer credits from a community college offering general education courses at a lower tuition rate. While this helps students and their families manage the cost of a university degree, it creates new budget strains for departments. This is especially true in the humanities departments, which have traditionally been responsible for students' general education credits through large introductory courses. Now that fewer students are enrolling in these courses, their overall department enrollments have shrunk significantly, causing the department budgets to shrink as well.

At some institutions, students who bring in transfer credits are not graduating more quickly, but instead choose to take more upper level courses to replace the time they would usually spend in introductory courses. Since these upper level courses are more expensive to offer than the introductory ones, this pattern demands more resources from the departments. Faculty are also concerned that transferable credits don't prepare the students for their program's coursework.

In an environment featuring more technology-enhanced education, faculty members are constantly trying to balance their responsibilities to undergraduate teaching with requirements from their institutions that they remain active in research. Time is the greatest barrier preventing faculty from experimenting more with technological enhancements to their teaching. On all of the campuses we visited there is a trend

toward converting some of the tenured faculty lines into lecturer or professional teacher lines to make better use of limited budget resources, to devote more personnel to undergraduate teaching, and to preserve time for research for tenured faculty.

Budgets may provide the greatest incentive for faculty to experiment more with technology-enhanced education. On those campuses where revenue from online courses flows back to the departments generating them, there seems to be a greater interest in developing new online courses. Budgets are also the impetus for many of the PFN campuses to look into the possibility of consolidating technical support services for online learning.

On every campus we visited there were extraordinary examples of online courses and modules that have been developed by individual faculty members. Sometimes it is the young faculty member who has a deeper understanding of technology and who develops an innovative teaching method, but just as often it is the long-serving, tenured faculty member who is deeply invested in finding new ways to engage undergraduates in thinking and learning. Sharing ideas from these creative faculty among PFN institutions would go a long way toward exciting and inspiring other faculty to experiment in their own areas with technology-enhanced education. We found an appetite among faculty to know more about best practices and proven high-value resources.

There is interest from faculty in the general concept of collaboration, but there does not seem to be as much interest in using teaching materials developed by others. Faculty feel protective of the ways in which they teach their students. They develop courses based on what they believe their students need and, although they are happy to make their resources available to others, most faculty find it hard to accept that others could meet their students' needs as well as they do. Furthermore, proper incentives and infrastructure are not in place to encourage collaborative development and use of teaching materials; some faculty are skeptical about the potential to construct such a system.

Based on the innovations and collaborations that have been successful on some of the campuses we visited, we recommend some ways that PFN institutions can do more to stimulate transformational change:

» Administrators can more clearly communicate to students and faculty the value of technology-enhanced education, while being transparent about the costs and strategic drivers for pursuing online learning technologies.

» Institutions can create clear and meaningful incentives, such as release time or recognition, for faculty and departments to innovate with technology.

» Institutions will need to develop and promulgate clear plans for implementing online learning in both its stand-alone and hybrid forms.

» Universities should collaborate on the design and development of the infrastructure, and consider creating incentives for their faculty and units to facilitate cross-institutional collaboration.

Introduction

In September 2013 Lumina Foundation funded Ithaka S+R to undertake two studies in collaboration with the Public Flagships Network, a consortium of 17 leading state research universities. The first study involved visiting ten of these universities to conduct interviews with administrators and department chairs with the goal of understanding the needs, benefits, and challenges related to collaboration around technology-enhanced education (which includes all forms of online and hybrid courses.) The second study involved interviews with prospective employers to understand why they recruit (or choose not to recruit) students from public flagship universities. (This paper will only focus on the first study.)

We recruited ten institutions from the Public Flagships Network to take part in this initiative and developed relevant interview protocols. After securing agreement from the institutions, we began the interviews in late October 2013 and concluded them by mid-February 2014. We promised individual and institutional anonymity so that we were able to gather entirely candid perspectives from both administrators and faculty. A two-person team from Ithaka S+R spent two to three days on each campus, and we interviewed a total of 214 individuals across all institutions.

The interviews were conducted by Kevin Guthrie, Deanna Marcum, Richard Spies, and Nancy Fried Foster of ITHAKA's senior staff, assisted by Clara Samayoa, Christine Mulhern, and Derek Wu.

In every instance, we enjoyed exceptional cooperation and support from the host campuses. They shared information freely, and they made their resources and expertise generously available to us. On all of the campuses, we interviewed senior administrators, chief budget officers, directors of online learning, career services staff, and the chairs of at least ten academic departments. There were five core departments that we included on every campus: English, mathematics, economics, sociology and psychology. The others were chosen to reflect differences in size, academic field, and perspective.

What follows is a description of what we found on these ten campuses. We have attempted to provide, first, an overview of the two challenges faced by public flagship institutions—changes in budget and business models and changes in student consumption of higher education—followed by an in-depth look at technology-enhanced education at these campuses. We asked a lot of questions about collaboration during our visits, and our report thus highlights both obstacles that can stand in the way of collaboration and examples of its success.

We considered it a privilege to talk with so many dedicated educators in so short a time period, to hear of the challenges they face and learn about their experiments and dreams. We are grateful to all who took part.

Budgets and Business Models

All public flagship institutions worry about declines in state funding. Academic activities at these universities have traditionally been funded by the state, tuition dollars, public and private grants, and revenue from other institutional functions, such as housing. University budgeting has traditionally been allocated to different schools and departments based on criteria such as enrollment, university mission, and research agenda.

Most universities we visited use Responsibility-Centered Management (RCM) budget models. In these models, money is allocated to colleges and departments based on formulas related to enrollments with adjustments for considerations such as research needs. These formulas vary across the universities and contribute to the variety of incentive systems we encountered. As budget pressures intensify, these budget models, and the specific variation an institution employs, appear to influence the types of revenue streams departments and colleges seek and which costs they cut.

Public flagship institutions have been impacted by the recent reductions in state support for all segments of higher education. Increasingly, funding at most of these institutions has come from tuition and student fees rather than from state support. However, given pushback from students frustrated with rising tuition and, in some cases, a hard cap on tuition rates by the state, public universities have been forced to think seriously about exploring alternative revenue streams.

Responses to budgetary pressures at the university and departmental levels

All of the flagship universities we visited have incurred budgetary pressures that are primarily due to decreases in state funding. As a result, all of them are working to increase alternate forms of revenue and are actively looking for ways to reduce their costs. Most of the budget-enhancing efforts are traditional in nature and where there is innovation, nothing has been particularly disruptive. For example, we see universities cutting administrative costs and centralizing services in search of greater efficiency. Some have raised tuition and increased the percentage of out-of-state and international students they enroll in order to increase revenue. Others have tried to cut departmental costs by requiring departments to revert all vacant faculty lines back to the college for review before they are returned, reallocated, or cut altogether. A few departments have attempted to increase revenues by developing new courses or programs and are now

charging fees for supplemental services. Finally, we witnessed a few examples of universities partnering with private, for-profit institutions or vendors for funding.

The budget situation at the department level is more varied. Some departments have been largely isolated from budget pressures, usually by the deliberate action of a senior administrative leader who believes that the activities of that department are essential to the core educational and research missions of the university, or because of student demand for particular subjects and fields. Others have seen their budgets cut significantly and, in a few cases, departments are even facing the possibility of being eliminated or absorbed into other units. Most, however, have experienced real reductions but are managing to cope with the pressures and still meet their commitments to faculty and students. Still, a number of chairs mentioned that they believe they are at or are approaching the breaking point, because they believe education and research quality will suffer if the budget constraints continue. These faculty members have made modifications to deal with the current constraints, but few have attempted to fundamentally change the way they teach and operate.

Almost every department has reduced all kinds of small-expense categories such as faculty travel and graduate student conference support. Many have reduced support staff, and some are also facing the prospect of a university- or college-wide centralization of departmental support services. A significant and noticeable reaction to budget cuts is the increasing number of departments that are slowly introducing the notion of full-time instructors to teach some of the very large foundation or service courses, in place of (or sometimes in partnership with) tenure-track faculty.

While there is concern about the "unsustainable" business model, none of the institutions have thus far instituted a significantly different model at the university level. Even where state appropriations have been cut significantly, and where efforts to supplement on-campus teaching with a major online initiative are farthest along, the primary focus of both administrators and faculty is on trying to do the traditional things as well as possible with more limited resources. In other words, thus far, efforts have been incremental—not the profound re-engineering that may be required for meaningful change in a constrained budget environment. For this reason, the PFN is emphasizing budget models as the first area for collective action.

Shifts in budget and revenue structures as a result of technology-enhanced education

Even though completely new budget and business models have not emerged, we observed, in some cases, a slight deviation from the traditional budgetary system that

seems to be directly responding to the challenges mentioned above. Institutions are beginning to structure their revenue schemes in ways that enable departments to better benefit from enrollment swings and innovative technologies. In such cases, departments and some faculty are taking a more "entrepreneurial approach" to online learning. Universities have begun, either directly or indirectly, to incentivize the growth of online learning for increased enrollments because they see potential for these techniques to address budget pressures. Three examples of such strategies stood out to us:

1. *A nearly direct relationship between enrollment and revenue*. At one university, a number of the colleges have set up a structure whereby the amount of total tuition revenue received by a certain department is proportional to the percentage of the college's total student credit hours represented by classes in that department. In other words, a department that increases its enrollment increases the number of student credit hours it contributes to the college total, and thereby increases the amount of tuition revenue it receives. Consequently, there is direct incentive for many departments to increase enrollment in their courses, and many find that the easiest way to do this is to offer online classes. In the case of some departments, a portion of the monies generated through online learning is channeled back to the developing faculty member in order to encourage him or her to develop even more online courses. The colleges whose deans filtered this revenue before allocating it to the departments saw less incentive for their departments to increase enrollments through online courses or other means.

2. *Paying an extra fee for an online class to the department*. At another university, residential undergraduate students pay a fee of approximately $100 (on top of regular tuition) for each online course they take. This money goes directly to the department offering the course, which can, in turn, use the money to support graduate students, bolster operating budgets, purchase equipment, and so forth.

3. *Allowing tuition revenue from online courses to flow directly to departments, fee or no fee*. In some cases, universities keep a certain percentage (usually more than 50 percent) of all revenues generated by their online classes. Occasionally, this policy applies only for the winter and summer terms. In other cases it applies only when classes enroll students who are currently designated as "off-campus" (usually, again, during the winter and summer terms). The proportion of revenue kept by departments depends on the institution (it may be as high as 75 percent). Departments are thus encouraged to be entrepreneurial and, in some cases, they run online learning almost as a "side business." One economics department, for example, has generated nearly $1 million in revenue from its online courses. Consequently, while enrolled students are the primary audience for most online courses, departments' intent on maximizing revenue will often try to attract non-enrolled students as well. The funds from online courses are usually used to counter the effects of budget shortfalls faced by the department, which affect everything from graduate programs to faculty lines. In most cases, the revenue generated by departments from online courses was not enough to completely offset the losses they faced from budget cuts, but some departments came close to doing so.

The traditional cost mechanisms have also shifted, especially in regard to online learning technologies. We witnessed a variety of models for supporting the costs of online education at the faculty and department level, from college and central administrative to third-party support. While departments often bear the time costs associated with these

courses, the college or the provost's office may sometimes cover costs associated with the technology instruction and equipment. Such support commonly comes through centers dedicated to a combination of teaching, learning, and technology that are meant to support faculty and instructors. In some cases, such centers are funded directly by the provost's office, and in other cases they are more school- or college-supported and oriented. We also witnessed departments that had funds to compensate instructors for developing online versions of traditional courses and updating a course. In one particular institution, a department paid $15,000 to an instructor or faculty member for the cost of developing an online course and $2,000 on a yearly basis to update it. Unsurprisingly, a department's ability to cover these costs is generally correlated with its ability to generate and keep the revenue from online courses. Additionally, departments are also beginning to release faculty from some teaching obligations in order to develop online material. In such cases, the department will carry the cost of covering the teaching responsibilities for the period or semester.

We observed that these deviations from the traditional budgetary system are having a big impact on the way the colleges and their departments operate. Departments were much more entrepreneurial in their approach to developing online courses if they retained the generated revenue, whereas the approach was more political in departments belonging to colleges that kept the money to subsidize other departments and smooth out revenue flows.

All of the universities we visited continue to grapple with their financial model. A few believe that they will be able to sustain their current model for a bit longer, but most are looking for alternatives. There is some experimentation under way at various levels of the universities, but none appears to have found a sustainable model for resolving budget constraints and complexities. At this stage, it seems that most shifts and efforts in budgets and cost structures at both the university and department level remain ad hoc and experimental in nature. Although the universities have not yet moved to implement systematic restructuring in how instruction is delivered, the senior leaders of PFN institutions believe that it is vitally important that the membership takes steps to fundamentally re-engineer the production function for teaching and learning.

Student Consumption of Higher Education

As tuition costs have risen and the economy has fluctuated, students and their parents have become more aware of the costs and benefits of a university education. They want a degree from a public flagship university because of its value and national recognition. The traditional path to a college degree was to spend at least four years at one institution, but now there are alternative paths that include online and transfer credits. Students have begun to use the alternatives as a means for reducing costs and increasing convenience. An emerging trajectory is one where students take lower-level, general studies courses elsewhere and then take higher-level courses at a public flagship, where they ultimately obtain their degree. Students today are also earning more credits by taking high school courses that count for college credit and by taking less expensive, often less challenging, and more convenient online courses in the summer and transferring those credits.

Additionally, students are more job-oriented than in the past and many are seeking double majors to better position themselves in the job market. Many of them are thinking about internship opportunities as soon as they arrive on campus, something that was seldom on a first-year student's radar in earlier times. Finally, today's students represent a generation born into a world of technology and interconnectivity, although that does not always translate into interest in or adeptness in technology-enhanced education.

States' influence on university policies

For many years, the education interests of state legislatures have focused on the K-12 sector. More recently, however, there has been a more intense focus on the price of higher education, especially at a time when recent college graduates are having greater difficulties finding jobs and are incurring an increasing amount of debt. Some states with schools in the Public Flagships Network have passed legislation to address some of these concerns, whereby the flagship campuses have to adhere to certain policies, especially regarding transferring credits across public institutions within the state. Across the board, there appear to be increases in Advanced Placement (AP) credits and community college credits being transferred to public flagship institutions. The extent to which these transfers are occurring depends, at many universities, on the state's policy for how institutions should accept these credits. Some recent state policies have had significant impacts on the number of credits students can transfer, and on the way in which they can do so.

At one university system, state laws determine that high school students at the top of their graduating class will automatically be granted admission to the public institution of their choice. Additionally, the state mandated that any community college or university lower division core course that is listed in the state's Academic Course Guide Manual must be accepted for transfer at any other state college or university. Furthermore, students who transfer from one institution to another as "core complete" cannot be compelled to take additional courses to meet core requirements. Due to the combination of these policies, many "first time in college" students arrive with more than a semester's worth of college credits.

Another state mandated an articulation agreement between state universities and community colleges guaranteeing transfer to any university system institution for any student who graduates with an associate's degree and a 2.0 grade point average. In addition, students may also receive AP credits—which count for college credit—from high school courses. Similarly, one of the states mandated that public universities and colleges shift from the quarter system to semesters, accept a score of three on all AP exams for college course credit, and allow the transfer of credits among all public institutions of higher education.

However, contrary to what one might expect, these policies have not necessarily translated into a decrease in average time-to-degree. Instead, students take more upper-level courses or spread their course load in order to stay in residence for the traditional four years. The result is an increase in the cost of a college degree for the university because upper level courses are more expensive to offer. If students continue to opt for a traditional four-year experience, the impact of these policies on university finances will not be easy to observe. There is little impact on revenue received by the institution if students choose to earn four years' worth of credits from the university. No university has taken any steps to ameliorate this effect. They are just beginning to observe these patterns emerging and it is unclear to them how these costs will grow. This is a situation that requires deeper thinking by the administration, and clearer communication to students and their families.

In addition, the increase in transfer credits has drawn the concern of faculty at flagship universities; many of them contend that on average, students transferring credits from community colleges are not as well prepared for advanced-level courses as are students who earn all of their credits at the flagship campus. Faculty commented that they cannot be certain of the knowledge base of students who have earned credits elsewhere. Many educators have observed the development of a two-tier system at these schools, with one tier comprised of the students who begin their college work at the four-year institutions and the other comprised of students who transfer from a community college. Several faculty who expressed these concerns have begun to work with administration, their

local community colleges, and high schools in the state to coordinate curricula and to help teachers do a better job. To help ensure quality of frequently transferred courses, one public flagship university has started an initiative to develop lower division course materials that can be delivered using a common technology platform in multiple settings, including credit-bearing courses in high schools and community colleges, along with instructor training and support. A few other universities have developed online courses and sometimes offer them over the summer as a way to encourage students to take their own courses instead of community college courses.

Less controversial among faculty, but of equal concern to administrators because of budget implications, are the AP credits that are increasingly popular on all ten campuses. For example, one university reported 30 percent of entering freshmen bring a semester's worth of AP credits with them. Another university is also experiencing a significant increase in the number of students bringing in AP credits, mostly for humanities courses. The impact is felt most strongly at the departmental level, because the AP credits allow students to opt out of courses that they would normally need to take at the university, and therefore depress enrollments in introductory courses. Departments can no longer rely on foundation courses as part of budget calculations in the same way, or at the same level.

Greater emphasis on "practical education"

All ten universities are experiencing a decline in humanities majors, with corresponding increases in engineering and business. Nearly every faculty member cited a change in attitude among students toward a greater focus on future employment, a phenomenon even more pronounced among students' parents. The issue of the marketability of degrees from public institutions has led to more attention being devoted on all of the campuses we visited to the total undergraduate experience—internships, opportunities for extra-curricular activities that build leadership skills, more real-life examples in the classroom, and opportunities to network with outstanding practitioners in students' disciplinary fields. University staff, such as personnel in career services and other student services who help students find these experiential opportunities, take on increasing importance for the students' college experience. Career services staff, in particular, are beginning to get involved with students as early as their first and sophomore years. Internship experiences are also becoming increasingly important, given that a significant number of the internships turn into full-time job offers by a student's senior year.

Several of the universities report an increase in the number of students who earn double majors or who add a business minor to a liberal arts major. At one university a quarter

of all of the undergraduates are enrolled as double majors, in most cases to provide better chances of finding employment after college. Students believe that by having two majors, they may become more marketable to an employer and have better chances for an internship or full-time job. The increase in AP and transfer credits also enables students to complete more upper-level courses in four years.

Student expectations for a technology-rich environment

Current students were born into a technology-rich world; they have always used the internet and computers, and they have adopted much of the social media available to them. Not surprisingly, students are arriving at universities with increased expectations with respect to the integration of technology into their everyday lives. Furthermore, when they bring their laptops into the classroom, they also bring to class a world of information just one Google search away. Interestingly, despite students' technological experience, they are not necessarily savvy when it comes to taking courses online. While they pressure faculty to incorporate technology into their courses and encourage the university to equip classrooms with technology, they are not usually aware of how to take full advantage of the technologies themselves for educational purposes. For example, a number of professors mentioned that they needed to instruct students on how to engage with online materials or how to take a fully online course. This suggests that additional support may need to be provided to students in online courses, or that the course designs should take these student experiences into consideration.

Faculty report that they have changed their teaching methods to accommodate, in part, the difficulties many students have in staying engaged through the balance of a traditional fifty-minute lecture. Interactive learning provides a way to make material more relevant to them, and online courses enable them to consume educational materials in smaller pieces.

Students' desire for greater flexibility and more options

Quite apart from any consideration of online learning, students simply want greater flexibility in planning their educational programs. This concern is particularly acute in professional schools, as many of their students are already working or have family obligations, and they often look for flexibility in scheduling to determine the feasibility of taking certain classes to advance their careers. However, this concern is not limited to professional schools. A number of public flagship universities have many nontraditional students, who often work while taking classes. Flexibility for them may well mean the difference between earning a degree or not, or between paying an extra semester's or extra year's worth of tuition. By offering courses in all formats and at many different

times, these universities attempt to meet the needs of international students who may need some preparatory courses to be successful in their majors, working adults who need more options at unusual times, and double majors who juggle the requirements of two disciplines. All of the universities in our study realize that the "typical" student is no longer their only concern.

Innovative example

One public flagship university recently launched nine bachelor's degree programs that students will complete entirely online, as well as four bachelor's completion programs for students who have an associate's degree. The program is aimed at students who live around the state but cannot attend the campus for a variety of reasons. It is not intended to take away any of the current on-campus students, but instead to increase the reach of the university. The programs are created by the faculty within the traditional departments, and they have control over the content and format of the courses. The state gives additional funding to the university to provide resources and support for instructional design, hardware, and IT. The initiative was mandated by the state legislature in order to increase access to higher education, and the university sees this as a way to launch itself as a leader in the domain of online learning.

Technology-Enhanced Education: Challenges and Opportunities

Decreased funding from state governments and changing patterns in students' consumption of courses and credits have resulted in significant challenges for public universities. In many cases, university administrators and boards of trustees have pinned their hopes on technology to ameliorate the challenges they face. The promise of technology is that it enables new pedagogical methods, while also removing the need for students to be in physical proximity to the classroom for learning to take place. There are also hopes that it can reduce costs by decreasing the resources required for a course and enabling universities to scale up the size of courses.

Administrators have no illusions about the necessity for change in higher education, and nearly all faculty recognize that the old models of instruction are rapidly giving way to new, more interactive forms of learning. All faculty describe the need for better forms of student engagement, and yet, systematic efforts to take advantage of technology-enhanced education have been stymied by numerous impediments.

In this section, we take an in-depth look at technology-enhanced education at the public flagships. We first focus on three main challenges that arise with technology-enhanced education at the ten campuses we visited: the intrinsic conflict between the research and teaching missions of the university; confusion surrounding online learning; and barriers to adoption. Then we conclude this section by discussing the ways in which technology-enhanced education has addressed institutional challenges.

Intrinsic tension among missions

Major state universities serve many masters, including their governing boards, their state legislatures, and the people of the state. Attending to large numbers of students with disparate goals means that these institutions must also serve multiple missions. The challenge for all of the public flagships is that public expectations continue to increase while institutional budgets cannot expand to meet those expectations, and the university's multiple missions therefore compete for attention and dollars.

Public flagship universities carefully guard their research standing. While their faculty mention undergraduate education as one area of focus, they quickly acknowledge that they receive the most credit from their institution and their discipline for their research, and not for their teaching. Every public flagship university must deal with the built-in

conflict between the need to provide the undergraduate experience that its students and their families expect, and at an affordable price, and the focus on cutting-edge research that burnishes the university's "brand" and makes it competitive among its peers.

As a result of conflicts between missions, a number of difficult questions have to be addressed when a flagship university raises the possibility of a major new initiative: Which of the institution's missions is the initiative designed to serve? How effectively and/or efficiently does it advance that mission at this time? How do the opportunity costs of such an initiative affect the institution's other missions?

The possibility of a significant expansion of online learning raises all of these questions (not to mention many smaller ones). How—and how clearly—the leadership of a university answers these questions can have a significant effect on the pace and the ultimate success of any such initiative. When asked whether their institution has a strategy to take advantage of online learning technologies, most faculty reported that they were uncertain about what their university was trying to accomplish with online learning and why it should invest time and energy in the effort. Faculty's assessment of why online learning is being pursued varied considerably and included the following reasons:

» To increase revenue by expanding into new markets

» To serve a population of students that their institution was unable to reach previously

» To improve retention and completion rates by making courses available online to regularly enrolled students who have trouble taking or completing a face-to-face course because of scheduling issues and/or other problems

» To improve learning outcomes and teaching effectiveness by using technology, especially in hybrid classes, to "flip the classroom," and increase active learning

» To cope with increased enrollments or with a reduction in teaching staff and with the lack of sufficient classroom space.

Some universities we visited are currently developing an online learning strategy, and at most of them, faculty are engaged in experimentation with teaching technologies. The administrators often mentioned the need for a strategic plan in order to move forward, but they are still in the process of examining what forms of technology-enhanced education are effective and how to best incorporate them into their own setting. Many individual departments are not yet at a point where they are developing plans for technology-enhanced education. While a few chairs mentioned that their departments had committees on online learning, the majority said that they had not yet developed strategic plans and probably would not do so before they saw a university plan.

We observed that universities have multiple audiences, but when thinking about technology-enhanced education they have identified three primary target populations: undergraduates, graduate and professional students, and the non-enrolled public. Not surprisingly, each of these audiences has its own needs and each values different uses of technology as part of its education.

Undergraduate students value personal interaction with faculty and peers, as well as flexibility in scheduling their courses. As a result, hybrid courses appear to be a type of technology-enhanced education that is best tailored to their needs. Graduate and professional students value flexibility much more than do undergraduates, partly because many of them have jobs and families and/or do not live on campus. They have specific interests and may be more familiar with technology-enhanced education or more motivated to effectively engage with it than are undergraduates. Universities are developing graduate, professional, and certificate programs online to serve these students, and in many cases, to expand to new markets. The larger public outside the university is currently not interested in receiving certification, transfer of credits, or personal interaction with faculty, but rather value the accessibility of knowledge. By and large, MOOCs—massive open online courses—are beginning to serve this audience. Some universities have also created online courses for high schools, either as outreach to the students to encourage them to enroll in the university, or as an aid to teachers to help them bridge the curricula between the high school and university.

Different terminologies for online learning

Communication obstacles can arise at the public flagships from misunderstandings over terminology about technology-enhanced education. During our visits, we encountered an array of definitions and uses of the term online learning across universities and departments. Generally, there was confusion during our conversations surrounding what type of online learning we were most interested in, and some faculty members pointed to confusion within the university about what constitutes online learning. A few interviewees jumped directly to MOOCs when we mentioned online learning and were often quick to emphasize that faculty would never be replaced by MOOCs. In departments and on campuses where online learning is more prevalent, faculty understand the variety of potential formats and some of the costs and benefits of different approaches. The most common types of online learning we observed included fully online courses, the live broadcasting of lectures, hybrid courses, the posting of course materials online, and MOOCs. The extent to which each of these has been developed or adopted depends on the institutional context, faculty preferences, the discipline, and the target audience.

Fully online courses

Most faculty interpret online learning as meaning fully online courses, where students engage with the course and complete all of the work entirely online. Within courses considered "fully online," we identified three main types.

1. The simplest and most straightforward type of "fully online course" entails a professor recording his or her usual lectures and posting them on a course management system with associated readings and discussion boards. These types of courses do not usually involve much redesigning of content or organization, nor do they offer significant interaction between students and the instructor or between students and other students.

2. Faculty also develop their own fully online courses by selecting activities, readings, and outside videos to post on a course website and by designing modules for students to work through. While aggregating the materials is a lot of work and often requires redesigning the course, many faculty said they found this much easier and preferable to creating their own videos. They supply some supplemental videos or other online content, but students rely on instructor notes and readings for most of the content. The instructor usually communicates regularly with students through the course management site and discussion boards to maintain engagement, though this varies by course level and type.

3. Broadcasting of live lectures is the third common type of fully online course. This format involves streaming a professor's lectures to students at home or in another classroom. The synchronous nature of this method contrasts with the asynchronous possibilities inherent in the previous two methods. This method enables the professor to reach students who are unable to come to class, or to allow a greater number of students to enroll in an oversubscribed course than could be seated in a single classroom, while still preserving the integrity of a live lecture.

Hybrid courses

Hybrid courses are usually designed with the intent of "flipping the classroom." This involves having students "ingest" the content outside of class, such as through lecture videos or online activities, and then participate in activities in class to reinforce student understanding of the content. Instructors often reduce the in-class time (usually by half) to compensate for the additional work they ask students to do outside of class. Additionally, class time can be used more efficiently; for example, the instructor can focus only on those topics with which students are struggling or they can practice solving problems. Faculty feel that it is important to maintain some in-class time in these classes to engage students and provoke participation.

For both fully online and hybrid courses, some instructors incorporate videos from YouTube or Kahn Academy to replace all or parts of the lecture. There are also a number of departments, usually in math, sciences, or economics that use online homework

resources and platforms such as Pearson or Aplia, which provide a bank of quiz and homework questions and usually include the technology to grade assignments automatically. Finally, online adaptive learning technologies such as Carnegie Mellon's Open Learning Initiative (OLI) are used to replace some lecture content and as a course management system.

Innovative example

The chair of the psychology department at one public flagship university is using technology to enhance student learning experiences and outcomes. He developed a simulcast massive online course, to teach a 1,500-student introductory course in psychology in this format. The class is a broadcast, and students are required to remotely log in. Evaluations consist of daily, cumulative, and personalized quizzes done online during every session. As a result, the class time is then used for discussion sessions of groups of ten to twenty students led by teacher assistants or volunteer students. In these discussion sessions, the students use software that assists with group dynamics and triggers participation. This software encourages and facilitates a democratic student participation in discussions, interprets and analyzes group dynamics based on words and speaking frequency, and indicates the level of influence and collaboration taking place. There is no textbook required for the class, and all course-related material is also provided online, reducing the cost for students.

The team behind the online course has also been collecting learning analytics on its effectiveness and has been able to demonstrate improvement in student outcomes. The university is looking to apply this method to other courses, and is looking for ways to monetize the course for an audience outside the university.

Posting materials online

At every campus, almost all instructors use online course management systems, such as Blackboard, Canvas, or Compass. How they use such systems varies, from posting grades to uploading readings and videos. These systems are a portal of communication between faculty and students, and they provide students with a more transparent understanding of grading. A few faculty members see the use of such systems as teaching online, even if they are only using the system as a supplement to the traditional lecture. Most faculty are driven to manage their courses online by student demands; department chairs mentioned that students complain when a faculty member does not post assignments or grades online. Generally, the universities also seem to have invested in IT support for their course management systems and in some professional development.

MOOCs

Despite their looming presence and the shadow they cast across some of these campuses, MOOCs have not had a significant impact on undergraduate education. There are a few examples of professors who have taught a MOOC and regard the MOOC experience as a great way to develop raw educational material for their courses and to have their lectures professionally taped. Similarly, some professors are incorporating materials from their own MOOCs into their classrooms. Furthermore, the process of creating a MOOC has informed some professors about teaching approaches involving technology, which they are now incorporating into their own classes. Beyond that, we did not uncover any cases of students taking MOOCs for credit, even if the MOOC was developed at their school.

Innovative example

A department at one university has worked closely with private companies to explore new experiential models of online learning. The department has an innovative partnership with a global semiconductor design and manufacturing company to develop the first MOOC with a lab component. The university provides the course material and their corporate partner provides a device that students around the world learn to program, including in countries such as Brazil and India.

Barriers to adoption of technology-enhanced education

Faculty attitudes, roles, and responsibilities

Faculty attitudes toward online learning are not always positive. Some of this negativity stems from unfavorable reactions toward MOOCs, which (as described above) are what many faculty think of when asked about online learning. These negative feelings about MOOCs have bled over to other types of technology-enhanced education. Faculty truly believe that the undergraduate experience cannot be replicated with MOOCs because students need interaction, tailored information, and faculty engagement. Some faculty are concerned that students enrolled in online courses will not do the work outside of class, and many professors of hybrid courses mentioned that they involve much more work for the students and demand greater student independence. In some cases, negative attitudes towards online learning are due to preconceived notions, miscommunication, and lack of exposure. In other cases, faculty members have experimented with fully online courses and have seen poor results for student learning.

The consequence of these various developments and attitudes is that the adoption of online learning technologies by faculty has been slow.

The extent to which the previously mentioned formats of online learning have been deployed to instruct undergraduate students depends in large part on faculty perceptions of their effectiveness and the work involved in adopting them. Faculty seem more open to hybrid courses and the live broadcasting of lectures because the hybrid courses enable the professor to engage with the students, and broadcasting preserves some sense of the live lecture. Although faculty in general seem slightly less aware of the hybrid models than of fully online courses, those who have taught in the hybrid format often report positive results, usually because they have seen greater student engagement.

For the most part, faculty do not seem overly concerned about online learning, largely because it is seen as an addition to, rather than a replacement for, traditional face-to-face instruction. Faculty read the higher education press and know about the disruptive potential of online learning, but they still believe their role in educating students in the context of a strong research university will remain relatively stable. Furthermore, despite ongoing worry about the impact of financial changes and environmental factors, most faculty at public flagships consider their institutions to be among the "unthreatened elite" and regard them as having "world-class faculty" and great students.

The faculty's lack of time is probably the most significant impediment to integrating technology into the classroom. Faculty research obligations often take precedence over their other activities, which include investing in improving their teaching. The opportunity costs of integrating technology into the classroom are higher than traditional investments in improved teaching because teaching with technology requires more time and attention than do traditional forms of delivery. For example, it takes time for a faculty member to deconstruct a course and rethink its approach and delivery. He or she must know something about the latest trends in technology in order to create the online and digital materials for their courses. Additionally, it takes time to apply technology in the classroom effectively. As a result, non-tenure-track faculty often serve as the impetus for designing online/hybrid courses, mainly because they are more motivated to improve their teaching. Thus, in an attempt to align faculty incentives, some universities are providing faculty with additional funds for transforming or updating courses, or a partial release from other teaching obligations while such courses are being created.

As a way to deal with the limited time and multiple roles of faculty, a number of the departments we studied have hired full-time semi-permanent lecturers to help support teaching loads. Nearly all of the universities in this study have, whenever possible, moved away from the use of temporary adjuncts (who traditionally have been hired by

rapidly growing departments facing heavy student demands for introductory courses) in favor of employing full-time professional teachers under contract for a fixed period of time, usually several years. These instructors tend to feel more connected to the university and to the students than do adjuncts. The semi-permanent lecturers or instructors appear to be developing many of the online courses at institutions we visited; they often have a great deal of interest in pedagogy and are willing to invest more time in developing innovative teaching techniques than are research faculty.

Ownership of teaching materials

On all of the campuses we visited, it was clear that faculty view "ownership" of their courses as critical to their teaching role. This is a deeply entrenched piece of the culture at every research university, and it results in some of the best and most devoted teaching. However, the downside of this system of decentralized ownership of courses is that no one is in a position to mandate—or even to suggest, in most cases—that a course should be taught differently. If there were a pedagogical change that an institution's leadership believed should be implemented broadly across the university, they would almost surely have to sell that idea department by department, faculty member by faculty member.

Furthermore, online courses cannot be built and taught by a single faculty member operating alone. Online courses can require a combination of pedagogical, technological, and production skills, and the faculty member conveying the knowledge to students in an online course is often dependent upon others to fully realize the benefits. Moreover, administrators become involved in the process through prioritization and allocation of financial, infrastructure, and support-staff resources. As a result, no single faculty member has full control over an online course. Faculty have always had—and still have—sovereignty over what to teach, but the options offered by technology with regard to how to teach a course raise questions about who is involved in "making a course" and who is responsible for what kinds of decisions. Online courses also raise a number of questions about intellectual property, given their complex ownership structures.

Ownership is not the sole governance issue. Additional governance concerns arose with MOOCs because administrators felt they had to move quickly when MOOCs came onto the scene so publicly and rapidly. Some administrators pushed through decisions about participation on MOOC platforms without going through the typical course approval and governance processes. This has raised concerns on some campuses. Some universities have brought these questions to the Faculty Senate for resolution, but most simply observe the issues for now, make temporary administrative decisions to keep things moving, and continue to build a list of questions for later consideration.

Insufficient institutional infrastructure for support

Another impediment to online learning is the lack of technical infrastructure and resources necessary to help faculty and lecturers transition their courses into an online and digital format. We witnessed successful examples of faculty creating their own "home-grown" materials and of faculty working together with an instructional designer; however, it was evident that none of the universities yet has the system-wide infrastructure to support faculty in a way that is cost-efficient and streamlined. Extensive IT support and instructional designers were usually available in the professional schools to help their own faculty develop online courses, but this was not usually the case in other schools.

From our visits, we were able to identify at least three types of support centers now involved in helping faculty and students transition to a technology-enhanced teaching and learning environment. First is the general "Teaching and Learning" center that has traditionally focused on pedagogy, but is now shifting more attention to the pedagogical aspects of online courses and the development of new teaching methods to improve student retention and learning. Second, "Informational Technology" support centers have the technical expertise and skills necessary to help faculty implement the technologies in their courses. Finally, "Distance Learning and Continuing Education" centers or schools have experience in creating online courses and are able to lend some of their expertise and resources to others in the university who may be interested in bringing online education to a different population. Not every university we visited has all three of these centers, and some have centers that combine some of the described services. But all universities are looking at online learning technologies from multiple perspectives, and the expertise of each type of center seems to offer some value to the faculty engaged in technology-enhanced education.

The level of centralization of these services varies across universities. There is no single model used by all institutions and each model has its disadvantages and advantages. Many universities have launched initiatives from within the provost's office to centralize support, achieve greater efficiency, provide resources that some colleges may not be able to afford, and help move the university forward in the use of technology-enhanced education. However, there are some universities that have stuck with a decentralized model. This approach affords colleges more autonomy over the type of support services they offer, provides easier access for faculty, and may enable faculty to work more closely with support staff that are knowledgeable in their field of study.

Student preferences

During our visits, some faculty also mentioned cases in which resistance to online learning came from the "traditional," residential students themselves. While students seem to be arriving at universities with increasing expectations about the integration of technology into their everyday lives, such mindsets do not naturally translate to greater demand for online courses. In addition, we heard that some students do not like fully online or hybrid courses because they realize that these courses often come with greater responsibilities. At one university, students were found to be performing equally well in hybrid courses and in face-to-face courses. But when surveyed, students indicated that they significantly preferred the face-to-face version of the course because it required less work than the comparable hybrid. It was also reported by faculty and department chairs that students often choose to attend a public flagship university in order to have face-to-face interactions with faculty and to build camaraderie with peers. Although they like the option of some online courses, they expect the majority of their courses to be face-to-face. Moreover, this is closely tied to the perceived value of the education they are receiving.

Budget systems

At most of these universities, the budgeting system is viewed as a significant impediment to investing in online teaching technology, because integrating online technologies into teaching takes time, and there is no clear monetary incentive to do so. We identified at least two ways in which the budget system creates disincentives for departments and faculty to take on the use of technology in their teaching. First, for the most part, faculty are not rewarded financially, nor are they rewarded in terms of tenure and promotion, for their teaching contributions or innovations. Thus, most see little reason to dedicate the time necessary to create technology-enhanced courses. Second, if a faculty member or department wants to use technology to reach a broader audience and increase enrollments, the budget systems at many of the universities we visited are not set up to share with the department, let alone the individual faculty member, any significant monetary benefit from increased enrollment. Thus, there may be no financial incentive to develop online courses in order to increase enrollments.

Technology as a tool for addressing university challenges

Despite these challenges, faculty members and administrators believe that introducing technology into the classroom will help solve some of the challenges public flagship universities face in the twenty-first century. Throughout our visits, we were able to identify particular patterns in the way universities were using and integrating technology

in the traditional classroom to address challenges and opportunities related to budgetary constraints, student demands, and student outcomes, as well as the universities' competitive standing.

Improving time-to-degree and completion rates

Reducing students' time-to-degree and improving completion rates are important themes at public flagship universities. Some universities and departments see the potential for teaching technologies to help address these concerns. Bottlenecks in introductory courses are hurting time-to-degree, and universities are struggling to provide additional instructors or classroom space to mitigate these holdups. There are some examples of departments offering hybrid or fully online sections to students who cannot find a seat in face-to-face sections, and other departments have opted to move all sections of introductory courses fully online to ensure the accommodation of all students. This has been particularly important in the STEM (Science, Technology, Engineering and Mathematics) fields, where enrollment has been growing rapidly. Furthermore, schools are looking to summer online courses that students can take from home to help reduce time-to-degree. By putting courses fully online, the institution can enable students to continue to take classes in the summer and move towards graduation more quickly. There are also a few professors who have created online supplemental work and tutorials to help reduce the disparities in college readiness among students. The goal of these efforts is to help students who might otherwise drop out and move them toward completing a degree.

Innovative example

At one public flagship university, the newly appointed director of an education research center believes that online learning can make a significant difference in remedial education. As a full-time faculty member in the physics and astronomy departments, her research is focused on remedial, asynchronous online materials for students taking physics. One of her most successful efforts involves the development of online tutorials for introductory and upper-level physics courses, which are both problem- and concept-based. Tutorials are available online and adapt to the student's initial knowledge and learning abilities, and students can access them at their own pace. The professor describes the tutorials as a guided approach to learning that supports students on a need-to-know basis. The tutorials have helped the physics department bring student knowledge and learning up to the required college level, and they allow professors to use class time and face-to-face interaction with students in the most efficient and productive way. Through this center, the university is also exploring how these tutorials and approaches can be applied to other disciplines in the sciences and can help improve student readiness for college and retention levels, as well as reduce time to graduation.

Alleviating space constraints

Physical constraints also create bottlenecks, especially in large introductory courses that cannot physically accommodate all interested students. Because these courses often serve as prerequisites to advanced courses, students unable to enroll in them in a timely fashion may take longer to complete a major and to graduate. Departments often do not have large enough classrooms, or enough additional classrooms, to enable them to expand section sizes or add new sections. Online courses provide a way for the department and faculty to reach additional students without constructing additional classrooms or buildings. Space constraints are a problem for some of the public flagships, especially for those that are located within large cities or in other areas where expanding the original campus is simply not an option.

Meeting student demands for greater flexibility and more options

Some universities believe that students expect online learning to provide them with greater flexibility. While the majority of students at the public flagship universities still want the residential undergraduate experience, students are also interested in taking a few classes online for the flexibility they offer with respect to other courses, extracurricular activities, or work schedules. Various departments cite the importance of online learning in providing increased flexibility for athletes and for nontraditional students who have families and/or full-time or part-time jobs. Departments offering online courses can avoid some of the scheduling conflicts that are especially common in required introductory courses and bottleneck courses. More commonly, professional schools use online learning to meet the demand for flexibility from graduate students who work or live at a distance.

Improving student learning

A few faculty members state that they have been using technology in their classrooms to improve student learning. This is especially common within hybrid or flipped classrooms, where professors cite being able to use classroom time to engage student interest and participation in active learning. In addition, professors have found that incorporating effective tools and strategies, such as videos or adaptive learning platforms, allows them to transmit information more effectively than in a lecture. We encountered a few instances where faculty collected data on student outcomes in both a hybrid version and the traditional version of the same course and found improved outcomes in the former. However, there are also some cases in which students did worse in the technology-enhanced versions of courses, leading to concerns from some regarding these formats.

Innovative example

Online versions of courses often have been used to better support large service courses on campuses, which are typically overcrowded and lightly staffed. One of the PFN psychology chairs is interested in revitalizing delivery methods for learning and redesigning courses in terms of the technology available and the capacity to improve student outcomes. Several years ago she experimented with a "semi-hybrid" course at the university, and now she has taken it upon herself to teach and revolutionize an introductory psychology class that serves 2,500 students per year. Traditionally, this course consisted of lectures to over 1,000 students in auditoriums, but since spring 2014, the course has been flipped, with classrooms of no more than 45 students each. For this course, the students are expected to read and respond to questions from the psychology course material from Open Learning Initiative (OLI), before attending small discussion sessions led by the chair of the department and a team of non-tenured lecturers and graduate students.

This team is also beginning to collect data on student learning from the professor's previous hybrid courses to better understand the effectiveness of the online materials and make changes to the curriculum accordingly. They have also developed a fully online version of the introductory psychology class, and they are recommending that students take it during the summer before their first semester at the university as a way to ameliorate deficiencies associated with college readiness and to manage student expectations about online courses.

Avoiding "credit leakage" to community colleges

Some universities are creating online courses to avoid credit leakage, which happens when students earn credits at community colleges instead of their primary institution, and the related loss of tuition revenue to the community colleges. The first step in this strategy has been to offer summer online courses, which enables the university to offer students some of the credits they might otherwise choose to earn at a nearby community college while home for the summer. Most students who seek to transfer community college credits to a four-year institution are doing so because the credits are less expensive. We did not hear about instances of universities offering online courses more cheaply to encourage students to choose them over courses offered by community colleges, although we heard some discussion about this potential. Finally, there were a few cases of departments creating online courses to be offered through a community college to ensure that transfer credits are of good quality.

Responding to external pressures to innovate

Some administrators and faculty with whom we met are carrying out online learning in response to external pressures to be innovative. Administrators feel pressure to "stay in the game" and not be left behind in the online learning space, especially as their peer institutions are moving forward. They also feel pressure from their state legislatures to increase access to higher education and reduce costs. Furthermore, they are continually aware of cost pressures and the potentially mollifying effect of technology-enhanced education. Although we found little evidence of being able to reduce costs of providing education, universities nevertheless continue to look for any potential cost-saving mechanisms that may exist through technology-enhanced education.

Fulfilling the institution's outreach mission

Some universities maintain that online learning can help fulfill part of their outreach mission. Some are using MOOCs as a way to engage a broader audience as well as promote their brand. In addition, a few universities have provided their own online materials to high schools or community colleges to help improve their instruction.

Ameliorating budget constraints

The availability of resources, or the lack thereof, has had a powerful impact on the adoption of online learning. Although many faculty members believe that online courses of quality are expensive to create, we witnessed two ways in which online learning has helped address budget tightening, has reduced or maintained costs, or has increased revenue at the departmental level. A number of the universities have seen a reduction in faculty lines in recent years, and they do not have enough instructors to teach their students in the traditional manner. As a result, some turn to fully online courses as a way to teach more students with fewer faculty members or instructors. Although these courses may cost more to develop than their traditional counterparts, they usually cost less than hiring a full-time professor. It is important to note that these departments may not have seen online learning as the best way to teach students, but in some cases it was the only way to teach students given their limited available faculty or other constraints.

Online courses at several universities offer the potential for additional departmental revenue through undergraduate fees, summer tuition, or expanded enrollments. Some departments have found that online courses can enable them to increase enrollments (especially in elective and summer courses) and attract majors. Departments and universities that are particularly hard-pressed for money have looked to online degree programs or undergraduate courses as a new means of generating revenue. As a result, departments could make a net profit from online courses, if additional revenue

generated from an online course exceeds the increase in costs associated with that course. This depends significantly on the type of online course, the resources available to the department and faculty, the university's budget model, and how revenues and costs trickle down to the department.

Collaborations

The public flagship institutions have all come together because they believe that there is some merit in jointly addressing the common challenges they face. In light of the budget, student consumption and other university challenges, it is clear that there is a need to think carefully about how the universities should address these collectively. In addition to the potential for technology-enhanced education to ameliorate these challenges, collaboration may enable these universities to tackle their concerns more efficiently and effectively. We discussed the potentials for collaboration with the faculty and administrators we interviewed and tried to gain insight into the types of collaboration that would be most useful to these universities. University administrators and many funding agencies believe that technology-enhanced education offers real potential for reducing costs by inter-institutional sharing of curricular resources.

Faculty attitudes toward collaboration

Faculty are generally receptive to the idea of collaboration, as most have been collaborating on research projects for a long time. However, faculty see several barriers to collaborating on the development of teaching tools or online instructional models across public flagship universities. First, teaching has, up until now, been a highly personal endeavor. Faculty members take great pride in their courses, and many believe that their teaching styles and methods are best for their students. The flagship universities also take care in developing a brand that their graduates will be proud of, and are concerned about how their institutional reputation will be affected if students start taking courses elsewhere. Furthermore, there are differences in student bodies and content needs across and sometimes within institutions. Even in the common introductory courses, faculty members often mentioned the uniqueness of their content, and as an example of a challenge to sharing teaching materials, cited difficulties in finding textbooks that align with their courses.

When pushed a little bit farther, some faculty members communicated the benefits of using resources from elsewhere, such as textbooks or supplemental videos. They all recognize that there is great difficulty in designing an online course and believe there may be potential for collaboration to ease this process. However, there is something different about an entire course, of which faculty are deeply protective, and which they cannot imagine importing. Where there was willingness to collaborate on this front, it was more often willingness to be the contributor of materials than to be the consumer of someone else's materials.

Beyond the faculty ownership concerns, there were several technical and accounting limitations to inter and intra-institutional collaboration that faculty mentioned, most of which they did not think could be resolved. How would credits for teaching load be allocated when professors collaborate? Would the technological infrastructures be compatible enough to make sharing across institutions easy? How would the revenue from tuition flow across universities? How would they deal with different schedules across the universities? Would the time it takes to set up a collaboration be greater than the time saved by collaborating?

Potential for collaboration

We noticed a few pockets within universities where the greatest potential for collaboration appears to lie, or where collaboration is already taking place. The degree of interest in collaboration varied significantly by discipline. Professional schools are the farthest along in developing online modules and courses, and they indicated some interest in sharing and importing at least parts of these. For example, we found that nursing and pharmacy programs and schools of education seem particularly advanced in online learning and in collaborating to move forward in their discipline.

Some departments were facing specific challenges that they felt collaboration might have the potential to address. Departments with rapidly increasing enrollments, for example, are struggling to meet the needs of their students. (These departments were usually concentrated in the STEM fields.) Chairs of such departments mentioned that using courses or materials from elsewhere may help them serve more students without increasing the number of faculty. Similarly, departments that have seen drastic reductions in faculty lines are looking for ways to reduce the workload of faculty members with increased teaching loads. Collaboration may reduce the materials they need to create for teaching.

Alternatively, faculty mentioned cases where there are relatively few students, where collaboration between institutions might help achieve economies of scale. For example, a department that, by itself, does not have enough student demand to offer a specific course and make it economically viable could potentially benefit by collaborating with another university in co-teaching a course by combining students and resources. This is not atypical for graduate-level courses, and we heard some examples of departments and faculty (often in very specific fields) already participating in this type of cross-institutional collaboration. For example, the classics department at one public flagship university is collaborating with a smaller state university to teach Ancient Greek through videoconferencing, because the latter's classics department could not afford to offer the course on its own, given the small number of classics majors there.

These examples of collaboration at the universities we visited usually occurred within regional boundaries and pre-existing networks, or between universities that consider themselves peers. Physical proximity makes collaboration easier. Certain campuses are so close together that it has been easy for faculty from one institution to work with faculty from the other, and for students to go easily from one campus to another. University reputation is also an important factor for faculty when evaluating with whom to collaborate. Many faculty members mentioned that they would want to be careful about identifying the best partners based on shared interests and departmental quality.

Collaboration is most evident on campuses that are part of the Committee on Institutional Cooperation (CIC), a consortium of the Big Ten member universities plus the University of Chicago, University of Maryland, and Rutgers University, headquartered in the Midwest. There has been a broad effort across most institutions in the CIC to share courses in the rare languages; students can take courses from elsewhere online when these courses are not offered at their own institution. Members of the Big Ten have met in disciplinary or administrative groups for many years, and the personal trust relationships that have developed have led to a high level of information-sharing and some collaborative projects. Faculty also mentioned the Great Plains Interactive Distance Education Alliance (GPIDEA), which is a partnership of twenty public institutions that offer online courses primarily in agriculture and human sciences. A few faculty members at institutions we visited are active in this consortium, although most mentioned the challenges they faced and were skeptical about the potential to do something similar on a larger scale. One university expressed interest in further collaboration; its English department has an enormous workload in teaching writing courses for all students on campus, and the faculty would be greatly interested in using modules created by other Public Flagship Network institutions just to manage the workload.

Types of collaboration and faculty interest

Across the board, the greatest interest in collaboration was in sharing information on best practices for technology-enhanced education, as opposed to sharing content. Faculty mentioned that lack of information on online learning and the difficulty in creating online and technology-enhanced courses are major impediments to their adoption. They think it would be most helpful to know what others are doing and how they are achieving success with technology-enhanced education. There is also some willingness to share some of the materials and tools that have enabled others to use technology to enhance their teaching. However, it is important to most faculty that they be able to customize their courses and choose how to use the available materials. For this reason, there was little interest in sharing full courses for undergraduates. There

was modest interest in sharing specialized graduate courses, and possibly upper-level undergraduate courses, when the university does not have the particular faculty expertise. The general belief was that the introductory courses varied too much by institution and that they would be hard to standardize because of requirements for subsequent courses.

Innovative example

With a dual appointment in psychology and in the learning research and development center of a public flagship, one professor is exploring the use of online tools dedicated to supporting writing education across the disciplines. His most successful project so far is a digital writing tool that has been widely adopted, and has been used in higher education. The tool is a double-blind peer review writing system with additional bells and whistles that encourage students to take it seriously. No grading by an instructor, teaching assistant, or graduate student is required, but instead, an accountability system is embedded into the program. Students are automatically evaluated on the accuracy of their feedback and the helpfulness of their comments. The tool has been demonstrated to improve student outcomes as well as help departments and faculty manage their resources. The professor mentioned that, to the best of his knowledge, the tool has 25,000 users, and it was recently licensed to a startup company.

Conclusions

The Public Flagships Network was formed to share ideas, best practices, and policy solutions to common institutional challenges related to educational productivity and excellence. The PFN believes that technology-enhanced education offers great promise for improving student learning, institutional efficiency, and enabling and sustaining new business models that are consistent with the educational and research missions of America's leading public research universities. The opportunities are enormous for this set of prestigious institutions to make real and lasting change, but these changes will need to be bold and purposeful.

Despite budget reduction at the state level and shifts in department budgets from the rise in transfer credits, departments continue to manage themselves in ways that are well known and comfortable. We found that many of the departments have replaced tenure lines with lecturer positions because they can hire several lecturers for the cost of a single tenure-line faculty member. Universities are loathe to interfere with the way departments carry out their obligations, but perhaps the time is right to reward departments that experiment with new business models for their work.

Working with the "coalition of the willing" is the line of least resistance for university administrators, but for broad-based change to occur strategic efforts are needed. The similar challenges faced by the PFN institutions make them prime candidates for finding collaborative solutions and for thinking big. What is clear is that relying on the volunteer efforts of a few faculty with entrepreneurial spirits will not bring the widespread change that is going to be effective in the long run.

While there is a strong realization that change is necessary, institutions are in the early stages of this work, and much more will be required to develop new business models that effectively leverage new technologies to help maintain or improve quality while controlling costs. Especially among faculty who have not experimented with online learning, there is a nearly universal belief that the traditional small class with a professor is the superior method of learning. Many students, while they look for opportunities to transfer credits from less expensive community colleges and take online courses for the sake of convenience, still expect to have a four-year "college experience" on a campus. The traditions of undergraduate education are strong.

However, the mission of the public university is broad. To take a single example, one public flagship university's mission statement asserts that the institution will "transform lives and serve society by educating, creating knowledge, and putting knowledge to work on a large scale and with excellence." Assuming for the moment that the mission

statement is meant for vast numbers of people, not simply for the number currently enrolled, technology-enhanced education could offer the greatest promise for meeting the educational part of that mission.

Yet, on the ten campuses we studied, for the faculty, deans, and administrators, world-class research is what primarily defines the public flagship university. Although all of the institutions are making dedicated efforts to improve the undergraduate experience, faculty are well aware that if they are to receive the benefits of tenure, it will be based on their research capabilities. On every campus, we heard concerns from faculty who would like to experiment with technology-enhanced learning modules for their students, but worried about the investment of time and effort that would be required to begin teaching in an entirely new way. Online learning modules with high production values require additional human capital investments, as well. Faculty need a significant amount of help in producing online content, and they will need technical support and encouragement to do so. Some of the campuses have made progress in this area already by establishing centers to provide this kind of support. Perhaps the flagship institutions can highlight their interest in developing better online learning experiences by giving awards for online teaching, as well as for traditional teaching.

We saw on each campus some extraordinary efforts by individual faculty. Often we learned that the work they are doing is little known, even on their own campuses. We believe efforts within the PFN to highlight and promote successful initiatives would be helpful to many faculty. For many, just seeing examples of the work others are doing is enough to spark ideas for their own disciplines. Including lecturers who are not tenure-track in these examples would also help deliver a message about how the university values time spent on these initiatives.

There are some steps that PFN institutions can take immediately to begin to stimulate transformational change:

1. Communicate clearly the value of technology-enhanced education to students and faculty while being transparent about both the costs (including the loss of cherished traditional practices) and the true strategic drivers for online learning. A few schools have undertaken broad-based communication efforts on their campuses, but much more is needed. Faculty need to see evidence of successful programs, and they need to understand what the tradeoffs are. Among departments, we noticed that those that were most enthusiastic about experimenting with technology-enhanced education tended to be departments in which colleagues also collaborated with one another and shared best practices (through brown-bag seminars, for example), while the less enthusiastic departments were more likely to emphasize greater autonomy at the instructor level.

2. Create clear and meaningful incentives for faculty and departments to innovate with technology. Currently there are clear disincentives for innovation—primarily in terms of the faculty time required and the lack of any "credit" or reward for the efforts of either individual

faculty members or departments—and the incentives are unclear. Where specific incentives have been offered, often they have been too small to have any meaningful impact. Incentives can be financial (more important for departments than for individuals), but institutions would do well to consider other incentives, such as recognition and respect. It would be especially helpful for institutions to reward departments that encourage professional teachers to create innovative learning materials and to acknowledge these as intellectual contributions. Examples of incentives that appear to have most meaning for faculty include acknowledging a professor's work in innovative teaching methods in online learning in his/her tenure or promotion review; providing course relief for professors who develop online courses; paying professors an additional amount to develop or update online courses; and allowing revenue from online courses in specific situations to flow back to the department. In our visits, we noticed that the departments that were most successful in taking advantage of technology-enhanced education to both enhance teaching and address budget shortfalls were also those that were most entrepreneurial and willing to experiment with different forms of teaching.

3. Develop and promulgate clear plans for implementing online learning in both its stand-alone and hybrid forms. Even though any such plan will have to be tentative about many of the details, it can at least set clear goals (i.e., articulate the reasons for implementing online learning), lay out the incentives and rewards that have been constructed for the first phase of the plan, and identify some number of pilot projects. The absence of any clear statement from leadership about what they hope to accomplish makes it easy for everyone else to fill in the blanks based on their own personal biases or, worse, to opt out.

4. Provide the resources needed to facilitate an easy transition to online learning. This includes developing the university infrastructure as well as support services that faculty will need. The Public Flagships Network may be able to collaborate on determining the best way to facilitate the transition and to provide some of the resources or information faculty seek.

5. All of the public flagship universities recognize the need to re-engineer the teaching and learning production function. This may be an excellent opportunity to develop collaborative programs that help all of these institutions make progress in this area.

The Public Flagships Network could emphasize the value of collaboration by developing a meaningful demonstration project in a core arts and sciences discipline and recruiting five to ten similarly situated institutions from within the PFN membership—institutions that are also similarly inclined to take some risks—into an ad hoc consortium for that project. Possibilities include such service courses as calculus or statistics, or broad foundation courses in fields such as psychology or economics. The goal would be to develop a course or courses that could deliver that portion of the curriculum to all of the campuses in the group in a way that, by virtue of this collaboration, was both more effective and more efficient.

The PFN should also explore whether collaborations among the leaders of campus-wide online instructional technology support would be beneficial. These leaders are well-positioned to assess what parts of the infrastructure are shareable versus what aspects need to be managed locally. They are also a potentially effective conduit for sharing best practices and examples of successful initiatives.

Finally, the PFN can also encourage collaboration among financial officers and provosts on these campuses to think collectively about changing business models, to experiment with new models, and to communicate effectively about the results with faculty. Faculty are often isolated from the facts about budgets. They know that budgets are a challenge, but they have little understanding of what the options are, or of how tradeoffs are negotiated.

The Future Agenda

The Public Flagships Network is borne of a need to re-think public higher education. This is a herculean task, but by consolidating efforts and learning from one another's successes, this group has the capacity to make real and lasting change. We note that, from our vantage point, it is unusual and important that these seventeen institutions that constitute PFN have already begun these discussions, and there may be benefits in exploring new kinds of cross-institutional collaborations to tackle these challenges. For example, institutions can collaborate in the design of their instructional technology and data infrastructures, to facilitate cross-institutional sharing of content and learning analytics. Some institutions have also begun to collaborate with each other on how they consume and analyze learner data from MOOCs. On the horizon is the question about whether and how institutions might share digital content—not only to leverage each other's resources and distribute the costs of creating content, but potentially to enable new kinds of learning experiences that transcend the traditional limitations of physical campuses.

From our interviews with a wide range of individuals from all ten campuses, we believe these should be the broad areas of focus for PFN over the next few years:

1. The current situation at the PFN institutions, and universities more broadly, suggests the need for re-thinking and re-engineering the educational production function. By thinking and working together, the PFN institutions can test and create new methods for redesigning learning methods and achieving cost reductions in higher education.

2. There is an inescapable tension between the need for a somewhat centralized approach to technology-enhanced education, with a clearly defined set of expectations and incentives, and respect for the insights of the faculty members. Few presidents want to upset the balance in shared governance and are questioning how to move forward. Discussions that take place within the context of PFN should help diminish the personal concerns and allow administrators and faculty to focus on the broad issues.

3. Technology-enhanced education raises several important questions about intellectual property and it is a generally uncharted territory. Significant work needs to be done in this area and PFN institutions can benefit by working collectively on identifying these issues and determining ways to address them.

4. Across these universities there is a trend toward less reliance on tenure-track faculty and more reliance on some mix of lecturers (a professional "teaching staff") and adjuncts. Universities are compelled to address evolving—and needed—changes in staffing patterns and the PFN should discuss the right balance for sophisticated research institutions of the 21st century.

5. Both administrators and faculty must be involved in the process of making decisions about trade-offs between cost savings and the quality of the undergraduate education and research. The PFN could be a productive channel for these conversations.

6. It is hard for most faculty to imagine that someone else's materials will be better for the students he or she knows so well. This is a significant culture problem that will require time and sensitivity to address. The PFN needs to work together to find the right degree of "customization" of courses and to develop ways to introduce this notion in ways that do not undercut the commitment each faculty member has to his or her students.

7. Pressures to change often come from sources other than the administration/faculty. They come from budget cuts imposed, de facto, by legislatures and resistance to rapid tuition hikes, students seeking to cut costs by transferring credits, and in some instances directly from legislative mandates. PFN should collectively study, understand, and develop strategies to respond to these external pressures.

8. Given the changes in student interest in flexibility and untraditional means for earning a university degree, it is important to think about how this will continue to effect universities and how the PFN can craft innovative responses to these patterns.

9. We have offered ideas for encouraging the PFN to mount some small number of well-thought out demonstration projects, targeted at particular problems that are widely shared, with the idea that success in any of these areas could stimulate other efforts. PFN is in an excellent position to experiment with new ideas and to encourage others to try to do the same.

10. Finally, serious attention needs to be given to experimenting with new business models in higher education. Administrators recognize that the current model cannot be continued much longer, especially as students' consumption of higher education changes. This is an urgent need for research and experimentation that is acknowledged by all of the PFN institutions.