Transforming Learning Through Technology: Educating More, Costing Less

BY CAROL A. TWIGG

TAKEAWAYS

1. Face-to-face instruction has been held as the gold standard of a quality academic program. But using information technology to redesign traditional courses can actually improve the quality of teaching, cut costs, and improve access and success.
2. A strong redesign often involves active learning opportunities; individualized, on-demand assistance; a balance between traditional and technological approaches; and a differentiated use of instructors and faculty members.
3. Improving learning through technology requires more than putting courses online. It means rethinking the way instruction is delivered, and it can be challenging to faculty and staff members. The support of boards and institutional leadership are the keys to success.

HOW CAN YOUR INSTITUTION IMPROVE academic quality? How can it control costs? How can it increase access and graduation rates? At the National Center for Academic Transformation (NCAT), we are working to help colleges and universities use information technology to resolve those major challenges.

We have found that technology can in fact be the key to raising quality, reducing costs, and improving access and success. But for colleges to use technology effectively, they have to confront a number of assumptions that can get in the way. Those assumptions include:

- Improving quality means increasing cost and, conversely, if you cut costs then inevitably the quality of education will go down.
- Information technology on a campus is a black hole of operating expenses—rather than an investment that can help deal with institutional problems.
- Using information technology in an academic program will threaten quality. Many people on campuses still believe that online learning might be okay, but the gold standard remains the professor in a classroom nose-to-nose with the student. And, recent surveys by the Pew Research Center and the *Chronicle of Higher Education* have found that even fewer among the general public believe online courses offer value equal to traditional ones.

We in higher education must rethink those assumptions and use technology in more innovative ways. How have we commonly used technology in the past? The two predominant forms of instruction on our campuses are the stand-up lecture—not just in lecture halls of 200 students but also

A New and Improved General Biology Course
Fairfield University (Fairfield, Conn.)

Fairfield University wanted to enhance quality by providing greater individualized instruction. Faculty members knew that students came to the general biology course with different backgrounds and levels of interest in the subject, and they wanted to find ways to engage all those students.

They wanted to focus on higher-level cognitive skills—to get away from an emphasis on memorization and move towards the application of scientific concepts. They wanted to create interactive learning environments in both their lectures and their labs to illustrate difficult concepts, to allow students to practice certain skills and test certain hypotheses, and to encourage students to work together to enhance their understanding of complex topics. They wanted both team-based and independent investigations.

How did the redesigned course differ from the traditional format? In the traditional course, professors taught seven relatively small sections of 35 students each, but they readily admitted that they all used the same lecture format. In the redesign, they cut the number of sections and enlarged them so they each had 140 students. But within those larger sections, they broke students into smaller learning teams to work on projects.

In the traditional format, seven faculty members were needed to teach the course, whereas the redesign only required four faculty members. The other three faculty members went on to teach advanced-level subjects that they couldn't have taught before because the institution didn't have the resources.

Results: The cost per student dropped from an average of $506 to $350. Faculty members saw significantly better mastery of content. The next course enrollment in biology went from 75 percent to 84 percent, so they were also retaining more students in the sciences.

in classes of 30—and smaller, more interactive seminars. We've simply bolted technology onto those existing formats.

Thus, for many years, the prevailing use of technology was the professor teaching on television, beamed out across the state, the nation, or the world, and essentially doing what he or she had always done in the classroom but with a wider audience. Currently, the most popular way to use technology is in the small online seminar where students meet with faculty members online, have discussion groups, and go through the course more or less as they would in a traditional classroom—except everything is happening on the Internet.

But while such approaches have increased access and flexibility for students, they have done little to improve quality. And they have not reduced costs because they simply added the cost of the technology as an additional layer on top of the cost of instruction.

New Approaches, Big Results

At NCAT, we wanted to see if we could challenge colleges and universities to rethink the way in which we mix technology and instruction so that we could both improve the quality of teaching and reduce the cost. Supported by the Pew Charitable Trusts, we conducted a national competition involving hundreds of institutions that were willing to step forward, and we ultimately selected 30 institutions to embark on large-scale course-redesign projects.

What does NCAT mean by course redesign? It is the process of redesigning whole courses, rather than individual classes or sections, to achieve better learning outcomes at a lower cost by taking advantage of information technology. Course redesign is not about putting courses online. It is about rethinking the way we deliver instruction, especially large-enrollment core courses, in light of the possibilities that technology offers.

We have focused primarily on large-enrollment introductory courses because they are often the freshman courses that make a big difference in whether or not students stay in college and succeed. We all know stories of kids who come to college intending to be doctors but who can't pass the first chemistry course. So our efforts are targeted at those crucial courses.

The initial 30 projects involved about 50,000 students and a good cross-section of institutions: community colleges, research universities, comprehensive state colleges and universities, and private institutions. We had 13 projects in quantitative areas (mathematics, statistics, and computer programming). We also had five projects in the natural sciences (biology, chemistry, and astronomy), as well as six in the social sciences (psychology, sociology, and American government). To round out the disciplines, we had six projects in the humanities (two in English composition, two in Spanish, one in fine arts, and one in world literature).

The bottom line: Of those 30 projects, 25 showed significant improvements in student-learning outcomes. The other five showed learning equivalent to what had occurred in traditional formats. And all 30 reduced costs.

In a freshman biology course at the University of Massachusetts, for example, faculty members did an analysis of their final exam before the redesign and found that about two-thirds of the questions tended to focus on terminology and memorization, and only about one-third focused on problem-solving skills. After the redesign, that ratio flipped: About two-thirds of the exams focused on higher-order skills. Yet students had better overall scores on what was a far more difficult exam.

We also looked at changes in course drops, failures, and withdrawals. Of the 24 institutions that measured those differences, we saw improvement in 18. For example, before the redesign of an algebra course at the University of Alabama, only 40 percent of the students successfully passed the course. After the first year of the redesign, the number rose to 60 percent and eventually to 80 percent. Before the

Six Models for Course Redesign

Current redesign models run a continuum from face-to-face contact to a fully online course. They include:

Supplemental model: keeps most of the traditional course format but adds elements outside of class to help prepare students better to come into class. It also changes what goes on in the class by creating an active learning environment within a large lecture-hall setting.

Replacement model: starts to replace the amount of time you spend in class with online instruction.

Emporia model: moves all classes to a lab setting featuring interactive computer software and on-demand personalized assistance.

Buffet model: allows students to pick and choose different ways of learning the same content within the course.

Linked workshop mode: eliminates developmental courses and offers instead "just-in-time" workshops linked to a college-level course.

Fully online model: eliminates all in-class meetings and moves all learning experiences online. These online courses are quite different than the ones you're used to thinking of with 20 students in a section. They may have 1,000 students in a section and have automated many of the course offerings.

redesign of an English composition course at Tallahassee Community College, 46 percent of the students didn't pass the course; after the redesign, that number dropped to 25 percent.

Meanwhile, all 30 projects reduced their costs and collectively produced annual savings of about $3 million.

Since the success of the initial Pew-supported program, we have created a national organization of institutions and companies that are interested in redesign. We've completed about 120 course redesigns, involving about 160,000 students nationwide each year. Looking at overall averages, 72 percent of these projects had improved student learning, with the rest showing learning outcomes equivalent to courses with traditional formats. The redesigns also reduced the cost by an average of about 37 percent, with reductions ranging from 9 to 77 percent. We calculate the annual savings for these courses to be $9.5 million to $10 million.

Other outcomes that have been achieved through the redesigns: increased course-completion rates, improved retention, better student attitudes toward the subject matter, and greater student satisfaction with the mode of instruction.

Lessons Learned

Based on our extensive experience, we can say with certainty that our redesign methodology will work with any discipline. It will work with 18-year-olds right off the farm, as well as working adults in distance-learning programs. It will work with institutions that are large and with those that are small. It will work with courses on campus as well as courses offered at a distance. It will work to redesign current courses or as a method for creating new courses. It will work both at the introductory level and the advanced level.

That's because it's a general methodology, not a fixed way of doing things or a "one size fits all" approach. The redesigns do, however, have some common characteristics and provide some clear lessons:

Redesign the whole course. If you're offering 40 sections of algebra, for example, redesign them all. You will get much greater quality control, cost reductions, and consistency of learning outcomes.

Emphasize active learning. Rather than viewing the professor as the sole purveyor of knowledge, successful redesigns engage students with the content in much more active ways. One of our favorite sayings about mathematics is that students learn mathematics by doing mathematics, not by listening to someone talk about doing mathematics. And you can apply that to biology, Spanish, English composition, and so on.

Use existing software. The great majority of redesigns take advantage of software that's available in the commercial marketplace—being produced either by the traditional textbook publishers or by new software companies. In fact,

A Developmental-Math Sequence Gets a Makeover
Cleveland State Community College (Cleveland, Tenn.)

The courses are organized into 10 to 12 mini-modules, rather than a traditional classroom format, and students are expected to complete one per week. They may go as quickly as they can, so some students finish more courses than one within a semester. They move through the sequence much more expeditiously than in traditional classes.

Also, instead of meeting in a traditional classroom, students now spend one hour in a computer classroom and two hours in a lab each week. The lab is open about 54 hours per week and is staffed by both instructors and peer tutors. All homework and testing are done online.

Results: In the past, an average of about 56 percent of students successfully completed the developmental-math program; after the redesign, 79 percent of students successfully completed it. Cleveland State's overall college-retention rate after the first year of redesign increased by 7 percent, and administrators attribute that directly to the redesign. It also is saving more than $50,000 annually. Faculty productivity has risen by 23 percent.

The college has also dealt with low-enrollment classes through course redesign. It offers a "one-room school house"—three different courses in one class section. Instructors can easily answer students' questions as they're moving through the software.

That allows the college to offer every course at each campus, so students have a much better chance of completing their programs on time. (For descriptions of more than 100 large-scale course redesigns, see the NCAT Web site at http://www.theNCAT.org/.)

something like 1,000 companies produce instructional software. By using commercially available software, faculty members can focus on pedagogical and organizational issues rather than trying to become software developers. That makes the process much more efficient.

How do students use the software? Some use it independently. They may work on math problems at 2 a.m. in their dorm rooms. But more frequently, you'll see students working in teams on group projects in class, where they use the computer both as a problem-solving tool and to support interactive learning.

Increase the amount of on-demand individualized assistance available to students. All the redesigns try to help students on demand. Sometimes that help is face-to-face in a lab; other times it is online. But the notion is to teach students when they're having the problem—not force them to wait until they have to come to class. By that time, they've probably lost interest or given up.

Automate only those aspects of the course that make sense to automate; leave other parts in the traditional format. The redesigns are not typical online courses. Some are fully online, but the great majority of them have face-to-face elements.

Faculty members designing the course ask, "What aspect of this course would really benefit from automation?" And they come up with things like grading homework, which is a repetitive task that a computer can do much more quickly and effectively than a human grader. But they also decide that, in some class discussions, they want to maintain face-to-face discussions. They make those choices within the constraints and characteristics of their particular disciplines.

Replace a single mode of instruction with a much more differentiated personnel strategy. I've always had a mental image of our nation's campuses: little boxes of individual instructors standing in front of classes all basically saying the same thing, over and over. Think about all the college algebra courses going on right now where everybody is doing the same thing.

In the redesigns, people ask instead, "Does everybody have to do the same thing? Could we divide our responsibilities differently? Could the software do some of these things? Could peer tutors be more effective at other kinds of tasks? Do we all need to work on the syllabus individually or could we work collaboratively? Could we team-teach pieces of the course?" And the result is many variations on courses.

Consider the law-firm analogy: You don't send the senior partner to do legal research. In higher education, we've made similar changes in using teaching assistants, but generally the way we've used them is either as the professor's handmaiden or a "mini me." The redesigns bring the right amount of resources and personnel to the task at hand. We found, for example, that peer tutors have been far more effective than graduate students when they're properly trained and supervised. They have a much greater rapport with undergraduate students.

Implications for Faculty and Board Members

In higher education, we know what good pedagogy is: encouraging students to spend more time on task, giving them frequent feedback, and so forth. But although you can do that fairly easy with a class of 15, it's much more difficult with a class of 1,000. Technology enables you to practice good pedagogy with large numbers of students.

What do faculty members say about the redesigns? Some quotes from faculty evaluations of our projects suggest the answer: "It's the best experience I've ever had in the classroom." "The quality of my work life has changed immeasurably for the better."

Why such high praise? Faculty members are often in a lab setting. They move among students, work with them on projects, and get to know them by name. They feel as if they're truly accomplishing something.

They also say it's a lot of work during the transition. Taking on one of these redesigns is not a light task. But the great benefit is that, once you've gone through the redesign process, you can continue to improve the course as you move forward.

What are the key points for boards?

It's not rocket science. Once you get the basic idea of how redesign works, you unleash a lot of faculty creativity and can see many positive results. You just have to focus on the key issues of increasing active learning, improving learning outcomes, and reorganizing the course to reduce costs.

Faculty members are not the problem. You will hear many administrators say, "We think this is great, but we just can't get our faculty to do anything." Well, we have worked with hundreds of faculty members across the country in all kinds of institutions, and we have found that if you give them direction and support, they will respond beyond your wildest dreams.

The problem is lack of leadership. We need our presidents, provosts, and board members to step up and say, "Course redesign offers a constructive alternative to budget cutting, and we want to help you do it."

Can information technology help resolve higher education's pressing problems? Yes, it can, if you move beyond your assumptions and redesign your approaches. ■

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T'SHIP LINKS: Peter Smith, "Low-Hanging Fruit: How Boards Can Improve Education Now ThroughPedagogy, Portability, and Price." March/April 2011.

OTHER RESOURCES: The National Center for Academic Transformation. www.thencat.org. Stephen G. Pelletier and Richard A. Skinner, "Technology in Context: 10 Considerations for Governing Boards of Colleges and Universities" (AGB Press 2010). Susan Whealler Johnston, "How Boards Oversee Academic Quality" (AGB Press 2010).