The National Center for Academic Transformation

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The National Center for Academic Transformation

www.theNCAT.org

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Mr. Chairman and Members of the Committee:

Thank you for inviting me to testify. I am President and CEO of the National Center for Academic Transformation (NCAT). NCAT was established in 1999 as a university center at Rensselaer Polytechnic Institute with funding from the Pew Charitable Trusts and became an independent non-profit organization in 2003. NCAT's mission is to help colleges and universities learn how to use technology to improve student learning outcomes and reduce their instructional costs.

Over the past 13 years, NCAT has worked in partnership with more than 200 colleges and universities, demonstrating how course redesign using technology can achieve quality enhancements as well as cost savings. NCAT has conducted four national and six state-based course redesign programs, producing about 153 large-scale redesigns. All redesigned courses have reduced cost, on average by 37%, ranging from 9% to 77%. Learning outcomes improved in 72% of the redesigns with the remaining 28% showing learning equivalent to traditional formats. Partner institutions include research universities, comprehensive universities, private colleges and community colleges in all regions of the United States.

It is important to understand what NCAT means by course redesign. Course redesign 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 the capabilities of information technology. Course redesign is not just about putting courses online. It is about rethinking the way we deliver instruction in light of the possibilities that technology offers.

The Challenge

American colleges and universities continue to be challenged by the need to increase access to higher education, to improve the quality of student learning, and to control or reduce the rising cost of instruction. These issues are, of course, interrelated. As tuition costs continue to rise, access is curtailed. If the quality of the curriculum inhibits students from successfully completing courses and programs, promises of increased access become hollow.

Solutions to these challenges appear to be interrelated as well. Historically, either improving quality or increasing access has meant increasing costs. Reducing costs, in turn, has meant cutting quality, access, or both. In order to sustain higher education's vitality while serving a growing and increasingly diverse student body, we must find a way to resolve this familiar —and seemingly intractable--trade-off between cost and quality.

America's colleges and universities have discovered exciting new ways of using technology to enhance teaching and learning and to extend access to new populations of students. For most institutions, however, new technologies represent a black hole of additional expense. This is because the majority of them have simply bolted new technologies onto an existing set of physical facilities, a faculty already in place and an unaltered concept of classroom instruction.

Under these circumstances, technology becomes part of the problem of rising costs rather than part of the solution. In addition, comparative research studies show that, instead of improving quality, most technology-based courses produce learning outcomes that are only “as good as” their traditional counterparts—what has come to be known as the “no significant difference” phenomenon. By and large, colleges and universities have not yet begun to realize the promise of technology to improve the quality of student learning, increase completion and reduce the costs of instruction.

The Initial Proof of Concept

Supported by an $8.8 million grant from the Pew Charitable Trusts, NCAT created the Program in Course Redesign (http://www.theNCAT.org/PCR.htm) in April 1999 to address the issues discussed above. The program taught colleges and universities how to redesign instruction using technology to achieve quality enhancements *as well as* cost savings. Thirty institutions were selected to participate from hundreds of applicants in a national competition.

All 30 redesign projects focused on large-enrollment introductory courses that have the potential to affect significant student numbers and generate substantial cost savings. Why focus on such courses? Because undergraduate enrollments in the United States are concentrated heavily in only a few academic areas. In fact, just 25 courses generate about half of all student enrollments in community colleges and about a third of enrollments in four-year institutions.

The topics of these courses are no surprise and include introductory studies in disciplines such as English, mathematics, psychology, sociology, economics, accounting, biology, and chemistry. Successful completion of these courses is critical for student progress toward a degree. But typical failure rates in many of these courses—15% at research universities, 30% to 40% at comprehensive universities, and 50% to 60% at community colleges—contribute heavily to overall institutional drop-out rates between the first and second year.

The insight that these figures point to is simple and compelling: In order to have a significant impact on large numbers of students, an institution should concentrate on redesigning the 25 courses in which most students are enrolled instead of putting a lot of energy into improving quality or cutting costs in disparate small-enrollment courses. By making improvements in a restricted number of large-enrollment prerequisite or introductory courses, a college or university can literally affect every student who attends.

The Program in Course Redesign produced many different models of how to restructure such courses to improve learning as well as to effect cost savings. In contrast to the contention that only certain kinds of institutions can accomplish these goals, and in only one way, the program demonstrated that many approaches can achieve positive results. And to counter the belief that only courses in a restricted subset of disciplines—science or math, for instance—can be effectively redesigned, the program comprised successful examples in many disciplines including the humanities, math and statistics, the social sciences, and the natural sciences. In each case, the *whole course* rather than a single class or section was the target of the redesign.

Here is a breakdown of the 30 participating institutions by curricular area:

QUANTITATIVE (13)

- Mathematics: Iowa State University; Northern Arizona University; Rio Salado College; Riverside Community College; University of Alabama; University of Idaho; Virginia Polytechnic Institute and State University
- Statistics: Carnegie Mellon University; Ohio State University; Pennsylvania State University; University of Illinois at Urbana-Champaign
- Computer Programming: Drexel University; University at Buffalo

SOCIAL SCIENCE (6)

- Psychology: California State Polytechnic University, Pomona; University of Dayton; University of New Mexico; University of Southern Maine
- Sociology: Indiana University–Purdue University Indianapolis
- American Government: University of Central Florida

HUMANITIES (6)

- English Composition: Brigham Young University; Tallahassee Community College
- Spanish: Portland State University; University of Tennessee, Knoxville
- Fine Arts: Florida Gulf Coast University
- World Literature: University of Southern Mississippi

SCIENCE (5)

- Biology: Fairfield University; University of Massachusetts, Amherst
- Chemistry: University of Iowa; University of Wisconsin–Madison
- Astronomy: University of Colorado at Boulder

Each of the 30 participating institutions conducted a rigorous evaluation focused on student learning, comparing the outcomes of redesigned courses with those of courses with the same content delivered in a traditional (pre-redesign) format. Results show improved student learning in 25 of the 30 projects, with the remaining five showing learning outcomes equivalent to traditional formats.

Each redesign team developed a detailed cost analysis of both the traditional and the redesigned course formats using activity-based costing. NCAT created a spreadsheet-based course planning tool (http://www.theNCAT.org/PlanRes/CPTdesc.htm) to guide institutions in this process. Completing the course planning tool allowed faculty members to consider changes in specific instructional tasks, make decisions about how to use technology (or not) for specific tasks, visualize duplicative or unnecessary effort and complete a cost/benefit analysis regarding the right type of personnel for each instructional task. At the beginning of each project, baseline cost data for the traditional course and projected redesigned course costs were collected; actual redesigned course costs were collected at the end.

Results showed that all 30 projects reduced costs by 37% on average, ranging from 15% to 77%. Other positive outcomes associated with the redesigned courses included increased course-completion rates, improved retention, better student attitudes toward the subject matter, and increased student satisfaction with the new mode of instruction. Collectively, the 30 redesigned courses impacted more than 50,000 students and produced an annual cost savings of $3.6 million--while simultaneously improving student-learning outcomes and increasing retention.

Since developing the Program in Course Redesign, NCAT has conducted four national and six state-based course redesign programs, producing about 153 large-scale redesigns. The number of disciplines have multiplied, including 16 in the humanities (developmental reading and writing, English composition, fine arts, history, music, Spanish, literature and women's studies), 93 in quantitative subjects (developmental and college-level mathematics, statistics and computing), 23 in the social sciences (political science, economics, psychology and sociology), 15 in the natural sciences (anatomy and physiology, astronomy, biology, chemistry and geology) and six in professional studies (accounting, business, education, engineering and nursing).

Detailed descriptions of each redesign project can be found on the NCAT website (http://www.theNCAT.org/PCR/Proj_Discipline_all.html).

Quality Improvement Strategies and Successes

Redesigned courses effect significant changes in the teaching and learning process, making it more active and learner-centered. The primary goal is to move students from a passive listening and "note-taking" role to an active-learning orientation. As one math professor succinctly puts it, "Students learn math by doing math, not by listening to someone talk about doing math." Lectures are replaced with a wide variety of learning resources, all of which involve more active forms of student learning or more individualized assistance. In moving from an entirely lecture-based to a student-engagement approach, student learning is less dependent on words uttered by instructors and more dependent on reading, exploring, and problem-solving undertaken actively by students themselves.

Many of the projects have demonstrated statistically significant improvements in student understanding of course content by comparing the performance of students enrolled in traditional and redesigned courses on commonly administered assignments and examinations. Redesign-course students in statics at Mississippi State University, for example, performed significantly better on assignments (average score of 90 versus 73) and in-class tests (average score of 79 versus 66) than their peers in the traditional group at a 95% confidence level. At Carnegie Mellon University, the performance of redesign-course students in statistics increased by 22.8% on tests of skills and concepts, and redesign-course students also demonstrated an enhanced ability to identify the appropriate statistical analysis to employ in a given real-world problem situation. At the University of Maryland Eastern Shore, the traditional and redesigned formats of an introductory chemistry course were taught using the same materials, homework assignments and exams. The number of students who earned a grade of C or better in the traditional course was 54.5 % compared with 69.4 % in the redesigned course.

Other projects have shown statistically significant improvements in overall student understanding of course content as measured by pre- and post-assessments that examine key course concepts. For example, at Northeast State Technical Community College in Tennessee, students enrolled in a traditionally configured developmental reading course posted an 11-point improvement on the standardized Nelson Denny examination, while the average gain of 21 points for students in the redesigned course was almost double that amount. The University of Tennessee, Knoxville found a significant and favorable five-point difference between student exam scores in a redesigned Spanish course and those of students enrolled in traditional sections.

Many of the projects have also reported significant improvements in their drop-failure-withdrawal (DFW) rates. At Arizona State University, the number of students earning a C or better in a computer literacy course increased from 26% in the traditional course to 65% in a demonstrably more difficult course. At the University of Alabama, the percentage of students completing a redesigned intermediate algebra course with a grade of C or better improved from 40% to close to 80%. At the University of Idaho, the percentage of students earning a D or failing was cut by more than half. Drexel University reduced its DFW rate in computer programming from 49% to 38%, Florida Gulf Coast University from 45% to 11% in fine arts, Indiana University-Purdue University Indianapolis (IUPUI) from 39% to 25% in introductory sociology, and the University of New Mexico from 42% to 25% in psychology.

What techniques have institutions found to be the most effective in improving student learning? The most prominent are the following:

- *Online Tutorials:* In redesigned courses, web-based resources—either commercially produced or developed by colleges and universities—that support greater student engagement with the material replace standard presentation formats. Such resources may include interactive tutorials and exercises that give students needed practice; computerized or digitally recorded presentations and demonstrations; reading materials developed by instructors or in assigned textbooks; examples and exercises in the student's field of interest; links to other relevant online materials; and individual and group laboratory assignments.

  Ideally, materials like these are modularized and tailored to incorporate examples drawn from a variety of disciplines to match the learning circumstances of students with different professional and personal goals. Using modularized materials also allows changes in content or format if students are having difficulty understanding a particular part of the course.

  Building on substantial experience in using and developing interactive materials, the University of Wisconsin at Madison developed 37 Web-based instructional modules in chemistry. Each module leads a student through a particular topic in six to 10 interactive pages. When the student has completed the tutorial, a debriefing section presents a series of questions that test whether the student has mastered the module's content. Students especially like the ability to link from a problem they have difficulty with directly to a tutorial that helps them learn the concepts needed to solve the problem.

Virginia Tech uses a variety of web-based course-delivery techniques like tutorials, streaming video lectures, and lecture notes as tools for presenting materials in a linear algebra course. Consisting of concrete exercises with solutions that are explained through built-in video clips, such tutorials can be accessed at home or at a campus lab. In redesigned courses, tutorials have taken over the main instructional task with respect to transmitting content: 86% of the students enrolled in Virginia Tech's linear algebra course reported that the computer presentations explain the concepts effectively.

- *Continuous Assessment and Feedback:* Shifting the traditional assessment approach in large introductory courses, which typically employ only midterm and final examinations, toward continuous assessment is an essential pedagogical strategy in these redesigns. Many of the projects include numerous computer-based assessments that give students instantaneous feedback on their performance. Automating assessment and feedback enables repeated practice as well as providing prompt and frequent feedback--pedagogical techniques that research consistently has proven to enhance learning.

  Students are regularly tested on assigned readings and homework using short quizzes that probe their preparedness and conceptual understanding. These low-stakes quizzes motivate students to keep on top of the course material, structure how they study and encourage them to spend more time on task. Online quizzing encourages a "do it till you get it right" approach: Students are allowed to take quizzes until they master the material.

  Quizzes also provide powerful formative feedback to both students and faculty members. Faculty can quickly detect areas where students are not grasping key concepts, enabling timely corrective intervention. Students receive detailed diagnostic feedback that points out why an incorrect response is inappropriate and directs them to material that needs review. For example, at the University of Northern Arizona, online quizzes used in a redesigned psychology course were perceived very favorably, as indicated by the percentage of students who agreed "somewhat" or "strongly" that quizzes were useful (60.4%), promoted understanding of class material (61.3%), helped in exam preparation (64.8%), and encouraged textbook reading (71.8%). Since students are required to complete quizzes before class, they are better prepared for higher-level activities once they get there. Consequently, the role of the instructor shifts from one of introducing basic material to reviewing and expanding what students have already been doing.

- *Continuous Support:* Various kinds of support systems enable students to receive help when they need it, not just when they go to class. Helping students feel that they are a part of a learning community is critical to persistence, learning, and satisfaction. Active mentorship of this kind can come from a variety of sources, allowing students to interact with the person who can provide the best help for the specific problem they have encountered.

Many of the redesign projects replace lecture time with individual and small-group activities that take place in computer labs staffed by faculty, graduate teaching assistants (GTAs) and/or peer tutors. In several instances, increasing lab hours has enabled students to get access to more one-on-one assistance. Students welcome the reduction in lecture time and the opportunity to work in groups to apply what they have learned. Collaboration also triggers peer pressure within groups, which can be a powerful incentive for students to keep up with their work.

- *Undergraduate Learning Assistants (ULAs):* Institutions such as Arizona State University, SUNY Buffalo State College, Frostburg State University, the University at Buffalo and the University of Colorado-Boulder employ ULAs in lieu of GTAs. These institutions and others have found that ULAs turn out to be better at assisting their peers than GTAs because of their understanding of the course content, their superior communication skills, and their awareness—based on their own recent experience--of the many misconceptions that undergraduate students often hold.

  In Colorado's redesigned introductory astronomy course, the instructor meets weekly with the ULAs and discusses in detail what is working and where students are having difficulty. Feedback from these weekly meetings gives the instructor a much better sense of the class as a whole, and of the individual students in it, than would otherwise be possible with a class of more than 200 students.

- *Increased Interaction among Students:* Many redesign projects take advantage of the internet's ability to support useful and convenient opportunities for discussion among students. Students in large lecture classes tend to be passive recipients of information, and student-to-student interaction is inhibited by class size. Through smaller discussion forums established online, students can participate actively. The University of Central Florida and IUPUI create small online discussion groups in which students can easily contact one another in their redesigned American government and introductory sociology courses. Students benefit from participating in the informal learning communities that are created in this manner. Software allows instructors to monitor the frequency and quality of student contributions to these discussions more readily and carefully than would be the case in a crowded classroom.

People who are knowledgeable about proven pedagogies that improve student learning will find nothing surprising in the above list. Among the well-accepted *Seven Principles for Good Practice in Undergraduate Education* developed by Arthur W. Chickering and Zelda F. Gamson in 1987 are such items as "encourage active learning," "give prompt feedback," "encourage cooperation among students," and "emphasize time on task." Good pedagogy in itself has nothing to do with technology, and we've known about good pedagogy for years.

What is significant about the redesigns is that they are able to incorporate good pedagogical practice into courses with *very large numbers of students*—a task that would have been impossible without technology.

In the traditional general chemistry course at the University of Iowa, for example, four GTAs used to be responsible for grading more than 16,000 homework assignments each term. Because of the large number of assignments, GTAs could only spot-grade and return a composite score to students. By automating the homework process through redesign, every problem is graded and students receive specific feedback on their performance. This, in turn, leads to more time on task and higher levels of learning. Applying technology is not beneficial without good pedagogy. But technology is essential to move good pedagogical practice to scale, where it can affect large numbers of students.

Cost Reduction Strategies and Successes

There are a variety of ways to reduce instructional costs. As a result, there are also a variety of strategies for pursuing instructional redesign, depending upon institutional circumstances. For instance, an institution may want to maintain constant enrollments while reducing the total amount of resources devoted to the course. There are two primary ways an institution can decrease costs per student even though the number of students enrolled in the course remains unchanged. First, it can use technology for those aspects of the course where it would be more effective, engaging faculty only in tasks that require faculty expertise. Cleveland State Community College, for example, was able to double the number of sections taught by faculty member in developmental mathematics without increasing individual workload. Second, it can transfer other tasks that are less academically challenging to those with a lower level of education. The use of ULAs described above exemplifies this approach.

But if an institution is in a growth mode or has more demand than it can meet through existing course delivery, it may seek to increase enrollments while maintaining the same level of investment. Many institutions have escalating demand for particular subjects like business, Spanish or information technology that they cannot meet because they cannot hire enough faculty members. By using redesign techniques, they can increase the number of students they enroll in such courses and relieve these academic bottlenecks without changing associated costs. Arizona State University, for example, has been able to increase the annual enrollment in Organizational Management and Leadership from 270 students to ~500 without additional resources. The University of North Carolina at Chapel Hill was able to increase the number of students enrolled in introductory Spanish by 40% while reducing the number of instructional staff in introductory Spanish.

What are the most effective cost-reduction techniques used by the redesign projects? Since the major cost item in instruction is personnel, reducing the time that faculty members and other instructional personnel invest in the course, and transferring some of these tasks to technology-assisted activities are key strategies. Some of the more predominant cost-reduction techniques used by the projects include:

- *Online Tutorials:* Computer-based, modularized tutorials are designed to lead a student through a particular topic that is presented interactively online. When students have completed the tutorial, they are presented questions that test whether they have mastered the content of the module. Online tutorials at Wisconsin help structure subsequent discussion sections by raising the probability that students will come to class prepared to ask questions. This means less preparation time for instructors.

  Similar use of online tutorials have been particularly effective in both developmental and college-level mathematics redesign at institutions such as Chattanooga State Technical Community College (TN), Cleveland State Community College (TN), Jackson State Community College (TN), Louisiana State University, Manchester Community College (CT), the Universities of Alabama and Idaho and Virginia Tech. Off-loading preparation time from instructors to software has enabled radical restructuring of teaching staff that reduces costs. Individual faculty members are no longer required to present the same content through duplicative efforts. Nor do they need to replicate exercises and quizzes for each section. Interactive tutorials can replace part—and, in some cases, all—of the “teaching” portions of the course.

- *Automated Assessment of Exercises, Quizzes, and Tests.* Automated grading of homework exercises and problems, of low-stakes quizzes, and of examinations for subjects that can be assessed through standardized formats not only increases the level of student feedback but also offloads these rote activities from faculty members and other instructional personnel. Some of the projects use the quizzing features of course management systems like Blackboard. Others take advantage of the online quizzes and tests that are built into software like MyMathLab and ALEKS from textbook publishers.

  Online quizzing sharply reduces the amount of time faculty members or GTAs need to spend on the laborious process of preparing quizzes, grading them, and recording and posting the results. Automated testing systems that contain large numbers of questions in a database format enable individualized tests to be easily generated, then quickly graded and returned.

- *Staffing Substitutions.* By constructing a support system that comprises various kinds of instructional personnel, institutions can apply the right level of human intervention to particular kinds of student problems. Highly trained (and expensive) faculty members are not needed to support all of the many tasks associated with delivering a course. As noted above, many universities are employing ULAs in lieu of GTAs as a key cost-saving device. By replacing expensive faculty members and graduate students with relatively inexpensive labor, an institution can increase the person-hours devoted to the course and at the same time cut costs.

  Another solution, implemented by Rio Salado College in Phoenix, is to employ a “course assistant” to address the many nonacademic questions that arise as any course is delivered—questions that can characterize up to 90% of staff interactions with students. This frees the instructor to handle more students and to concentrate on academic interactions rather than logistics.

- *Online Course-Management Systems*: Course management systems—software packages that are designed to help faculty members transfer course content to an online environment and assist them in administering various aspects of course delivery--play a central role in most of the redesigns. Some projects use commercial products like Blackboard; others use homegrown systems created centrally for campuswide use or specifically for the redesigned course. Still others use instructional software that includes an integrated course-management system. Sophisticated course-management software packages enable faculty members to monitor student progress and performance, track their time on task, and intervene on an individualized basis when necessary.

  Course management systems can automatically generate many different kinds of tailored messages that provide needed information to students. They can also communicate automatically with students to suggest additional activities based on homework and quiz performance, or to encourage greater participation in online discussions. Using course-management systems radically reduces the amount of time that faculty members typically spend in nonacademic tasks like calculating and recording grades, photocopying course materials, posting changes in schedules and course syllabi, sending out special announcements to students—as well as documenting course materials like syllabi, assignments, and examinations so that they can be used in multiple terms.

- *Shared Resources:* When an entire course (or more than one section) is redesigned, faculty begin by analyzing the amount of time that each person involved in the course spends doing each activity. This highly specific task analysis often uncovers instances of duplicated effort and can lead to shared, more efficient approaches to course development. The often substantial amounts of time that individual faculty members spend developing and revising course materials and preparing for classes can be reduced considerably by eliminating such duplications

  For example, Penn State has constructed an easy-to-navigate website for its introductory statistics course that contains not only material on managing the course but also a large number of student aids and resources, including solutions to problems, study guides, supplemental reading materials for topics not otherwise treated in the text, and student self-assessment activities. Putting assignments, quizzes, exams and other course materials on a community website for the course can save a considerable amount of instructional time.

- *Reduced Space Requirements:* Using the internet to deliver particular parts of a course as a substitute for face-to-face classroom instruction enables institutions to use classroom space more efficiently. Two or three course sections can be scheduled in the same classroom where only one could be scheduled before.

With regard to cost savings, the redesign methodology is an unqualified success. Virtually every NCAT project has produced cost savings, again ranging from 9% to 77%. Some saved more than they planned to; others save less. Why is there such a large range in cost savings across the projects? Differences are directly attributable to the different design decisions made by the project teams, especially with respect to how to allocate expensive faculty members. Redesigns with lower savings tended to redirect, not reallocate, saved faculty time: They keep the total amount of faculty time devoted to the course constant, but they change the way faculty members actually spend their time (for example, interacting with students rather than lecturing.)

Others substantially reduce the amount of time devoted to the course by non-faculty personnel like GTAs, but keep the amount of regular faculty time constant. Decisions like these reduce total cost savings. By radically reallocating faculty time to other courses and activities, in contrast, Virginia Tech produced cost savings of 77% in its redesigned linear algebra course. Most projects *could* have saved more with no diminution in quality, if they had made different design decisions.

By using technology-based approaches and learner-centered principles to redesign their courses, these pioneering institutions are showing us a way out of higher education's historical trade-off between cost and quality. Some of them rely on asynchronous, self-paced learning modes, while others use traditional, synchronous classroom settings but with reduced student/faculty contact hours. Both approaches start with a careful look at how best to deploy *all* available instructional resources to achieve the desired learning objectives. Questioning the current credit-for-contact paradigm of instruction, and thinking systematically about how to produce more effective and efficient learning, are fundamental conditions for success.

Implications for the Future

Now that it is clear that large-scale course redesign *can* produce substantial savings, an obvious question that arises is, who should benefit from these savings?

Institutions that have produced savings from course redesign have used the savings in many different ways:

- stay in the department to support continuous improvement of the course and/or the redesign of other courses;
- underwrite a greater range of course offerings at the upper division or graduate level;
- allow the institution to accommodate greater numbers of students with the same resources;
- stay in the department to reduce teaching loads and to provide more time for research;
- allow the institution to redesign similar courses outside of the original department;
- enable the institution to offer distance learning courses that were previously impossible due to resource constraints;
- allow the institution to free up classroom space as a result of the reduction in face-to-face class time; and
- improve the training of part-time faculty.

Once institutions start creating pools of surplus instructional resources through redesign instead of simply spending every resource that is available, we will be forced to rethink many of our assumptions about planning and budgeting. How should those funds be reallocated? Should the resulting extra resources, for example, be reinvested in ongoing course development? Should the faculty members involved in the redesign benefit directly as a reward for increased productivity? Perhaps the academic unit should capture the savings to reinvest in further course redesign. Or should the savings be returned to the institution to be reallocated for other uses? A host of institutional policy issues about who gets what and for what will be involved, as well as numerous practical matters like ensuring continuous investment to support the innovations that will be needed to keep generating such cost savings. How an institution rewards faculty and staff for increased productivity is also an important consideration in building the case for academic restructuring. Ultimately, <u>if implemented on a large scale across the institution</u>, course redesign can be an important tool in stopping the relentless rise in college costs.

Higher education has traditionally assumed that high quality means low student-faculty ratios, and that large lecture-presentation techniques supported by cheap labor constitute the only viable low-cost alternatives. But it is now clear that course redesign using technology-based, learner-centered principles can offer higher education a way out of this historical trade-off between cost and quality. New models demonstrate that it is indeed possible to improve learning and reduce costs at the same time. For the first time, we can have our cake and eat it too.