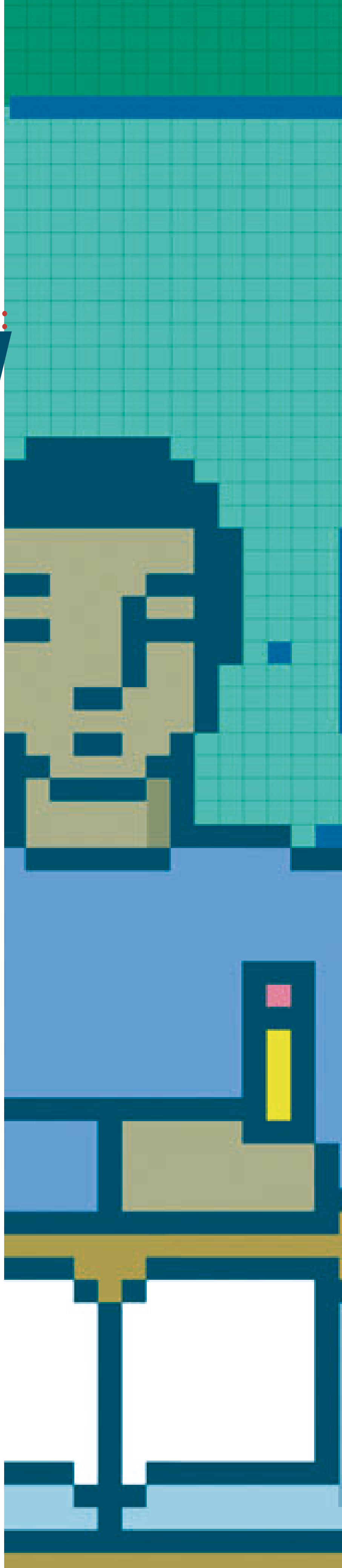
By Carol A. Twigg

IMPROVING LEARNING AND REDUCING COSTS: NEW MODELS FOR ONLINE LEARNING



Every college and university in the United States is discovering exciting new ways of using information technology to enhance the process of 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. Most campuses have simply bolted new technologies onto a fixed plant, a fixed faculty, and a fixed notion 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 rather than improving quality, most technology-based courses produce learning outcomes that are simply "as good as" their traditional counterparts—in what is often referred to as the "no significant difference" phenomenon.[1] By and large, colleges and universities have not yet begun to realize the promise of technology to improve the quality of student learning and reduce the costs of instruction.

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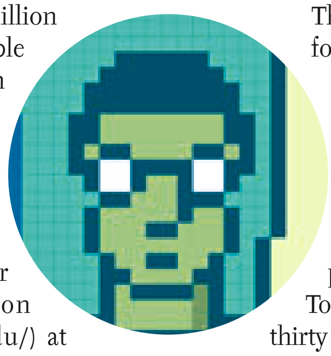


Supported by an $8.8 million grant from the Pew Charitable Trusts, the Program in Course Redesign (http://www.center.rpi.edu/PewGrant.html) was created in April 1999 to address these issues. Managed by the Center for Academic Transformation (http://www.center.rpi.edu/) at Rensselaer Polytechnic Institute, the Program is supporting colleges and universities in their efforts to redesign instruction using technology to achieve quality enhancements as well as cost savings. Selected from hundreds of applicants in a national competition, thirty institutions received a grant of $200,000 each, with the grants awarded in three rounds of ten. The thirty institutions include research universities, comprehensive universities, private colleges, and community colleges in all regions of the United States.

The Center has required each institution to conduct a rigorous evaluation focused on learning outcomes as measured by student performance and achievement. National experts have provided consultation and oversight regarding the assessment of learning outcomes to ensure that the results are reliable and valid. To date, results show improved student learning in twenty of the thirty projects, with the remaining ten showing no significant difference. Each institution has also been required to develop a detailed cost analysis of both the traditional and the redesigned course formats, using a spreadsheet-based course-planning tool (http://www.center.rpi.edu/PewGrant/Tool.html) developed by the Center. Preliminary results show that all thirty institutions reduced costs by about 40 percent on average, with a range of 20 percent to 84 percent. Other outcomes include increased course-completion rates, improved retention, better student attitudes toward the subject matter, and increased student satisfaction with the mode of instruction. Collectively, the thirty redesigned courses affect more than 50,000 students nationwide and produce a savings of $3.6 million each year.

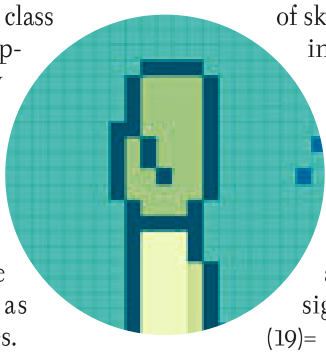
The course-redesign projects focus on large-enrollment, introductory courses in multiple disciplines, including the humanities (6), quantitative subjects (13), social sciences (6), and natural sciences (5). What do these projects have in common? To one degree or another, all thirty projects share the following six characteristics:

1. *Whole course redesign.* In each case, the whole course—rather than a single class or section—is the target of redesign. Faculty begin the design process by analyzing the amount of time that each person involved in the course spends on each kind of activity, a process that often reveals duplication of effort among faculty members. By sharing responsibility for both course development and course delivery, faculty save substantial amounts of time while achieving greater course consistency.
2. *Active learning.* All of the redesign projects make the teaching-learning enterprise significantly more active and learner-centered. Lectures are replaced with a variety of learning resources that move students from a passive, note-taking role to an active, learning orientation. As one math professor put it, "Students learn math by doing math, not by listening to someone talk about doing math."
3. *Computer-based learning resources.* Instructional software and other Web-based learning resources assume an important role in engaging students with course content. Resources include tutorials, exercises, and low-stakes quizzes that provide frequent practice, feedback, and reinforcement of course concepts.
4. *Mastery learning.* The redesign projects add greater flexibility for when students can engage with a course, but the redesigned courses are not self-paced. Rather than depending on class meetings, student pacing and progress are organized by the need to master specific learning objectives, which are frequently in modular format, according to scheduled milestones for completion.
5. *On-demand help.* An expanded support system enables students to receive assistance from a variety of different people. Helping students feel that they are a part of a learning community is critical to persistence, learning, and satisfaction. Many projects replace lecture time with individual and small-group activities that take place either in computer labs—staffed by faculty, graduate teaching assistants (GTAs), and/or peer tutors—or online, enabling students to have more one-on-one assistance.
6. *Alternative staffing.* By constructing support systems consisting of various kinds of instructional personnel, the projects apply the right level of human intervention to particular student problems. Not all tasks associated with a course require highly trained, expert faculty. By replacing expensive labor (faculty and graduate students) with relatively inexpensive labor (undergraduate peer mentors and course assistants) where appropriate, the projects increase the person-hours devoted to the course and free faculty to concentrate on academic rather than logistical tasks.

Although all thirty projects have these characteristics in common, each has chosen a design model that implements the characteristics in a way that varies according to the discipline involved, the particular student audience, and the preferences of faculty. After examining the similarities and differences in how these common characteristics are arrayed in the various projects, the Program has been able to identify five distinct course-redesign models: supplemental, replacement, emporium, fully online, and buffet. A key differentiator among them is where each model lies on the continuum from fully face-to-face to fully online interactions with students.

The Supplemental Model

The supplemental model retains the basic structure of the traditional course, The key characteristic of the replacement model is a reduction in class-meeting time, replacing face-to-face time with online, interactive learning activities for students.



particularly the number of class meetings. Some of the supplemental redesigns simply add technology-based, out-of-class activities to encourage greater student engagement with course content. Others change what goes on in the class meetings as well as adding out-of-class activities.

The redesign of general psychology at the University of New Mexico (UNM) (http://www.center.rpi.edu/PewGrant/RD3%20Award/UNM.html) and the redesign of introductory statistics at Carnegie Mellon University (http://www.center.rpi.edu/PewGrant/RD2%20Award/CMU.html) exemplify the first version of the supplemental model of redesign. Each institution kept the lecture portion of the course intact, including the number of class meetings, but supplemented lectures and textbooks with a variety of computer-based activities.

At UNM, students receive credit for completing three online mastery quizzes each week. Students are encouraged to take the quizzes as many times as needed until they attain a perfect score. For all quizzes, only the highest scores count. The more time students spend taking quizzes and the higher their scores, the better they perform on in-class exams. A two-disc CD-ROM, which contains interactive activities, simulations, and movies, is used to review and augment text material. At UNM, the drop-withdrawal-failure (DWF) rate in the course has fallen from 42 percent in the traditional format to 18 percent in the redesign, and the number of students who received a C or higher has risen from 60 percent to 76.5 percent.

Carnegie Mellon has redesigned the laboratory portion of its statistics course while leaving the lecture portion intact. The redesign uses SmartLab, an automated, intelligent tutoring system that monitors students' work as they go through lab exercises. SmartLab provides them with feedback when they pursue an unproductive path and closely tracks and assesses individual students' acquisition of skills in statistical inference—in effect, providing a personal tutor for each student. After using SmartLab, students increased their scores on a test of skills and concepts by 3.65 out of 16 items, for a 22.8 percent increase, a significant improvement, $t(19)= 5.877$, $p< .001$. In addition, SmartLab helped students achieve a level of statistical literacy not deemed possible in the course before its redesign.

The redesign of introductory biology at the University of Massachusetts–Amherst (http://www.center.rpi.edu/PewGrant/RD2%20Award/UMA.html) and the redesign of introductory astronomy at the University of Colorado–Boulder(UC) (http://www.center.rpi.edu/PewGrant/RD1Award/UCB.html) exemplify the second version of the supplemental model of redesign, changing in-class activities as well as adding out-of-class activities. The goal is to create an active learning environment within a large lecture hall setting supplemented by a variety of out-of-class activities that ensure students are prepared when they come to class.

Before class, UMass students review learning objectives, key concepts, and supplemental materials posted on the class Web site. To assess their preparation for class, students then complete online quizzes, which provide immediate feedback to students and data for instructors to assess students' knowledge levels. Instructors are able to reduce class time spent on topics that the students clearly understand, increase time spent on problem areas, and target individual students for remedial help. During class, UMass uses ClassTalk, a commercially available, interactive technology that compiles and displays students' responses to problem-solving activities. Class time is divided into ten- to fifteen-minute lecture segments followed by sessions in which students work in small groups applying concepts to solve problems posed by the instructor. Group responses are reported through ClassTalk. The instructor moderates the discussions and draws out key issues to reinforce specific ideas or reveal misconceptions. Redesigning in-class activities has encouraged students to come to class; in turn, this increased attendance has had a positive effect on student learning. At UMass, attendance in the traditional format averaged 67 percent; in the redesigned course, attendance averaged 90 percent, which correlated significantly to performance on exams. In addition, exams no longer emphasize recall of factual material or definitions of terms; 67 percent of the questions now require reasoning or problem-solving skills, compared with 21 percent previously.

At UC, the entire introductory astronomy class (approximately 200 students) meets twice a week. At the first meeting, the instructor provides an overview of the week's activities. About a dozen discussion questions are posted on the Web; these range from factual questions testing basic knowledge, to complex questions requiring students to draw conclusions, to questions intended to elicit controversy. Midweek, students meet for one hour in small learning teams of 10 to 15 students (supervised by undergraduate learning assistants) to prepare answers collaboratively and to carry out inquiry-based team projects. Teams are supported by software that allows them to collaborate synchronously or asynchronously. All teams post written answers to all questions, and every team member must sign up as a designated answerer for one or two questions.

At the next class meeting, the instructor leads a discussion session in which he directs questions not to individual students but to the learning teams. Before the meeting, the instructor uses software to review all the posted written answers to a given question. If all the teams have correctly answered a given question, the instructor skips that question. Instead, he devotes the discussion time to questions with dissonant answers among teams. Periodically, the instructor poses a related question and gives the class time for each team to formulate an answer. The discussion sessions both reinforce what students have learned and clear up misconceptions. Rather than emphasizing students' mastery of facts, the redesign is teaching students to develop their understanding of the scientific process through written and verbal communication and to draw conclusions from collaborative inquiry-based activities.

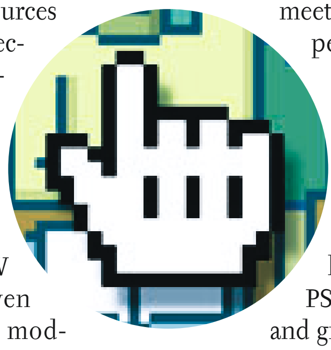
The Replacement Model

The key characteristic of the replacement model is a reduction in class-meeting time, replacing (rather than supplementing) face-to-face time with online, interactive learning activities for students. The assumption is that certain activities can be better accomplished online, either individually or in small groups, than in a class. In some cases, out-of-class activities take place in computer labs; in others, they occur online so that students can participate anytime, anywhere. One version of the replacement model replaces some class meetings with online activities while keeping in-class activities more or less the same. Others replace some class meetings with online activities and also make significant changes in what goes on in the remaining class meetings. Rather than assuming that face-to-face meetings are the best setting for student learning, these projects have thought about why (and how often) classes need to meet in real time and the content of that meeting in relation to the desired learning outcomes.

The redesign of introductory statistics at Pennsylvania State University (Penn State) (http://www.center.rpi.edu/PewGrant/RD1Award/PSU.html) and the redesign of general chemistry at the University of Wisconsin at Madison (UW) (http://www.center.rpi.edu/PewGrant/RD1Award/UWM.html) exemplify the first version of the replacement model of redesign. Each institution has replaced a portion of its class meetings with online activities while keeping the lecture format in the remaining class meetings.

Penn State's course redesign involves reducing lectures from three to one per week and changing two traditional recitation sections to two computer-studio labs. In the computer-studio labs, students work individually and collaboratively on prepared activities. Approximately 30 percent of the lab time is used for elaboration of concepts, 60 percent for computer-related work and class discussion of the results, and 10 percent for online quizzes on concepts related to the activities. Students are regularly tested on assigned readings and homework using Readiness Assessment Tests (RATs), short quizzes that probe students' conceptual understanding. Constituting 30 percent of the students' grades, RATs are given five to seven times during the course. Students prepare to take the RATs outside of class by reading the textbook, completing homework assignments, and using Web-based resources. Students then take the tests individually. Immediately following the individual effort, the students take the same test in groups of four. In addition to motivating students to keep on top of the course material, RATs have proven to be very effective in detecting areas in which students are not grasping the concepts, enabling faculty to take corrective actions in a timely manner.

The emporium model eliminates all class meetings and replaces them with a learning resource center featuring online materials and on-demand personalized assistance.



At UW, Web-based resources have replaced one of two lectures and one of two discussion sessions per week; the rest of the course remains unchanged. Building on substantial experience in using and developing interactive materials, UW has developed thirty-seven Web-based instructional modules in chemistry. Each module leads a student through a topic in six to ten 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 content of that module. Students particularly like the ability to link directly from a problem they have difficulty with to a tutorial that helps them learn the concepts needed to solve the problem. To help students structure their studying, the chemistry team has also developed 417 homework question sets that include diagnostic feedback pointing out why each incorrect response is not appropriate.

The redesigns of introductory Spanish at the University of Tennessee–Knoxville (UTK) (http://www.center.rpi.edu/PewGrant/RD2%20Award/UTK.html) and at Portland State University (PSU) (http://www.center.rpi.edu/PewGrant/RD3%20Award/PoSU.html) and the redesign of college composition at Tallahassee Community College (TCC) (http://www.center.rpi.edu/PewGrant/RD3%20Award/TCC.html) exemplify the second type of replacement model, in which some classes are replaced with online activities and the remaining classes are changed. Each institution has redesigned its entire course by shifting many instructional activities to the technology while using the classroom portion of the course to focus on those activities that require face-to-face interaction.

The most significant academic problem in traditional Spanish courses is that about 85 percent of in-class time is spent explaining and practicing grammar and vocabulary instead of practicing the expressive skills of speaking and writing. Both UTK and PSU have reduced class-meeting times from three to two per week and moved those course aspects that can be better accomplished using technology to an online environment. UTK online activities include grammar, vocabulary, and listening exercises; PSU's include testing, writing, and grammar instruction as well as small-group activities focused on oral communication. Students receive immediate feedback and detailed explanations in response to their online work, and class time is freed for interactive and collaborative learning experiences. Online grading has given the instructors more time to prepare their classes and to focus on meaningful communicative and collaborative tasks in class. By making these changes, both universities have been able to increase the time that students spend in oral communication. Furthermore, they have been able to increase the number of students who can be served with the same personnel resources.

Like most other colleges, TCC has traditionally taught writing in small sections (approximately 30 students). Considerable class time was spent reviewing and reteaching basic skills, thus reducing the amount of time during which students could engage in the writing process. By shifting many basic instructional activities that can be readily individualized to technology, TCC's redesign enables students and faculty to focus on the writing process in the classroom portion that remains. TCC uses technology to provide various resources: diagnostic assessments resulting in individualized learning plans; interactive tutorials in grammar, mechanics, reading comprehension, and basic research skills; online tutorials for feedback on written assignments; follow-up assessments; and discussion boards to facilitate the development of learning communities. These activities take place in two labs per week, and the resources are accessible to students at any time. In the one class meeting that remains, students work individually or in small groups on a wide range of writing activities that foster collaboration, proficiency, and higher levels of thinking.

The Emporium Model

The emporium model was first developed at Virginia Tech (VT) (http://www.center.rpi.edu/PewGrant/RD1Award/VA.html). The model is based on the core idea that the best time to learn mathematics is when the student wants to do so rather than when the instructor wants to teach. The redesign model allows students to choose when to access course materials, what types of learning materials to use depending on their needs, and how quickly to work through the materials with the support of sophisticated instructional software and one-on-one on-site help. Following the successes achieved at VT, the University of Alabama (http://www.center.rpi.edu/PewGrant/RD2%20Award/UA.html) and the University of Idaho–Moscow (http://www.center.rpi.edu/PewGrant/RD2%20Award/UI.html) have replicated the emporium model with student bodies that are less prepared to study mathematics.

The emporium model eliminates all class meetings and replaces them with a learning resource center featuring online materials and on-demand personalized assistance. The model requires a significant commitment of space and equipment. VT's Math Emporium holds 500 workstations as well as other specialized spaces and equipment. The University of Alabama's Mathematics Technology Learning Center (MTLC) contains 240 computers plus rooms for individual tutorial activities. The University of Idaho's version is called Polya and contains 72 computers, in pods of four, designed for as many as three students to work together at a single monitor. Moving away from the three-contact-hours-per-week norm, the emporium model significantly expands the amount of instructional assistance available to students: VT's Math Emporium is open 24/7; Alabama's MTLC is open 71 hours per week; Idaho's Polya center is open 86 hours per week.

Multiple sections of a course are combined into one large course structure, replacing duplicative lectures, homework, and tests with collaboratively developed online materials. Virginia Tech has combined 38 linear algebra sections of approximately 40 students each into one 1,500-student section; the University of Alabama has combined 44 intermediate algebra sections of approximately 35 students each into one 1,500-student section. The University of Idaho has moved two precalculus courses, previously organized in 60 sections of approximately 40 students each, into its Polya learning center, treating each course as a coherent entity. Each university, by teaching multiple math courses in its facility, can share instructional person-power among courses, significantly reducing the cost of teaching these additional courses.

The emporium model is heavily dependent on instructional software, including interactive tutorials, computational exercises, electronic hypertextbooks, practice exercises, solutions to frequently asked questions, and online quizzes. Modularized online tutorials present course content with links to a variety of additional learning tools: streaming-video lectures, lecture notes, and exercises. Navigation is interactive; students can choose to see additional explanation and examples along the way. Online weekly practice quizzes replace weekly homework grading. With the development of a server-based testing system, large databases of questions are easily generated, and grading and record-keeping are automatic.

Each emporium is staffed by a combination of faculty, GTAs, and peer tutors. Instead of spending time preparing lectures or grading homework and tests, instructors and others devote time to responding directly to each student's specific, immediate needs. Emporium helpers do not answer students' questions but rather direct students to resources from which they can learn. By creating a kind of triage response team, the emporium model increases the number of contact hours for students while it greatly decreases the cost per hour for that contact. Staffing adjustments can be made based on real use. For example, Alabama's initial plan was to staff the MTLC primarily with instructors and to use graduate students and upper-level, undergraduate students for tutorial support. It soon became apparent that the undergraduate students were as effective as the graduate students in providing tutorial support, thus eliminating the need for graduate students. Based on student-use data collected during the first semester of operation, Alabama also reduced the number of instructors and undergraduate tutors assigned to the MTLC by matching staffing levels to student-use trends.

As in the supplemental and replacement course-redesign models, there are two types of emporiums. Virginia Tech follows an open-attendance model, whereas Alabama and Idaho have added mandatory attendance and required group meetings to ensure that students spend sufficient time on task. Alabama requires students to spend a minimum of 3.5 hours per week in the MTLC and to attend a thirty-minute group session each week. This session focuses on students' problems and allows instructors to follow up in areas where testing has defined weaknesses. Idaho students are assigned to focus groups, of 40 to 50 students each, according to their majors so that particular applications can be emphasized. Groups meet once a week to coordinate activities and discuss experiences and expectations. Both universities believe that the group activities help build community among students and between students and instructors.

The Fully Online Model

On most campuses, the job of a faculty member is seen as monolithic: to perform a collection of tasks that are, with few exceptions, carried out alone. American higher education remains what Bill Massy and Bob Zemsky have called a "handicraft" industry in which the vast majority of courses are developed and delivered as "one-offs" by individual professors.[2] In most colleges and universities, this repetitive, labor-intensive approach has been transferred to online education as well. Individual faculty members design and deliver multiple course sections, each of which is relatively small in size. Web-based materials are used largely as supplemental resources rather than as substitutes for direct instruction. This model assumes that the instructor must be responsible for all interactions, personally answering every inquiry, comment, or discussion. As a result, faculty members often spend more time teaching online and interacting with students than is the case in classroom teaching.

Very few of the courses involved in the Program in Course Redesign are fully online, and those that are do not follow the labor-intensive model used by most online programs. Instead they adopt many of the design principles used by the supplemental, replacement, and emporium models described above. Rio Salado College's redesign of four precalculus mathematics courses and the University of Southern Mississippi's redesign of its world literature course exemplify the model of the fully online course.

Rio Salado's redesign (http://www.center.rpi.edu/PewGrant/RD1Award/rio.html) is based on using Academic Systems' mathematics software and the addition of a nonacademic course assistant. The Academic Systems software presents the content of the course so well that instructors did not need to spend time delivering content. The addition of a course assistant to address non-math-related questions (which constituted 90 percent of all interactions with students!) and to monitor students' progress frees the instructor to concentrate on academic rather than logistical interactions with students. As a result, one instructor is able to teach 100 students concurrently enrolled in any of four math courses. Before the redesign, the instructor typically taught 35 students in one section.

Rather than relying on individual faculty members in small sections to provide feedback to students, Rio Salado takes advantage of the Academic Systems software's large bank of problems and answers for each topic to increase the amount and frequency of feedback to students. All assignments are completed within the context of the software and are graded on the spot. Because of this immediate feedback, students know which course aspects they have not mastered and are able to take appropriate corrective actions. The software enables each student to work as long as needed on any particular topic. Students can take the end-of-module quizzes as soon as they are ready, moving quickly or slowly through the material depending on their

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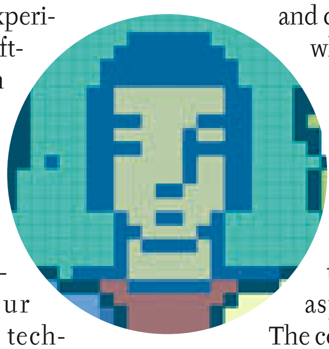
comprehension and past experience or education. The software also provides a built-in tracking system that allows the instructor and the course assistant to know every student's status (both time-on-task and progress through the modules) in each of the four courses. By using these techniques, Rio Salado has been able to increase completion rates from 59 percent to 65 percent while tripling the number of students handled by one instructor.



The University of Southern Mississippi's redesign of its world literature course (http://www.center.rpi.edu/PewGrant/RD3%20Award/USM.html) moved 16 to 20 face-to-face lecture sections (approximately 60 students each) per term into a single 800-student online section organized around 4 four-week modules. A course coordinator, responsible for overall course administration, manages the team-teaching of four faculty members (who each teach one module in their area of expertise) and four graduate assistants (who help students with writing and grade their essays). The faculty members are responsible for content, complementary materials, quizzes, and exams. The faculty team offers modularized course content through a combination of optional-attendance live lectures and required, Web-delivered, media- and resource-enhanced presentations. Each module lasts four weeks. Students complete a pre- and post-quiz for each module. Links to additional required literary and/or critical readings, audio and/or video files, and other resources devoted to particular authors or themes are provided. Writing assignments are administered by WebCT and are graded by graduate assistants; multiple-choice exams administered by WebCT after each module provide students with immediate feedback regarding their understanding of particular themes.

Consistent content coverage means that all students have the same kinds of learning experiences, resulting in significant improvements in course coherence and quality control. Treating the whole course as one section also eliminates duplication of effort on the part of instructors; faculty involved in the course can divide their tasks among themselves and target their efforts to particular aspects of course delivery. The coordinator and the four faculty members each receive credit for teaching a single course. Whereas before the redesign, Southern Mississippi needed to staff 16 to 20 sections, the university now requires the equivalent of only 5 staffed sections to serve all students. Thus, by using a coordinated approach, Southern Mississippi has more than tripled the number of students that faculty can handle.

The Buffet Model

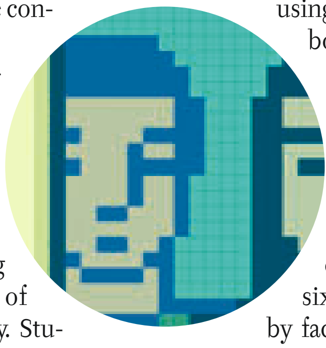
Although all of the models discussed above have demonstrated that they can successfully improve the quality of student learning while reducing the cost of instruction, each of these models tends to be attached to one way of doing things and treats all students as if they were the same. In essence, like the traditional classroom model, these course-redesign models represent a one-size-fits-all approach, albeit a much improved one. Yet one of the strongest reasons for using information technology in teaching and learning is that it can radically increase the array of learning possibilities presented to each individual student. Thus, the "right way" to design a high-quality course depends entirely on the type of students involved. By customizing the learning environment for each student, institutions are likely to achieve greater learning successes.

Students need to be treated like individuals, rather than homogenous groups, and should be offered many more learning options within each course. Rather than maintaining a fixed view of what all students want or what all students need, institutions need to be flexible and create environments that enable greater choice for students. Students differ in the amount of interaction that they require with faculty, staff, and one another. At the British Open University, for example, approximately one-third of the students never interact with other people but pursue their studies independently. New York's Excelsior College reports that 20 percent of its students take up to 80 percent of staff time, indicating a strong need for human interaction, in contrast to the 80 percent of students who require very little interaction.

The Ohio State University (OSU) is redesigning its introductory statistics course, which enrolls 3,250 students each year. In the process, the faculty have come up with a metaphor that captures a new way to think about online learning environments. OSU has created a "buffet" strategy, which offers students an assortment of interchangeable paths that match their individual learning styles, abilities, and tastes at each stage of the course. Like the emporium metaphor originated by Virginia Tech, a buffet suggests a large variety of offerings that can be customized to fit the needs of the individual learner.

Since students learn in different ways, even the best "fixed menu" of teaching strategies will fail for *some* students. In contrast, OSU's buffet of learning opportunities includes lectures, individual discovery laboratories (in-class and Web-based), team/group discovery laboratories, individual and group review (both live and remote), small-group study sessions, videos, remedial/prerequisite/procedure training modules, contacts for study groups, oral and written presentations, active large-group problem-solving, homework assignments (GTA graded or self-graded), and individual and group projects. Thus, for a specific objective, students may choose to hear and discuss a familiar vivid example in lecture, view and read about a real example in an annotated video presentation, encounter an example in a group problem-solving session, or generate an example through a group project. Students may elect to explore a concept by working in a data-analysis laboratory, in an individual Web-based activity, or in a facilitated study

All five models treat the course not as a "one-off" but rather as a set of products and services that can be continuously worked on and improved.



session or by explaining the concept to others.

To promote commitment to follow-through and to enable efficient tracking of their progress, students enter into an online contract that captures their choices of learning modes at the beginning of each of four units of study. Students receive an initial in-class orientation that provides information about the buffet structure, the course content, the learning contract, the purpose of the learning styles and study skills assessments, and the various ways that they might choose to learn the material. Out of class, they complete online learning styles and study skills instruments and receive a report of their results, as well as directions on how to use this information to build the online course contract.

Students are initially given a set of default, software-generated study options to match their learning styles and study skills; these options can be changed according to students' preferences. The finished contract gives each student a detailed listing of what needs to be accomplished, how this relates to the learning objectives of the unit, and when each part of the assignment must be completed—leading up to the unit test three weeks later. Based on their own experiences in the initial unit and on reading students' testimonials from earlier quarters, students may decide to make changes in their contracts for subsequent units. The course software monitors students' progress on an individualized basis throughout each unit, suggesting alternative learning strategies when needed.

Among the many advantages of the buffet model is that it allows research-driven decisions to be made about individual course elements. Florida Gulf Coast University (FCGU) has redesigned its required fine arts course (http://www.center.rpi.edu/PewGrant/RD3%20Award/FGCU.html) using the buffet model. Twenty-five sections of 30 students each were consolidated into a single section, using a common syllabus, textbook, set of assignments, and course Web site. Students were placed into cohort groups of 60 and, within these groups, into peer learning teams of 6 students each. The redesigned course includes six modules, each designed by faculty experts. A structured buffet of learning experiences tied to each content module was developed to meet the varying needs of students with different learning styles as measured by the Myers-Briggs Type Indicator instrument. Options for learning included live lectures and discussions, taped lectures, labs and other hands-on experiences, textual-based material, practice exams, commercially produced videos, Web-based resources, and learning experiences related to the arts in the students' home communities.

FGCU has discovered two things: (1) the students did not attend any of the live learning experiences, sticking instead with the text and online materials in WebCT; and (2) they did very well—better than the students who attended lectures in the face-to-face courses. The average score on standardized exams in the traditional course was 70 percent, versus 85 percent in the fully implemented redesign, and the percentage of D and F grades went from 45 percent in the traditional to 11 percent in the redesigned course. As a result, FGCU plans to eliminate some of the live course elements and build on the strengths of the online materials.

Conclusion

Currently in higher education, both on campus and online, we individualize faculty practice (that is, we allow individual faculty members great latitude in course development and delivery) and standardize the student learning experience (that is, we treat all students in a course as if their learning needs, interests, and abilities were the same). Instead, we need to do just the opposite: individualize student learning and standardize faculty practice. But with its connotations of words like *regulate, regiment,* and *homogenize,* the word *standardize* does not precisely capture what is required. What higher education needs is greater consistency in academic practice that builds on accumulated knowledge about improving quality and reducing costs.

All five models discussed above—supplemental, replacement, emporium, fully online, and buffet—treat the course not as a "one-off" but rather as a set of products and services that can be continuously worked on and improved. Two factors in the design strategies used by each model are key: (1) the collective commitment of all faculty teaching the course, and (2) the capabilities provided by information technology. Would it be possible for a single professor conducting an online class to develop such creative, comprehensive, learner-centered designs as exemplified by the redesigns discussed above? Perhaps, if the individual spent most of his or her career working on the class. Would it be possible for institutions to offer a buffet of learning opportunities to thousands of students annually without the aid of information technology? Most certainly not. Information technology enables best practices to be captured in the form of interactive Web-based materials and sophisticated course-management software. Faculty can add to, replace, correct, and improve an ever-growing, ever-improving body of learning materials. Sustaining innovation depends on a commitment to collaborative development and continuous quality improvement that systematically incorporates feedback from all involved in the teaching and learning process. *e*

Notes

1. See the "No Significant Difference Phenomenon" Web site, (http://teleeducation.nb.ca/nosignificantdifference/), which provides selected entries from the fifth edition of Thomas L. Russell's 1999 book *The No Significant Difference Phenomenon,* a comprehensive research bibliography on technology for distance education covering 355 research reports, summaries, and papers.
2. William F. Massy and Robert Zemsky, "Using Information Technology to Enhance Academic Productivity," Educom NLII white paper, 1995, (http://www.educause.edu/ir/library/html/nli0004.html).