THE PEW LEARNING AND TECHNOLOGY PROGRAM

Innovations in Online Learning

Moving Beyond No Significant Difference

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Preface

During the early 1990s, many of those interested in the impact of information technology liked to talk about "paradigm shifts." Despite its attainment of cliché status, the concept of a paradigm shift is a powerful one. Most who were once skeptical of the impact of the Internet on the ways we do business in all facets of society now recognize that our paradigms are, in fact, shifting.

The word *paradigm* comes from the Greek word *paradeigma,* meaning "model" or "pattern." A paradigm represents a way of looking at the world, a shared set of assumptions that enable us to understand or predict behavior. Paradigms have a powerful influence on individuals and on society because our view of the world is determined by our set of assumptions about it. To put it another way, our vision is often affected by what we believe about the world; our beliefs often determine the information that we "see."

Extending this concept to technology, a paradigm effect may prevent people from seeing what is happening around them and from realizing the potential in a new application of technology. As Jim Wetherbe, Bobby G. Stevenson Chair in Information Technology at Texas Tech, puts it, "The biggest obstacle to innovation is thinking it can be done the old way." Familiar examples of how, in Wetherbe's words, "technique lags behind technology" come to mind:

- Faced with the invention of the telegraph, the Pony Express initially responded by buying faster horses. When that failed, the organization tried to hire better riders. It did not realize that the world had changed, and the Pony Express went out of business.
- Shot from a single fixed position while actors paraded in front of the camera, early motion pictures were essentially stage plays on film. In 1903 *The Great Train Robbery* introduced narrative storytelling to films along with parallel action. Filmmakers intercut two or more stories taking place at the same time shot from different camera positions and distances, and an entirely new art form was born.
- The first ATM was located inside a bank and was available only during banking hours. Bankers viewed this technological innovation as an automated teller. Real innovation did not occur until ATMs were placed outside banks and in malls, grocery stores, and airports, available twenty-four hours a day.

As we enter the new millennium, colleges and universities are offering thousands of online courses and, in the process, are ostensibly altering centuries-old methods of teaching and learning. Some would argue that this represents a paradigm shift. But does it?

There is no question that the higher education community has moved well beyond the time-and-place-specific campus paradigm of the 1980s and early 1990s, when discussions of IT applications consisted primarily of wiring the classroom or wiring the campus. Most of those engaged in online learning programs promote the benefits of 24/7 access to courses and degree programs. Because they may not need to go to campus as frequently or at all, students also value the flexibility offered by online programs. A lot has changed.

At the same time, a lot has not changed. The vast majority of online courses are organized in much the same manner as are their campus counterparts: developed by individual faculty members, with some support from the IT staff, and offered within a semester or quarter framework. Most follow traditional academic practices ("Here's the syllabus, go off and read or do research, come back and discuss."), and most are evaluated using traditional student-satisfaction methods. This is hardly surprising, since most online courses are offered by traditional institutions of higher education. To return to our paradigm discussion, a paradigm provides boundaries for behavior, guidelines for action, and rules for success. All paradigms give practitioners a worldview that enables them to solve specific problems. The higher education paradigm, honed and perfected for hundreds of years, has served us well.

Leaders of the old paradigm community have a tremendous amount of time and energy invested in using the old rules. Consequently, they are often resistant to change and less likely to look for creative, innovative approaches to new opportunities. In much the same way that Thomas Kuhn (who first called our attention to the idea of paradigm shifts) observed scientists trying to "save the theory," so too do defenders of the old

paradigm focus their efforts on old solutions to new problems.

The problem with applying old solutions to new problems in the world of online learning is that these applications tend to produce results that are "as good as" what we have done before—what is often referred to as the "no significant difference" phenomenon. Thomas L. Russell's compendium of more than 355 comparative research studies suggests that students in technology-based (typically, distance learning) courses learn as well as their on-campus, face-to-face counterparts (http://teleeducation.nb.ca/nosignificantdifference/). These studies have typically been used by distance educators to defend the quality of their courses and programs against the once-predominant view that learning takes place only in a physical classroom. What we need now, however, are new approaches that go beyond producing no significant difference.

On December 8–9, 2000, in Phoenix, Arizona, we gathered a group of faculty and administrators—those who were already "moving the ATMs outside the bank," so to speak—to consider the question of how to move online learning beyond being "as good as" traditional education. Before our meeting in Phoenix, we asked participants to think about how information technology can be used specifically to address the major challenges of higher education: improving quality, increasing access, and reducing costs. This paper, like the symposium discussion, is organized as a response to those objectives.

As we began our discussion in Phoenix, we asked symposium participants to do three things. The first was to analyze their assumptions about distributed learning. For example, although it is generally acknowledged that the more-effective online learning environments are learner-centered, there is much controversy and disagreement about what "learner-centered" means. Advocates of "community" may demand residencies or synchronous online sessions, sincerely believing that such activities are learner-centered. Others view asynchronous learning environments as a keystone of learner-centeredness because such environments offer students greater flexibility. Is asynchronous communication de rigueur if one is learner-centered, or is synchronous exchange an important part of the learning experience? All too frequently, even innovative institutions fall back on a one-size-fits-all approach ("All of our student must do . . ."), forgetting that students are different and have different needs. What do we really mean by being learner-centered?

The second thing we asked the symposium participants to do was to step out of their paradigms and identify the strengths of each of the distributed learning approaches that we discussed at the symposium—especially in regard to particular kinds of students or particular academic topics—rather than advocating for one approach versus another. Are there some general principles that distinguish more innovative approaches?

Third, we asked the participants to explore what needs to be done to improve online education. Rather than comparing online learning with traditional higher education, how can we identify new models and talk about what is better rather than what is "as good as"? What are the important variables that create a rich online learning experience, one that makes real improvements in academic practice? How can each of us learn from others' approaches and borrow aspects that can be integrated into our own learning environments?

A few words about terminology are in order. Throughout this paper, the terms *distance learning, distance education, distributed learning,* and *online learning* are used more or less interchangeably. At times, the use of *distance learning* seems appropriate because the issues under discussion most frequently concern off-campus (distance) versus on-campus learning. At other times, particularly when describing the new higher education environment, the phrase *distributed learning* more clearly expresses the changing nature (and the blending) of all forms of higher education. In any event, the reader should not draw unwarranted conclusions from a particular usage.

There is a saying among aficionados of Thoroughbred racing: "It's not how fast you run; it's how you run fast." Our goal in this paper is to show that it's not providing student services online; it's how you provide student services online. It's the difference between online office hours and Rio Salado College's "Beep a Tutor" idea: immediate on-demand help for students having learning problems. It's the difference between a campus bookstore that mails books to distance learners and a professor who provides a one-click link on a course Web site to a particular Amazon.com page so that students can order the required book. As you read this paper, we urge you to ask yourselves whether you are taking advantage of the capabilities of information technology in general and the Internet in particular as you design online learning environments or whether you are simply migrating your on-ground approaches online. Only by doing the former will we move beyond "no significant difference."

I. Individualization: The Key to Innovation

One can think of distributed learning programs as existing on a continuum from rather traditional, *teacher-led* distance learning programs on the one end (e.g., faculty teaching via television, faculty putting their courses on the Web, faculty leading computer-conference-based seminars) to more innovative, *learner-centered* programs that rely on a combination of high-quality, interactive learningware, asynchronous and synchronous conversations, and individualized mentoring on the other end. The former programs follow traditional schedules and structures (e.g., semesters, group meetings), may be delivered to fixed sites or involve residency requirements, and tend to be developed primarily by individual faculty members with appropriate IT support. The latter are modularized and self-paced, may include group experiences as appropriate and desirable, are delivered anywhere (sites, homes, and workplaces), diagnose students' skill and knowledge level as they begin their programs of study, award credit for learning acquired outside formal educational structures to enable students to move more quickly through their programs, and are developed by teams of faculty, instructional designers, learning theorists, and IT staff, sometimes in partnership with commercial providers.

An example of a well-regarded traditional online program is the Master of Science degree in Library and Information Science (LEEP3) at the University of Illinois at Urbana-Champaign (see page 6). Courses and programs on the teacher-led end of the spectrum emulate face-to-face pedagogies and organizational frameworks, striving to make their quality equivalent to that of on-campus offerings. Programs such as LEEP3 do a fine job of replicating high-quality campus experiences. But do they go as far as they might in making significant improvements in the cost, the quality, or the access dimensions of student learning? Do they take full advantage of the inherent strengths of the Internet, which enables greater flexibility, convenience, and personalization?

A fundamental premise of this paper is that as long as we continue to replicate traditional approaches online—and continue to treat all students as if they were the same—we will once again find the "no significant difference" phenomenon vis-à-vis quality, and we will make only a negligible dent in the access problem rather than taking full advantage of the networked environment. And because these approaches bolt on technology to traditional teaching approaches, they will fail to reduce costs and, indeed, will frequently increase overall cost.

Despite the fact that the higher education community tends to treat quality, access, and cost as three separate and distinct issues, they are very much intertwined. It is now widely recognized, for example, that higher education's historical approach to increasing quality—adding more faculty, more facilities, more resources—has simultaneously increased costs. We also know that access will be directly affected if the cost of higher education to students continues to rise. So too does a one-size-fits-all definition of academic quality limit access for students who bring diverse preparation, abilities, and interests to each learning experience. Conversely, because these three issues are so inextricably linked, there may be ways to address all of them simultaneously by using information technology. This paper gives example after example of how a particular approach to improving quality can also reduce costs while increasing access. Even though the issues of quality, access, and cost are addressed in separate sections below, the interrelationships among them will become apparent.

As we think about how to design more effective online learning environments, one thing is clear. We need to treat students as individuals rather than as homogenous groups. Rather than maintaining a fixed view of what all students want or what all students need, we need to be flexible and create environments that enable greater choice for students. Participants know from their own experience that students differ, for example, in the amount of interaction that they require with faculty, staff, or 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 requiring very little interaction.

A number of institutions, like the University of Central Florida, are trying to understand possible relationships between

University of Illinois at Urbana-Champaign
Master of Science Degree: LEEP3

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HTTP://ALEXIA.LIS.UIUC.EDU/GSLIS/DEGREES/LEEP.HTML

Now in its fifth year, LEEP3 is a site-independent, distance education scheduling option for the Master of Science degree offered by the Graduate School of Library and Information Science (GSLIS) at the University of Illinois at Urbana-Champaign (UIUC). All LEEP3 students must meet the same standards for admission and satisfy the same degree requirements as on-campus students. To date, 110 students have graduated, representing forty states and seven countries. The retention rate exceeds 95 percent. Most students enroll in two courses per semester. Students range in age from their early twenties to late fifties.

Students begin the program with a twelve-day stay on campus in the summer, during which they complete a half-unit required course ("Libraries, Information & Society") and a noncredit technology workshop, while developing a sense of community. Thereafter, each course in which they enroll includes one on-campus session. Since the courses emphasize group work and projects, it is important that students have built relationships that enable them to work effectively together electronically. Courses *may* have up to two hours per week of synchronous interaction at a regularly scheduled time, with the rest of the communication accomplished asynchronously.

All full-time GSLIS faculty teach in LEEP3 on a regular basis. They are given released time to prepare their courses for delivery via LEEP3 as well as a reduced course load the first semester they teach in LEEP3. On-campus faculty receive extraordinary support because we are committed to keeping their research efforts uncompromised. LEEP3 courses have been taught by seventeen GSLIS faculty and twenty-four adjuncts (from a variety of professional positions and geographic locations).

Technologies currently in use support the following activities: asynchronous discussions; live-session interactivity (e.g., class presentations by faculty, students, and guest lecturers; group Web browsing; text chatting; desktop sharing; breakout rooms for small group discussions); archives of live sessions (including all class components—audio, images, text—with events synchronized for seamless playback); collaborative document creation and editing (create, edit, and share documents online without leaving one's Web browser). Students in our program are learning about uses of technology in ways we cannot teach by traditional instruction. They are learning to work on virtual teams, they are learning about the effects of technology on individuals and organizations, and they are learning to work independently with technological problems. They build an understanding of the sociotechnical dimensions of work, when technology moves from being an object of study to an embedded pedagogy.

Various approaches are used to make LEEP3 students feel more connected with events on campus. Special on-campus lectures are recorded and made available using Real Audio through the LEEP3 Web pages. Live sessions with the dean are scheduled once a semester to discuss students' experiences with the program. Students have an opportunity to learn about different career options through live sessions, interacting with professionals with varied careers.

The goal of the LEEP3 program is to create a significant difference in the way students participate in a rapidly changing profession. Librarians must entirely change the notion of who they are. One important way of helping them do that is to create a community of practice—that is, practice in the new environment. Many of these students work in old-fashioned library positions. If left alone to work more independently, they would not have the opportunity to develop a network of new library and information science professionals. Consequently, we believe that some face-to-face components are essential to a student's retention, success, and sense of professional community.

Even with the requirement for on-campus visits, the program has strong demand from around the world and from U.S. locations, like Alaska, that do not have easy access to library and information science instruction. At the same time, UIUC acknowledges the limitations of the approach, since the on-campus components create additional costs and logistical problems for students. A second limitation is the requirement for stable Internet access that supports synchronous activities. Students from South America and the rural United States have had difficulties and, in some cases, have been unable to continue in the program.

students' learning styles and online course development and delivery as well as the implications of that understanding for how we design online learning environments (see page 8). In a recent paper, UCF researchers summarized a number of studies that have examined the learning styles of students who enroll in distance education courses:

- Boverie, Nagel, McGee, and Garcia (1997) incorporate the Kolb Learning Style Inventory (1998) into their study of learning styles, emotional intelligence, social presence and their relationship to satisfaction with distance education. They conclude that only social preference exists as a significant predictor of course satisfaction.
- Tyler and Baylen (1998) use the Learning Styles Exercise developed by Kiersey and Bates (1978), finding the majority of their Web-based students are extroverted and judging, contrasting strongly with the instructor's preference for introversion and perceiving. They speculate that differing perceptions of courses may be explained by contrasts (and potential conflicts) in learning styles between the instructor and students.
- James and Gardner (1995) propose that learning styles are cast within a perceptual, cognitive, and affective framework, and suggest instructional design components for distance education that conform to learner needs within those three components.
- Verduin and Clark (1991) argue that attention to the mode of learning preferred by students is important to the instructor who is designing distance learning experiences. They cite that Canfield (1983) developed a learning style model and instrument that bears relevance to online learning, and suggest that maturity has relevance in learning style considerations.
- Ross and Schultz (1999) make recommendations for the interaction of online learning and learning styles relying on the theories of Dunn and Dunn (1978) and Gregoric (1982). They make specific suggestions for teaching and learning activities that conform to learning preferences of students.[1]

One implication of this research is that we need to think more creatively about how to develop course designs that respond to a greater variety of learning styles rather than concluding that online learning is more suitable for one type of student than another. The University of Central Florida has determined, for example, that the passive-independent Long type is more at risk in UCF's online courses than are other types of students.

Because certain types of students respond more positively to today's versions of online courses, some institutions have thought about counseling students who may not be successful not to take online courses. Instead, we need to be more thoughtful about course design so that we include structures and activities that work well with diverse types of students. Taking this approach rather than limiting enrollment in online courses for some students requires real change, since it requires us both to understand our students as individuals and to offer many more learning options within each course.

This paper is structured around a series of case studies presented by symposium participants. Some of these cases deal with courses, others with degree programs, and still others with institutions. At the symposium, participants described how their courses, degree programs, or institutions are trying to move beyond the "no significant difference" phenomenon by breaking away from the one-size-fits-all approach of traditional environments, whether on campus or online. We call these paradigm shifters the *new providers.*

All of the cases address increasing quality, improving access, and reducing costs to one degree or another, some more so than others. Each was selected because its approach to online learning is in some way differentiated from the instructor-led, semester-bound "traditional" approach that is predominant in higher education today. As a whole, they are characterized by such things as flexible enrollment options for students; personalized, on-demand, 24/7 student services; innovative curricular design that includes a focus on applied or problem-based learning taught by practicing professionals; and learner assessment that is integrated throughout the curriculum by diagnosing students' knowledge and skill levels as they begin their programs of study and by responding accordingly.

Among the new providers, we distinguish between the *groundbreakers,* or those who have been leaders in breaking away from traditional approaches in many respects, and the *new pacesetters,* or those who have moved further along the continuum toward greater individualization for students.

No institution, program, or course described in the case studies has moved as fully along that continuum as is possible—and some have done more in one arena than another—but each illustrates a way to think about moving beyond the "no significant difference" phenomenon as we gain greater experience and knowledge about the intersection of online learning and the individual needs and interests of our students.

University of Central Florida Reactive Behavior Patterns: Implications for Web-based Teaching & Learning

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At the University of Central Florida (UCF), we are investigating the learning-style patterns of students taking Web-based courses. We base our measurement protocol on the theory of William A. Long of the University of Mississippi Medical School. Long theorizes that students most accurately exhibit their preferences for knowledge acquisition and concept formation when they encounter ambivalence—the pull from dependence to independence that reflects counterpoised feelings toward a set of stimuli (e.g., interacting with parents and teachers, leaving home for college, forming expectations of academic and social life on campus, or taking an online course for the first time).

According to Long, individuals have an affinity for one behavior type. The intersection of energy level and of the need for approval yields four basic Long types, defined by two dimensions (aggressive-versus-passive and independent-versus-dependent). These types may be augmented by four ancillary traits. Aggressiveness denotes the energy level that students bring to the learning environment. Aggressive types are high-energy students; passive types are low in energy. Dependency identifies the level of approval that students need from others, with dependent types thriving on approval and independent types having little need for it. Long argues that the teacher's major role is to remove (or at least be aware of) obstacles that impair students' normal progression.

The following gives a brief overview of the Long types:

- *Aggressive Independent (AI).* These students possess high energy levels, are action-oriented, and have little need for peer or teacher approval. They lack judgment, express their thoughts and feelings impulsively, and tend to be disorganized and nonlinear, preferring to work independently. They resolve conflict through confrontation. They are challenging students, preventing teacher complacency. Often in leadership positions, AI students can develop into fresh and direct individuals who deal with situations as they are encountered. Teaching strategies for working with AIs include offering them choices, having clearly defined behavioral expectations, using independent activities, and assigning them leadership roles.
- *Aggressive Dependent (AD).* Like AI students, AD students possess high energy levels and are action-oriented, but they need peer and/or teacher approval. They are nonconfrontational and eager to please, rarely expressing negative feelings like anger or disapproval. They participate in class, often seek out the instructor outside of class, and maintain harmony within group situations. They perform at or above their ability. AD students are high achievers found in honors courses, student government, service organizations, and athletic programs. Teaching strategies for working with ADs include providing ample opportunities for instructor approval, supplying guidelines so that they do not take on more than they can handle, and creating opportunities to mentor other students.
- *Passive Independent (PI).* Passive Independent students can be stubborn, nonparticipatory, or withdrawn, presenting formidable challenges to both parents and teachers. They resist pressure from authority and are not concerned with approval. They are at great risk in academic settings because they resist the "system" continuously (e.g., they don't meet deadlines). PIs prefer to work alone. They are particularly baffling when manifesting superior ability yet behaving in ways contrary to their own best interests. They may present a poor academic self-concept from long-term underachievement patterns. Teaching strategies for working with PIs include establishing short-term goals and offering as much flexibility as possible.
- *Passive Dependent (PD).* These students are gentle, sensitive, nonconfrontational, and very compliant. The PD's need for approval dominates parental, peer, and teacher relationships. They are highly sensitive to the feelings of others, and they perceive disagreement and criticism as personal rejection. They are always at risk (e.g., if you tell them to tie the right shoe, they will tie only the right shoe and not the left because you didn't tell them to do so). As PDs mature, their excessive need for approval becomes the mark of a gentle, caring human being. Teaching strategies for working with PDs include establishing clear and complete directions for accomplishing tasks and providing a great deal of encouragement.

Upon examining the distribution of Long Types in UCF's courses, we discovered that all Long types are evenly represented in face-to-face general education courses but not in comparable Web-based classes.

Type	N	%
Aggressive Dependent	228	60
Aggressive Independent	87	23
Passive Independent	47	12
Passive Dependent	19	5

Furthermore, we discovered differences among Long types regarding attitudes toward fully online courses. Fifty eight percent of ADs and 65 percent of PDs indicated that they missed face-to-face interaction in a traditional classroom. AIs and PIs indicated less need for face-to-face interaction: only 16 percent of AIs and 10 percent of PIs indicated lack of face-to-face interaction as a negative.

How learning styles pertain to issues such as achievement, retention, and withdrawal should be further examined. Clearly, the online environment provides the flexibility to develop individualized strategies to address differences in learning styles. We are examining the possibility of providing advance organizers for our students that advise them about expectations, role changes, and instructional challenges in online learning as compared with their on-campus, face-to-face courses.

II. Improving the Quality of Student Learning

When asked about their views on the quality of online learning, most people in higher education begin by comparing what occurs in an online course with what goes on in the traditional classroom. A common assumption is that online learning cannot measure up to the in-class environment. In contrast, because of their years of direct experience with online learning, the symposium participants began their discussion about quality with the conviction that online learning is certainly as good as classroom learning. Rather than trying to compare one format with the other, symposium participants spent most of their time discussing the following question: What kinds of approaches to online learning will improve the quality of student learning? Consequently, they were able to come up with many ideas about how to improve quality by taking advantage of the capabilities of information technology and the Internet. In doing so, they considerably broadened what we mean by a "high-quality" learning experience. This new concept of quality takes us far beyond what is possible in a conventional classroom.

A fundamental premise of the symposium is that greater quality means greater individualization of learning experiences for students. This means moving away from teaching and learning ideas that begin with the thought that "all students need …" Information technology enables us to meet the needs of diverse students when, where, and how they want to learn. When we think about how to utilize technology to improve learning, the key is to focus on what we can do with IT that we cannot do without it. Technology can create environments that provide individualized learning approaches that serve each person in ways that he or she can most benefit.

Many of the leading institutions described in the cases in this paper tend to be attached to one way of doing things (e.g., synchronous versus asynchronous approaches). They thus illustrate pieces of the puzzle, if you will. Yet we are moving toward an online environment that radically increases the array of possibilities presented to each individual student. The ability to customize the learning environment so that each student can achieve in a variety of ways increases the likelihood that learning success online will be higher than learning success in the traditional classroom, dominated by a one-size-fits-all approach. Thus, the "right way" to design a high-quality online course depends entirely on the type of students involved.

Most of today's online courses consist of putting the faculty member's course online. These "traditional" online courses, much like their campus counterparts, are developed and delivered by individual faculty members, with some support from IT staff. Most follow traditional academic practices ("Here's the syllabus, go off and read or do research, come back and discuss."), and most are evaluated using traditional student-satisfaction methods.

All of the new providers described below use technology to create a learning environment that is quite different from the traditional model. As one symposium participant put it: "We do not put the faculty member's course online. Rather we use the faculty member's expertise to define the learning outcomes, the applications of that learning, the content, and potential difficulties that students may encounter." Rather than trying to replicate a teaching model online, the idea is to create what has been called a "resource" model, an environment in which students interact and wrestle with learning materials directly (or in teams), under the tutorial guidance of a mentor.

When we think about how to utilize technology to improve learning, the key is to focus on what we can do with IT that we cannot do without it. Technology can create environments that provide individualized learning approaches that serve each person in ways that he or she can most benefit.

Both the groundbreakers and the new pacesetters agree that students (either directly or in teams) need to interact with learning materials that allow them greater choices of assignments and resources. The key goal is for the students to become engaged in active "doing" in the learning process—that is, to move beyond merely reading text. Where the two kinds of new providers part company is the level of individualization

Rio Salado College
A Systems Approach to Online Learning

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Rio Salado College's twenty-two years of experience with distance learning, along with its extensive use of adjunct faculty and its belief in systems thinking, have shaped its online program. Currently, Rio's online program offers students more than two hundred unique courses, 90 percent of which are available for students to enroll in every two weeks (twenty-six start times per year), with the remainder usually available for enrollment six to eight times per year. We never cancel a class that is offered online. If only one student enrolls, we can accommodate that student. When we survey students about what they like most about our distance program, they always give high ratings to the convenience factor of having access to education when they need and want it.

Technology provides the management system that enables faculty members to handle several starts at one time. The technology also allows for more timely interaction between faculty members and students, thus keeping everyone on track. Payment to adjunct faculty is adjusted according to the number of starts and the number of weeks the course will run—for example, thirteen weeks with two starts versus nineteen weeks with three starts. Because faculty at Rio are facilitators of student learning rather than presenters of information, it is easy to respond to students individually.

Courses are created through a course-development process that ensures that each course aligns with the "Rio brand" of distance learning. All courses are asynchronous (testing is the only face-to-face requirement) and include a consistent navigational template and a focus on developing independent learners. The course-development process produces one version of each course, and adjunct faculty members teach/facilitate the majority of Rio's courses.

All students and faculty are supported by a full range of online services. At Rio, you will not find a distance or online learning department. Rio's philosophy is that the entire college must work as a system to support its distance/online program. Six areas of the college form the system that supports Rio's online students and faculty members:

- The course development and support department is a cross-college group that makes decisions regarding format, delivery, and emerging technologies. The department links a content expert (usually a faculty member) with a team of specialists, each of whom plays a part in the creation of an online course. Depending on the complexity of the course, the team can include a faculty member who has extensive expertise in the development of online courses and the use of online technology, a Web technician, a programmer, an editor, someone to handle copyright issues, and someone to coordinate initial testing of the course. The team also ensures that the course aligns with Rio's brand of distance learning.
- The faculty services department recruits adjunct faculty and works with the full-time faculty and support team to provide new adjunct faculty with training. Adjunct faculty members learn to use the technology, become familiar with online pedagogy, and are made aware of Rio Salado College's expectation for providing timely student feedback.
- The student services department provides a full range of support services via phone and/or online. Services include tutoring (our "Beep a Tutor" program uses pagers to provide a student with a tutor within one to two hours of the page, seven days a week, fourteen hours a day); advising and counseling (advisors call at-risk students as determined by survey); library services (including a reference librarian available seven days a week); testing (proctors are offered at six Phoenix locations six days a week or through an approved proctor at educational institutions or military bases); and an online bookstore.
- The information services department provides a technology help desk available seven days a week, fourteen hours a day, to all faculty members and students. In addition, it provides other support technology such as voice-mailboxes for all faculty members and for students in language courses.
- The admissions and records department provides a variety of rosters and grade reports every two weeks to accommodate Rio's twenty-six rolling enrollment periods. Every start date is assigned a unique section number.
- The marketing department provides course schedules and brochures and also manages a call center that provides prospective students with information about distance learning options.

At Rio Salado College we believe that if all the parts of the system work well together, most students can succeed in the online classroom, so rather than screening out "at risk" students, we try to identify them and provide assistance. Our retention data tell us that 80 percent of students who are active in the second week of the course will successfully complete the course.

to which the course aspires. While increasing the quality of courses from an instructional-design perspective, the groundbreakers tend to maintain a one-size-fits-all approach, holding to the conviction that their particular model is the "best." In contrast, the new pacesetters create a far richer learning environment in which students may make a variety of choices that meet their particular learning needs.

The Groundbreakers

Rio Salado College, the University of Phoenix, the British Open University, and Cardean University share a common approach to course development and delivery. Rio Salado's "systems approach" typifies this model.

Individual courses at groundbreaking institutions are designed in the context of clear goals and desired learning outcomes set by content experts. The learning activities required of students are well thought out and correspond to what we know about human learning. As an example, UNext's Cardean University business courses are designed based on the "learning by doing" philosophy of John Dewey and on current social constructivist views of learning.

The groundbreakers make several significant gains in quality when compared with those institutions using the traditional method of putting courses online. First, the level of the instructional design, including both pedagogical and technological aspects, is greatly increased. Rather than the single-source ("do your own thing") instructional development process employed by most institutions, the groundbreakers involve teams of experts in course development. Second, quality-control processes are more centralized, more collegial, and more elaborate than those in the traditional approach. Finally, course support structures, both during development and during delivery, are tightly integrated with the courses themselves, so that both students and faculty are assured of rapid responses to their needs.

The New Pacesetters

Virginia Tech, Drexel University, and Ohio State University, all part of the Pew Grant Program in Course Redesign,[2] are developing new approaches that radically increase the quality of both the students' learning experience and the learning outcomes achieved. Ohio State uses a buffet analogy to capture this new approach to online learning (see page 14).

Many believe that mass customization is emerging as the organizing business principle of the twenty-first century. Internet-based e-commerce now makes it possible, for example, for customers to order computers designed to their exact needs and specifications, obtain customized home mortgages, and compile music CDs containing any combination of songs. By offering students a buffet of learning opportunities that can be customized to their learning needs, Ohio State, Virginia Tech, and Drexel University are pointing the way to a radically new approach to online learning.

Courses offered by the new pacesetters have five key features that can improve the quality of student learning:

1. An initial assessment of each student's knowledge/skill level and preferred learning style
2. An array of high-quality, interactive learning materials and activities
3. Individualized study plans
4. Built-in, continuous assessment to provide instantaneous feedback
5. Appropriate, varied kinds of human interaction when needed

1. Assessment of Knowledge/Skill Level and Learning Style

The first step in creating an individualized learning environment is to assess each student's entering skill and knowledge level as well as his or her preferred learning style. Florida Gulf Coast University (FGCU) offers an introductory general-education course called "Styles and Ways of Learning." In that course, students complete the Myers-Briggs Type Indicator (MBTI) instrument, which identifies students' preferences among sets of mental processes or mental habits. The MBTI makes students aware of the various ways in which they engage the world most successfully—for instance, through collaborative or individual experiences and through hands-on or intellectual processes. In its redesign of its introductory art-appreciation course, "Understanding the Visual and Performing Arts," FGCU will create learning activities that build on differences in students' learning styles so that students can be directed to the learning activities most suited to their preferred learning styles, thus giving them a greater chance of completing the course successfully.

In those environments that take full advantage of IT's capabilities, such assessments are incorporated into course software. In its redesign of introductory statistics, Ohio State will integrate, directly into its course software, a learning-style inventory instrument developed by Barbara A. Solomon and Richard M. Felder at North Carolina State University (http://www2.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/ilsweb.html).

Cardean University Problem-centered Pedagogy

THOMAS M. DUFFY, PROVOST
HTTP://WWW.CARDEAN.EDU/

UNext's Cardean University offers graduate-level business courses and a DETC-accredited MBA degree via the Web. We employ a business-to-business model in which we sell directly to companies, who then provide the courses to their employees. We are in the process of beginning to sell directly to students. We are also developing academic partnership models—that is, our courses will be used to enrich the offerings and extend the reach of traditional colleges and universities.

Key features of our model include permitting students to start a course at any time and to progress at their own rate; providing high-quality learning experiences; providing a "high-touch" experience; and ensuring access through 28.8 connection speeds to accommodate home and on-the-road access.

We offer two types of courses. Mastery courses, which are one credit each and lead to an MBA, require about twenty-five hours of effort to complete. These courses follow a problem-centered pedagogy and are facilitated by an instructor. Quantum courses, which are noncredit, executive education courses and take two to five hours to complete, focus on current business issues. The design of Quantum courses follows a direct instruction model in which students are provided key concepts, elaboration on those concepts, guided practice with application of the concepts, an assessment of understanding, and finally, a consideration of applying the concept in other contexts.

Cardean seeks to distinguish itself in terms of the quality of the courses offered. High quality is achieved in four ways:

- *Quality content partners.* We have partnered with Columbia, Carnegie Mellon, the University of Chicago, the London School of Economics, and Stanford for our content. Requiring final approval by the university partner, courses are co-branded with that partner.
- *Quality pedagogy.* We do not "put the faculty member's course online." Rather, we use the faculty member's expertise to define the learning outcomes, the applications of that learning, the content, and the potential difficulties that students may encounter. In the Mastery courses, we use that information to create a problem-centered learning environment. Students begin with a real business problem; all learning centers around working on that problem and understanding the concepts and skills associated with working on the problem. In Quantum courses, the focus is on ensuring that the course is oriented toward the application of concepts.
- *Quality assurance.* All of our courses are reviewed by our Learning Instruction unit at Cardean and by the university partner to ensure that all dimensions are of high quality. Further, all courses undergo formative evaluation by current students, who provide feedback on problems they encounter. Finally, we monitor our courses after they are released to identify and provide any "fixes" that are required.
- *Highly interactive environments.* In Mastery courses, up to twenty-five students are grouped into a "class" based on a reasonably common start time. These students share a common discussion environment and an instructor. The instructor's role is to build community and to facilitate students' discussion of the concepts and problems in the course and the application of those concepts to their work environment. Instructors who work for Cardean have at least a master's degree and complete a six-week Cardean certification program. In Quantum courses, there is no instructor facilitation, but there is also a community environment to support students' ongoing discussion of the concepts and skills.

To elaborate our problem-centered approach, the key goal is to engage students in active "doing" in the learning process—that is, to move students beyond merely reading text. Courses are designed around real-world business problems. Rather than reading chapters and studying for a test, students use learning resources to work on real-world business problems. Students may be placed in the role of "analyst" and assigned to evaluate several investment options in order to provide a rationale for recommended action. Each course ends with a reflective or debriefing activity: what was learned, what is needed to get a better understanding, where else do these concepts apply, and how can the process for working on problems like these be improved? This reflective activity is critical to students' abstracting and indexing the learning that has occurred. Finally, performance outcomes for each course assess students' ability to apply the concepts learned to real-world situations.

This instrument, which helps students develop a self-awareness of their learning style, scores students on their degree of active versus reflective learning, sensing versus intuitive learning, visual versus verbal learning, and sequential versus global learning. The course team will also integrate a study skills assessment instrument, developed by Ohio State's Academic Learning Lab, to guide students in making appropriate choices from the buffet of learning opportunities.

Riverside Community College's redesign of its college algebra course is based on using ALEKS (Assessment and LEarning in Knowledge Spaces), a Web-based, artificial-intelligence program that generates individualized student assessments, study plans, and active learning sets. Through sophisticated modeling of each student's "knowledge state" of elementary algebra, ALEKS focuses clearly and precisely on exactly what the student is most ready to learn at a given moment. Based on this information, ALEKS creates customized active learning sets for each student. Students then work through the customized sets, building momentum, confidence, and ultimately, subject mastery. ALEKS also provides collective reports on the students in all classes, pointing out common problem areas that can be addressed. Because ALEKS is Web-based, it is available to students twenty-four hours a day, seven days a week.

2. An Array of Interactive Materials and Activities

All the new pacesetters offer students a broad array of learning materials and activities. In Virginia Tech's Math Emporium, for example, numerous types of learning experiences are available. Students gravitate toward the kind of experience they find best for them. Since students have different learning preferences, the availability of recorded lectures and interactive, Web-based materials enables some students to complete the course primarily on their own, interacting with faculty and other students only to the extent required by the course. Others prefer to take advantage of the variety of support activities and facilities as well as opportunities to interact with course faculty, teaching assistants, and peer mentors. By working collaboratively to design the course, faculty members are able to create, change, adapt, and add to an ongoing body of materials.

Good learningware engages the full range of the human senses through multimedia technology and almost always forces students to make learning decisions. In other words, good learningware encourages active learning.

Effective Web-based materials, often called *learningware,* go far beyond simply transferring traditional material to the Web, since a simple transfer cannot improve learning. Rather than replacing textbooks, these materials supplement them with activities: interactive simulations that can be actively manipulated, that provide engaging and challenging tasks, and that supply instant feedback on performance. Computer games like "flight simulator" are the ready analogy here; these can be devised in virtually any field. Good learningware engages the full range of the human senses through multimedia technology (e.g., visual examples of concepts, short news clips, or foreign-language conversations that can be reviewed as many times as a student desires) and almost always forces students to make learning decisions. In other words, good learningware encourages active learning.

3. Individualized Study Plans

Unlike traditional course structures that engage students in the same series of activities regardless of students' disparate abilities and interests, individualized learning environments permit students to move quickly through content they already know and spend more time on areas they find more challenging. Students engage in study at their preferred time rather than at prescheduled times. Students do not all have to do the same thing but rather learn at their own pace.

The new pacesetters' courses are not completely self-paced, since experience shows that laissez-faire, unstructured, totally self-paced models do not work well and can lead to high attrition rates. Having freedom and responsibility for their own learning may be substantially different from students' previous educational experiences. The greatest problem is getting students to spend time on task. Some students are extremely slow to log in; if students fall behind, they often lack the support to catch up in time, and many simply won't make it. Good online programs include a clear structure that paces student learning and builds in mastery assessments to certify progress and achievement of learning goals. Commercial course-management software packages such as WebCT and Blackboard are able to track students' time on task online. Students need help in adapting to this different style so that they do not mistake freedom of choice for a lack of course requirements.

Ohio State University
A Buffet of Learning Opportunities

DEPARTMENT OF STATISTICS
HTTP://WWW.CENTER.RPI.EDU/PEWGRANT/RD3%20AWARD/OHIO.HTML

Under the auspices of the Pew Grant Program in Course Redesign, Ohio State University (OSU) is redesigning "Introductory Statistical Concepts," a five-credit course enrolling 3,250 students each year. OSU's redesign will implement a "buffet" strategy, offering students an assortment of interchangeable paths that match their individual learning styles, abilities, and tastes to approach each stage of the course and learn each course objective. Like the "emporium" metaphor used by Virginia Tech, a buffet suggests a large variety of offerings that can be customized to fit the needs of the individual learner.

OSU develops the metaphor as follows. Research in learning theory tells us that students are more likely to comprehend and retain the concepts under study when they have (1) a real, vivid, and familiar example to anchor the concept, (2) a second, less-familiar example to demonstrate wide applicability to alternate contexts, (3) a means to discover the general principle, and (4) practice working with the concept. These four stages are the appetizer, salad, entrée, and dessert of a full meal. Since students learn in different ways, the best "fixed menu" of teaching strategies will nevertheless fail for some students, even if those strategies offer the "full meal" of these four learning stages for every course goal.

In contrast, OSU's buffet of learning opportunities will include lectures, individual discovery laboratories (in-class and Web-based), team/group discovery laboratories, individual and group review (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 (graded by teaching assistants 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 practice working with a concept in a data analysis laboratory, in an individual Web-based activity, or in a facilitated study session or by explaining it to others in a jigsaw-formatted review.

The buffet strategy can also accommodate choice in the sequence in which these four stages are presented. For example, it will match the learning style of students who learn better by starting with the big picture and moving to specific examples, as well as students who learn by starting with specifics and moving to the general principle.

To promote commitment to follow-through and to enable efficient tracking of their progress, students will enter into an online "contract" that captures their choice of learning modes at the beginning of each of four units of study. Students will 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 will 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.

Each student will initially be given a set of default study options generated by software to match their learning styles and study skills; this set of options can be changed according to a student's preferences. The finished contract will give the student a detailed listing of what needs to be accomplished, how it 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 other students' testimonials from earlier quarters, students may decide to make changes in their contracts for subsequent units.

The course software will monitor students' progress on an individualized basis throughout each unit, providing a variety of learning activities and suggesting alternate learning strategies. For example, if a student shows a deficiency in a low-stakes quiz, the software will suggest an alternate approach to learning the objective involved. In one case, a student may be directed to a study session covering the topic involved. In a second case, a student may be directed to an applet activity that was not included in the original assignment.

Teaching styles and capabilities also vary, and the buffet approach allows OSU to better match the teaching assistants who support the course with the delivery options for which they have a talent. Teaching assistants who do well in one-on-one help but have not yet mastered the management of whole class discussions can facilitate study sessions or provide individual help during problem-solving sessions. Teaching assistants who have a talent for facilitating small-group discussions and managing the dynamics of a hands-on laboratory experiment should utilize these skills and not be overburdened with grading duties. This supply-side match, coupled with the student demand-side match, will greatly individualize the instructional process even though a course may have a very large enrollment.

Using technology to manage course administration and monitor weekly progress reports and diagnostics will also allow OSU to move to a modular course format. Students will be able to earn from one to five credits based on successful module completion. By requiring students to demonstrate a passing-level proficiency in one unit before proceeding to the next, OSU can identify severe deficiencies and address them early, resulting in a lower failure/withdrawal rate. Thus, the several hundred students who now fall behind and feel compelled to withdraw will have the option of demonstrating proficiency without having to drop all five credits. Analysis of previous data on drops shows that OSU will be able to eliminate one-fourth of the course repetitions, thereby opening slots for an additional 150 students per year.

Drexel uses the term "self-scheduled" rather than "self-paced" in describing its new learning environment. Students can plan their work on a particular module to fit their schedule as long as they complete each module by the end of the week. Thus, at the end of each week, all students working on a particular module will have taken the final assessment for that module and will be at the same point: ready to move on to the next module. The goal is to maximize students' flexibility in learning the course material as best fits their learning preference and schedule while providing enough structure for them to make the same kind of forward progress as in a traditional course. Linking students to a definite learning plan with specific mastery components and milestones of achievement and creating some form of early-alert intervention system are critical components of course design.

4. Built-in Continuous Assessment

When faculty members shift the traditional periodic assessment model (midterm and final examinations) toward continuous assessment, students view assessment as a learning experience rather than as an all-or-nothing performance measure. Few people would be surprised to learn that students, if allowed to do so, will often put off study until shortly before exams and that such cramming does not lead to long-term retention of information. Spacing quizzes (either graded or non-graded) throughout the semester improves overall understanding and retention of terminology and concepts.

The advantages of continuous assessment include an increase in the time that students spend studying, a higher level of familiarity with tested material and of comfort with the testing process, immediate feedback, and the ability to see the result of effort on achievement. Assessing students' understanding of concepts is very effective in detecting areas in which students are not grasping the concepts, thereby enabling corrective actions to be taken in a timely manner, and in preparing students for higher-level activities in the computer labs. Periodic mastery testing helps students keep up with the readings and recognize holes in their understanding, and it promotes understanding of the content. Threading assessment continuously throughout a course also obviates the threat of cheating.

Online assessment tools, moreover, have increased in sophistication and now make continuous assessment more feasible and easier to manage. UIUC's Mallard and Michigan State's CAPA are two examples of these sophisticated software tools (see pages 25 and 29). Computer-adaptive testing and assessment of individual students' strengths and weaknesses can craft customized paths of learning that present learning materials tailored to meet assessed gaps in abilities and provide tasks that are appropriately challenging. Carnegie Mellon University has developed an "intelligent tutor" that can follow a student's progress and adapt the learning environment to respond to areas of difficulty a student may have. The ALEKS mathematics software package can quickly display the location of individual learners or groups of learners on a particular vector of development, allowing faculty mentors to plan interventions accordingly.

5. Appropriate, Varied Human Interaction

Helping students feel that they are a part of a learning community is critical to persistence, learning, and satisfaction. In many cases, human contact is necessary for more than just learning content. Encouragement, praise, and assurance that they are on the right learning path are also critical feedback components, helping students get through rough times and keep on working. Knowing that someone is there to help when they get stuck and to get them moving again gives students the confidence that they can succeed.

In many cases, human contact is necessary for more than just learning content. Encouragement, praise, and assurance that they are on the right learning path are also critical feedback components, helping students get through rough times and keep on working.

Such active mentorship can come from a variety of sources, such as traditional instructors (faculty and graduate teaching assistants) and more advanced undergraduate students. Access to a large support system of fellow students and tutors who are available virtually around the clock is a key component to these new designs.

Students also learn from each other. Research has shown that students in distance education take on the role of "teacher" more often than do students in traditional classrooms. This not only has obvious implications for the content and mode of instruction but also sets up a model of learning communities that is invaluable when our students enter the work world. Knowledge-management software can structure a situation in which students can be actively encouraged to get in touch online with others who recently encountered and overcame similar problems.

III. Increasing Access to Higher Education

When asked how online learning can lead to greater access to U.S. higher education, most people think about increasing access to campuses and their current structures and services. Symposium participants were able to come up with far more creative ideas about access—ideas that take advantage of the capabilities of information technology and the Internet. In so doing, they broadened considerably what we mean by *access,* moving beyond giving students who cannot travel to a classroom the opportunity to participate in higher education. Access means different things to different people; it does not have a one-size-fits-all definition. Information technology enables us to expand our definition of access to meeting the learning needs of diverse students when, where, and how they so desire. Technology can create environments that provide *individualized* access to learning, access that serves each person in ways that he or she can most benefit.

Symposium participants generally agreed that the key to designing more-accessible learning environments is to eliminate constraints. As one participant put it, the more virtual (anyplace, anytime) the delivery model, the more accessible it is. Too many distributed learning models still burden students with the constraints of time and place (someplace, same-time). In addition to those of time and place, there are academic constraints that contribute equally to limiting access. Just as the standard semester is emblematic of time constraints, so do standard academic structures like the three-credit course or the institutionally based degree program restrict access to higher education.

Asynchronous learning environments have done a lot to eliminate the constraints of time and place, but have they done as much as possible to take advantage of the capabilities of the Internet? The overwhelming majority of online programs, like their on-campus counterparts, follow traditional term (semester or quarter) "class" models, a classic case of applying old solutions to new problems. Why? Most surely the reason is institutional convenience; few would argue that students prefer fixed start times. Clearly, information technology can support new structures that offer greater flexibility for students. Indeed, without the support offered by information technology, individualizing instruction is both expensive and logistically challenging. Once an institution recognizes how information technology can manage a more diverse approach to organizing instruction, there is little reason to retain a lock-step approach.

Information technology can support new structures that offer greater flexibility for students. Indeed, without the support offered by information technology, individualizing instruction is both expensive and logistically challenging.

The Groundbreakers

In contrast to prevailing practice, Rio Salado College, the University of Phoenix, and Cardean University have revolutionized the college calendar. At all three institutions, entering students do not have to wait until the next semester begins in order to enroll. At Rio Salado, students have access to more than two hundred online courses, the majority of which start twenty-six times a year (the remainder usually start six to eight times a year). This means that any student who wants to take a course never has to wait more than two weeks to start. In addition, although each course is advertised as a fourteen-week class, students are allowed to accelerate or decelerate as needed. Rio never cancels a class that is offered online. If only one student enrolls, he or she can be accommodated. Information technology provides the management system that enables faculty members to handle several starts at once, keeping everyone on track.

The University of Phoenix uses a rolling-cohort model in its online programs, enabling a course to begin as soon as eight to thirteen students are ready to start a particular study. Cardean University also allows its MBA students to begin at any time, once a cohort of about twenty-five is established. In both cases, students share a common discussion environment and an instructor, whose role is to build community and facilitate students' discussion of the application of course concepts to their work environment.

The University of Phoenix, like Rio Salado and Cardean, makes flexible access to its programs and courses one of its highest

University of Phoenix
A Focus on the Customer

JORGE KLOR DE ALVA, PRESIDENT
AND KURT A. SLOBODZIAN
VICE PRESIDENT, INSTRUCTIONAL TECHNOLOGY
HTTP://WWW.PHOENIX.EDU/

To understand the University of Phoenix Online educational model, one must first understand the mission and purpose of the University of Phoenix. University of Phoenix is a regionally accredited postsecondary institution committed to the needs of working adults. The typical University of Phoenix student is thirty-five years old (in the United States, University of Phoenix students must be over twenty-three) and is employed full-time, typically in a middle-management role. To meet the needs of that population, the University of Phoenix has developed a teaching/learning model that is respectful of the knowledge and experience that our students bring with them to class and that is attentive to their need for efficient and professional customer service.

From its inception, the University of Phoenix has focused on helping students achieve life and career goals by delivering degree programs in a cohesive and comprehensive manner. All University of Phoenix instruction is organized around a collaborative model that positions the instructor as a learning "facilitator." University of Phoenix programs are developed by faculty teams to ensure that course objectives and outcomes are presented in a sequence that builds both knowledge and confidence.

This learner-centric approach is complemented by a customer orientation that places high value on all aspects of customer service. The University of Phoenix "unbundles" critical student services and provides each student with a team of specialized counselors who work together from their respective areas of expertise to ensure accurate and timely assistance with enrollment, financial services, and academic advisement. Every time another institution takes four weeks to send a catalog, we gain a student. Everything we do is tracked and logged to ensure that we are providing the best customer service possible.

The same clear vision that has made the university successful as a campus-based institution has helped to build the University of Phoenix Online into a premier distance learning organization. Founded in 1989, the University of Phoenix Online was among the first to provide complete college-degree programs entirely online. Unlike other programs, which are partially delivered via mail, telephone, or videotape or require some on-campus attendance, the University of Phoenix Online allows completion of 100 percent of the curriculum via the Internet. This includes all administration, registration, and the acquisition of course materials.

Students enter the program as a cohort and take one course at a time. Students register only once. They know exactly what they will take at the beginning of their career and know exactly when they will graduate. Class participation is mandatory. Class instruction is conducted asynchronously, through threaded discussions that, like the discussions in our classroom-based model, place a high emphasis on student participation and interaction. The course completion rate is 97 percent; the graduation rate is 65 percent.

Curriculum is outcomes-based and workplace-oriented. All faculty must be employed in the area in which they teach (e.g., a faculty member must be an accountant in order to teach accounting). Every student works in a study group or team to develop workplace skills such as critical thinking, teamwork, and so on. In all courses, what must be covered on a week-to-week basis is scripted and linked to outcomes that students must reach at the end of each class. Testing takes place to make sure both that the students are learning and that the faculty are teaching what they are supposed to. Curriculum is professionally developed on a master curriculum calendar and is assessed every year, ensuring that courses are kept up-to-date.

The University of Phoenix is an outcomes-driven institution that measures its success through a heavy emphasis on student assessment. Because each program's outcomes are specified by the faculty developers who designed it, we are able to maintain a high level of content consistency within each program. That consistency enables us to benchmark and assess students' progress both in the core competencies of their area of study and in those broader areas (such as critical thinking) that form the bigger picture of our educational programs. These competencies are assessed through matched pre- and post-tests administered to students as they enter and exit their major course of study.

Understanding that the success of our students is predicated on effective customer service, we place an equal emphasis on ensuring the quality of the customer service component of our institution. The university annually administers more than 600,000 student end-of-course surveys, as well as conducting periodic alumni surveys. Faculty too are surveyed after each class to ensure that course materials are current and effective and that students are achieving the outcomes needed for the rest of the sequence of study.

Through these measures and surveys, we can assert with confidence that our online students are achieving at levels equal to or exceeding those of our classroom-based students. Furthermore, our high level of accountability serves us well in demonstrating our effectiveness to corporate customers.

Our teaching and learning model has always put a high value on small class size, which encourages active student participation. Consequently, a typical class size at our physical campuses is fifteen students. At Online, we recognize that facilitating class discussions requires additional faculty involvement, and we have typically kept class sizes 20 to 25 percent smaller (about nine students per class) than for our campus-based instruction. For that reason, current costs for Online instruction are actually higher at University of Phoenix Online than at any of our campus facilities. Although we believe that technological advances will likely result in a long-term cost reduction for our distance delivery, we are cautious to balance these "efficiencies" against our desire to ensure student achievement and our need to guarantee the highest-possible level of customer service.

Rio Salado College Online Human Anatomy

JOHN ARLE, FACULTY CHAIR OF SCIENCES
HTTP://WWW.RIO.MARICOPA.EDU/CI/VISITORS_CENTER/SCIENCE/HOME.SHTML

In 1995, Rio Salado made a commitment to moving our entire program online to take advantage of the emerging possibilities of the Internet. After nineteen years of award-winning classroom teaching, I was, once again, a beginner. My first online efforts were lessons heavy with information presentation. Eventually, I evolved to a format that guides student research and engages students in active learning.

Each online lesson is divided into four sections: introduction, instruction, self-assessment, and student summary of learning:

- The introduction provides a brief overview of the new lesson content, linking previous learning with the new content and actively engaging students in a review of that learning.
- Lesson instruction begins with a list of learning objectives that describes exactly what students need to master. Objectives are then subdivided into individual research focus points and questions, indicating the topics that students need to research from course resources. Resources may include the textbook, CD-ROMs, Web sites, online PowerPoint shows, audio files, video files, PDFs, and so on. Within a particular lesson, conceptual instruction is integrated with lab instruction.
- The self-assessment section interactively exercises the students' new learning, using online resources such as interactive tutorials, tests, puzzles, practice lab practicals, games, and written assignments. With online media, materials available for this component are nearly unlimited.
- The student summary section requires students to respond to probing essay questions that ask them to explain specifics learned from the lesson.

Human interaction is concurrent with technology-mediated instruction and self-assessment. Online discussions interconnect teacher and students, providing further interaction between students and the content as well as a needed "high-touch" component. Without this contact, many students will fail in their efforts to work independently through an entire class.

I have discovered that the online format of instruction and the immediate access to technology have expanded my ability to teach specific scientific topics and have increased my effectiveness. I can engage students in anatomical study in ways that cannot be done in a face-to-face class. I now teach human anatomy and physiology courses with interactive virtual human dissection, as opposed to using a cat in a tray. Some skeptics may point out the two-dimensional versus three-dimensional compromise of virtual dissection. My reply is, "At least I'm using the right species."

To create the virtual human dissection lab, I use two CD products from ADAM.com (Animated Dissection and Anatomy Modeling): ADAM Interactive Anatomy (AIA) and ADAM Interactive Physiology (AIP). The AIA program allows me to construct a series of interactive slides linked to the AIP CDs that guide the students' observations. The AIP CDs are structured by body system: nervous, muscular, urinary, respiratory, fluids and electrolytes, and cardiovascular. Together, these interactions are extremely detailed, allowing students to identify structures, dissect further, or move in any direction. They provide students with both a highly interactive environment and an incredibly rich self-assessment program. Seeing how these systems work is far more compelling than reading or hearing my descriptions.

For all microscope work, I replace microscope observations of body tissues with online views and links to medical schools. Histological (microscopic tissue) examination is possible through online photomicrograph libraries. I use two Web sites, one at the Loyola University Medical Education Network (http://www.meddean.luc.edu/lumen/MedEd/Histo/frames/histo_frames.html), the other at the University of Kansas (http://www.kumc.edu/instruction/medicine/anatomy/histoweb/).

Grades are based on homework (10 percent), two take-home tests (30 percent), and midterm and final exams (60 percent). I use a national standardized test generated by the Human Anatomy and Physiology Society. The national achievement average is 51 percent on this test, and the sample base is entirely from the traditional classroom. My students (entirely online) score an average of 63 percent on these same items.

priorities. Study at each of these institutions is primarily asynchronous. Each has a focus on providing greater access to learning for working adults—the majority of whom are isolated from typical college classrooms by time, geography, or transportation barriers—and each has designed its environment accordingly. When these institutions survey students about what they like most about their programs, the convenience factor of having access to education when students want and need it always ranks high.

The New Pacesetters

Just as information technology enables institutions to create more flexible access to existing courses and programs by eliminating the constraints of time and place, so too does it allow us to expand our definition of access to eliminate *academic* constraints. Pacesetting institutions are increasing access via information technology in three important academic dimensions: academic resources, degree programs, and learning through modularization.

Increasing Access to Academic Resources

Some institutions are going beyond creating access to traditional faculty and other academic resources. Rio Salado has found a way to eliminate an academic constraint—the need for students to come to the physical campus to take laboratory-based courses. Rio teaches anatomy and physiology courses completely online using virtual techniques, reducing laboratory costs without sacrificing quality (see page 18).

Out of several hundred online courses offered by Rio Salado, four science courses rank in the top eleven, an indicator that students want this expanded kind of access. At the British Open University, expensive or dangerous home experiment kits (e.g., chemistry laboratories, telescopes, microscopes) have been replaced by virtual instruments and experiments. Most science courses at the university are CD-ROM-based. In addition, both Rio Salado College and the British Open University emulate field trips online (e.g., field trips by geology students have been replaced by virtual field trips that can draw more easily on high-quality support materials).

Increasing Access to Degree Programs

Whereas most people in higher education think about access within a construct of time and place, symposium participants pointed out that academic policy constraints are frequently more potent. Expanding access to higher education requires overcoming the many academic barriers established by individual institutions. The issues of access to full-degree programs and of credit transfer among multiple institutions have been a challenge to colleges and universities for many years, but the existence of the Internet and the explosive growth of online learning have radically escalated their importance.

Although not all online learners seek degrees, many do. Public-policy goals that drive most virtual university efforts, for example, include increasing the number of degree-program graduates. As one symposium participant commented, it is an accepted truism in higher education that adult learners will not begin a degree program if they cannot see how they will complete it. If online learning is going to expand access significantly in the near future, we will need to increase the number of degree programs that students may complete entirely at a distance.

It is an accepted truism in higher education that adult learners will not begin a degree program if they cannot see how they will complete it. If online learning is going to expand access significantly in the near future, we will need to increase the number of degree programs that students may complete entirely at a distance.

Institutions that accept transfer credits or work experience relatively freely, while offering virtual degree or certificate programs, are especially effective at increasing access. Many students may prefer to take courses from more than one institution, and this trend is accelerating.

At Excelsior College, students can pick and choose how they will complete their degrees and which learning services they need to advance their educational goals, depending on their particular life circumstances. Some students use all of the Excelsior College learning services, some use none, and some pick and choose. Some students complete their degrees exclusively through credit-by-examination, some take courses from many different institutions, some rely on distance education courses to complete their degrees, and some attend only one institution in their local communities. Some students take a few examinations, a few distance courses, and a few classroom courses taught at one or two local institutions. In addition, since Excelsior places no caps on the kind or amount of transfer credit that it will

Excelsior College

What You Know Is More Important than Where or How You Learned It

PAULA E. PEINOVICH,
VICE PRESIDENT FOR ACADEMIC AFFAIRS
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With a mission of access, excellence, and diversity, Excelsior College (formerly Regents College) has served experienced adult learners exclusively at a distance since 1970. Approximately 90,000 graduates and 25,000 learners a year take advantage of the institution's self-paced, portable programs.

At Excelsior College, "being virtual" means recognizing collegiate-level learning virtually wherever it occurs and ensuring quality through rigorous assessment. One corollary to our principal premise that "What you know is more important than where or how you learned it" is that there are a variety of equally valid and reliable ways to measure and validate learning. A second corollary is that learners themselves are responsible for their own learning. Thus, the institution's role is to support and facilitate students' learning in the many settings in which it occurs and to assess that learning using methods so rigorous that outcomes equivalent to those achieved in traditional institutions can be clearly demonstrated. The phrase "many avenues, one goal: a college degree" captures the essence of the institution.

The college requires neither academic nor geographic residency. Its philosophy is manifested in an undergraduate academic program based on an outcomes model. Its institutional core functions include the direct assessment of student learning, the evaluation of students' prior learning that has been validated by recognized quality-assurance frameworks, academic advising at a distance, educational brokering, and learning support services.

Excelsior College is the only institution in the United States that is both a degree-granting institution and a nationally recognized assessment organization. Excelsior Examinations (formerly Regents College Examinations) is the standardized credit-by-examination program the college provides not only to its own students but to any student who wants to validate learning and have it recorded on a college transcript. Students study independently, schedule an appointment at a Prometric testing center when they are prepared to sit for the examination, and present themselves to be tested.

Quality-assurance frameworks that the college recognizes to validate students' prior learning include regional accreditation, accreditation by the New York State Board of Regents, programs evaluated by the American Council on Education (military training, business/industry training, national examination programs), programs evaluated by the New York Program on Non-Collegiate Instruction, international credentials evaluated by Educational Credential Evaluators, and special programs that have been evaluated by Excelsior's own faculty. Learners send in over 70,000 transcripts and educational records per year for the institution to validate, evaluate, and apply to their educational status reports based in the Excelsior College student system. This student system equates to an educational credit bank, or "passport," where all prior learning is integrated into a single academic record.

The Excelsior College academic advising program is carried out both online and on the telephone. Academic advisors work in teams to serve students. Services include educational program planning, values clarification, decision-making, and career planning. Advisors are available to respond to students' requests and needs, and they provide various outreach programs to learners who do not appear to be making academic progress. A suite of online inquiry services allows students to take care of purely administrative tasks such as ordering materials and scheduling their examinations.

Academic advisors also coordinate the evaluation of students' prior learning and the application of that learning to the requirements of the students' chosen degree programs, and they assist students in deciding how to complete degrees. Students may take courses from regionally accredited colleges (both on campus and at a distance) and sit for additional examinations. The college maintains DistanceLearn, an extensive database of distance learning courses from regionally accredited colleges, to aid advisors in their roles as educational brokers. With over 20,000 courses, DistanceLearn serves as the backbone of the Peterson Web site (http://www.lifelonglearning.com/) and also provides the raw data for ongoing research that the institution conducts on trends in distance learning.

In addition to academic advising, Excelsior provides an array of support services from which students may select, based on their educational needs and interests, learning preferences, personal circumstances, and time constraints. These services include multimedia guided-learning packages for Excelsior Examinations, the Regents College Virtual Library (in conjunction with Johns Hopkins University), the Regents College Bookstore (in conjunction with Specialty Books), a book exchange (for students to buy and sell used books), and the Electronic Peer Network (EPN).

The EPN provides a constellation of online learning support services, both synchronous and asynchronous. A schedule of weekly "chats" is published for students to come online to chat with advisors and each other about a variety of relevant topics. A writing center allows students to submit papers to be critiqued for any course or examination for which they may be preparing. Each of the Excelsior Examinations has a "room" where students can study together, and there is a "study buddy" locator to assist individuals in finding study partners. In addition to the online study groups, Excelsior College also offers workshops for independent learners preparing for examinations via individual and group teleconferences, and in-person workshops are offered around the country.

recognize from regionally accredited colleges, students do not need to repeat learning they have already achieved in other collegiate settings. The college thus reduces the total number and cost of courses that students must take to complete their degrees (see page 20).

Students at Excelsior College have neither cohorts nor calendars. They can create programs of study that combine on-campus courses, online courses, test preparation, and independent study to individualize the time and place of study while achieving common learning outcomes as validated by Excelsior's highly regarded standardized examinations. Trading academic residency for rigorous assessment clearly expands access to higher education.

Increasing Access to Learning through Modularization

To make learning available to the greatest number of people, we can *modularize* or break down educational content into smaller chunks that can be reorganized or recombined to meet the learning needs of individual students. Modularization characterizes most of the features of the buffet-style courses described in the preceding section on improving quality.

With [customized learning materials], students can potentially decrease the time they spend on a particular course, increase their success rates, and reduce the number of times they repeat a course, all of which play an important role in increasing access to U.S. higher education.

By modularizing course content, pacesetting institutions are able to tailor the study to different types of students with different goals. Like Ohio State, Drexel University is exploring how modularization can benefit both students and institutions (see page 22).

Modularization moves us further along the continuum from what has been called *just-in-case* learning to *just-in-time* learning. As applications of information technology become more sophisticated, we can identify weaknesses in students' learning as they progress through a course. Students can then focus on these areas of weakness and spend less time on content areas they already understand. Customized learning materials can be presented to students in order to provide more practice and/or greater variety in the types and levels of difficulty. With such focused study, students can potentially decrease the time they spend on a particular course, increase their success rates, and reduce the number of times they repeat a course, all of which play an important role in increasing access to U.S. higher education.

Drexel University
Modularizing Computer Programming

DEPARTMENT OF INFORMATION SCIENCES
HTTP://WWW.CENTER.RPI.EDU/PEWGRANT/RD3%20AWARD/DRXL.HTML

Drexel University is redesigning the "Introductory Computer Programming" course by combining two courses, "Computer Programming I," the primary entry point for computer science majors, and "Computer Programming B," a less technical version of the course. Taken together, the two courses are required for 33 percent of all freshmen. Since the computing backgrounds of entering students vary widely, the traditional lecture-based format that treats all students as if they are the same has substantial limitations. To accommodate student diversity, a mixture of presentations and hands-on participatory learning experiences using interactive, Web-based modules will replace the traditional model. In addition, course credit will be variable: it will depend on the number of modules successfully mastered and the level of skill mastery that the student attains.

To accommodate students' different learning goals, the modules will cover particular aspects of computer programming at different levels of knowledge and skill. Students will be assigned workfrom the module at a level appropriate to the objectives of the long-term goals of their major, allowing those in different majors to acquire the appropriate skill level for each technique and concept. Thus, information systems majors will need to master one subset of the material; computer engineering majors will need to master additional material beyond that; and computer science majors will need to master the entire module. Students may access all levels of each module, allowing those in less technical majors to learn additional material if they desire.

The redesigned course modules will be organized according to Bloom's Taxonomy, which delineates levels of subject mastery as follows:

- *First level.* Students know the terminology and specific facts about a subject.
- *Second level.* Students gain increased comprehension of the material and are able to explain the material and interpret what they have learned.
- *Third level.* Students can apply their knowledge in new situations to solve relatively simple problems.
- *Fourth level.* Students can analyze problems to discover component parts and interactions.
- *Fifth level.* Students can apply prior knowledge in original ways to produce things that are new and different and can evaluate the methods used.

Each student must complete the level designated for his or her major, including passing the final assessment quiz. Level three is the minimum level of mastery for all students to attain. Both computer science and computer engineering students need to reach the fifth level of mastery to some degree, since they will face highly technical problems that must be solved in original ways. Because they will need to implement highly technical programming solutions to complex problems, computer science students must develop a deeper knowledge of computing than the other majors, including the fifth level of Bloom's Taxonomy—the ability to judge the methods used—particularly when problems are complex and may not have a single well-defined solution.

The modules will also be designed so that three modules encompass material equivalent to one credit. If a student successfully completes nine modules, it will be the equivalent of completing a traditional three-credit course. Students will receive course credit based on the number of modules they complete and the module level they master. Students who have difficulty with the higher levels will be able to change majors and still receive course credit without having to drop the course and repeat modules already mastered. This aspect of the course design addresses a significant resource problem at Drexel, since many students enroll in computer science without understanding the nature of the work. Once in the course, they may find other computing majors more appealing. The redesigned course will enable them to change majors without losing the work they have invested in a programming course for their now-abandoned major.

Students will also be able to enter the course in one of three cohorts based on their performance on a knowledge and skills placement test. The modular approach will allow Drexel to place advanced students more accurately so that they will not need to cover material they already know. Those with little or no programming experience will enter at module one and earn three credits for successfully completing all nine modules. Those with some skills and knowledge will enter at module four and earn two credits for successfully completing the remaining six modules. Those with moderate skills and knowledge will enter at module seven and earn one credit for successfully completing the remaining three modules. Students will also be able to review earlier modules if they want to make sure their knowledge is complete, and they will be able to do so at their own pace without being held back by students for whom this knowledge is new.

Drexel's goal is to create modules that provide a complete instructional program for the student, including online access to digitally recorded lecture presentations; reading materials developed by the instructors or in the assigned textbook; examples and exercises in the student's field of interest; links to other online materials of interest; individual and group laboratory assignments; and self-assessment material to provide feedback on the skills being learned. The new organization of the course and the variety of materials and activities will allow for greater flexibility in catering to diverse learning styles: students can rely on the textbook, lectures, group work, or individual coaching to master a module. In addition, students will be able to seek help from a variety of different people—the faculty member, graduate teaching assistants, and peer mentors—again allowing flexibility in interacting with the person who can provide the best help for each particular problem.

IV. Reducing the Costs of Teaching and Learning

When the issue of cost is raised in relation to online learning, many people in higher education focus on the question, does online learning cost more or less than traditional instruction? The predominant belief is that it costs more. Temple University's president, David Adamany, typifies the views of many; he was recently quoted in the *Chronicle of Higher Education* as saying, "No one has yet found a way for online learning to be economically viable."[3]

The issue of cost is directly related to that of access. As one symposium participant noted, it is very difficult for most existing institutions to expand access, whether on campus or online, without facing significant budget increases. Without new funding sources, enrollments can only expand on the margin: where courses and programs have insufficient enrollment and new students can fill empty seats. A contributing factor is that productivity in higher education is declining. Between 1977 and 1997, the number of students in higher education has increased by 27 percent while the number of faculty has increased by 56 percent, resulting in a decline in the student/faculty ratio from 16.2:1 to 15:1.[4]

One symposium participant commented that faculty, via threats of unionization, had forced the participant's institution to limit the number of students in online courses to twenty, which in turn limits the ability both to scale (i.e., produce more cost-effective courses) and to serve more students (i.e., increase access). Indeed, a new, emerging paradigm for traditional online courses calls for a 20:1 (or less) student/faculty ratio, reflecting the on-campus small seminar. Campus leaders are rightly concerned that such applications of information technology are increasing instructional costs rather than controlling or even reducing them. Online learning offers enormous possibilities for guiding and managing instruction, for communicating with students, and for assessing student performance and knowledge on a much larger scale than is currently the norm if we can change the student/faculty ratio. The issue is, how can we handle large numbers of students cost-effectively?

Rather than simply comparing the costs of one form of instruction with another, symposium participants were asked to consider the following question: What kinds of approaches to online learning do you believe can lead to a reduction in instructional costs? By thinking of ways to take advantage of the capabilities of information technology and the Internet and, in so doing, by reconceptualizing the way that courses are designed, participants were able to come up with many creative ideas about how to make collegiate instruction more cost-effective.

The highest cost component of instruction is faculty personnel. Currently, the job of a faculty member—whether in class or online—is seen as monolithic: a collection of tasks that are, with few exceptions, carried out by one person. Faculty usually believe they must and will play all roles in the course-development and course-delivery process. Traditional online providers suffer from what one symposium participant called a "craft mentality," in which a high-priced faculty member is her or his own developer and technical support person, not to mention learning theorist. Information technology offers the possibility of altering this paradigm. Once the many roles or tasks that a faculty member performs are disaggregated—that is, separated and seen individually—the opportunities for substitution and cost reduction become clearer.

Higher education has known for decades that substituting cheaper labor for more expensive labor reduces instructional costs. The use of graduate teaching assistants, adjunct and part-time faculty, and other instructional personnel has enabled institutions to keep their costs from rising beyond what they are now. The knock has always been that our dependency on part-time faculty reduces the quality of instruction, and anecdotal evidence seems to support that view. The academy, broadly, worries about institutions that rely too heavily on adjunct faculty for two reasons: (1) the academic program may fall into the hands and control of administrators who make decisions based on financial expediency rather than academic quality; and (2) quality assurance may be difficult to maintain, since the academy has neither the infrastructure nor the culture to support a close monitoring of ubiquitous and disenfranchised adjunct faculty.

Both the groundbreakers and the new pacesetters follow a strategy of substituting cheaper labor for more expensive labor and of employing more differentiated kinds of labor in both course development and delivery. What distinguishes their

methods from higher education's historic approaches? First, both types of new providers rely on technology-based, common or centralized development of course structures and course materials, enabling a much tighter level of quality control. Second, both take advantage of the ability of IT to disaggregate instructional roles to even greater levels of granularity while ensuring overall course coherence. Third, both reduce the duplicative development costs of individual faculty members and enhance the quality of instructional and assessment materials. And fourth, both enable multiple faculty to teach the same material and thus to handle more students.

The Groundbreakers

Originated by the British Open University and replicated with their own twists by the University of Phoenix, the Dallas Community College District, and Cardean University, groundbreaking institutions focus on creating an efficient course-development process and supporting that process with tools that increase efficiency. The model is one in which large, up-front investments are made in single courses, using the best expertise possible in the development team, with the expectation that very large numbers of students will ultimately enroll. In 1999, for example, the British Open University piloted what is now its most successful online course—"You, Your Computer, and the Net"—with 800 students. This year, the course had a total student cohort of some 12,000.

For course delivery, the groundbreaking model employs a relatively small core of full-time faculty to set academic standards, oversee curriculum, establish academic policies including degree requirements, and so on. Part-time, adjunct faculty carry out the bulk of instruction. The University of Phoenix, for example, has 240 full-time faculty and more than 8,000 part-time practitioner faculty members. Rio Salado has 25 permanent faculty and 750 adjunct faculty. Quality control is strong because, in each case, courses are developed and monitored centrally, unlike the adjunct model used by most traditional institutions in which part-timers have relatively free rein to teach as they like.

Despite their gains in cost-effectiveness on many fronts, several of the groundbreaking institutions have created a relatively expensive delivery model by restricting the student/faculty ratio to anywhere from 9:1 at the University of Phoenix to 25:1 at Cardean. To support the smaller ratios, Phoenix charges one-third more tuition for its online courses than for its classroom-based courses. While taking advantage of IT to coordinate course development and to ensure a high level of

The British Open University Approach to Online Learning

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Over 150,000 students register with the British Open University each year, including 5 percent non-U.K. EU students and 10 percent outside the EU. The university is considered by many to be the world's leading distance learning institution. The quality and effectiveness of the university's teaching is monitored through the collection, analysis, and dissemination of data about the strengths and weaknesses of the materials and services provided and the quality of the student's experience and learning outcomes.

All students of the university are offered a comprehensive advice, guidance, and learning support service, starting from the initial point of inquiry through to completion. A full range of media has traditionally been used to support students, including a strong telephone-based advice and guidance service, student toolkits on study skills, TV programs, group and individual face-to-face support from course tutors, and residential and day schools. Learning and teaching materials have been sent to students in a number of ways including print, broadcast television and radio, videocassettes, audiocassettes, home experiment kits, and CD-ROM. Web-based advice and guidance, e-mail as an advisory medium, and the use of computer-media conferencing for teaching and learner support are expanding across all services.

CD-ROM use has grown dramatically in the last few years as the primary distribution media for computer-based learning and teaching materials. Driven by the rapid growth of the Internet and prospective students' expectation that courses will be available online, the Open University aims to establish the critical baseline of IT elements for all courses and programs by 2002 and build IT elements into courses to achieve compulsory IT elements for all university degrees by 2005.

The university is now working with software tools that take advantage of the immediacy of the Internet and the large data-storage capacities and versatility of DVD technology. Hybrid developments of this kind are referred to as "Connected DVD," and the university is developing Web-based student learning environments, using DVD-ROM discs to store data-intensive media that form part of the student's learning and teaching materials. The versatility of DVD technology allows the disc-based material to be used online or offline in a variety of ways. The development of connected DVD learning environments challenges distance educators to develop new authoring styles and new ways of creating and managing content and to recognize that there is a blurring of distinction between the development and the delivery of online learning and teaching material.

University of Illinois at Urbana-Champaign
The Spanish Project

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In 1989, the UIUC University Senate mandated a graduation requirement of three semesters of foreign language, but excess demand for Spanish prevented its implementation. Beginning in fall 1998, we revised the basic language sequence in Spanish to allow technology to deliver part of the instruction. We based the innovation on successes that we had already achieved using instructional technology in first-year Italian (fall 1996) and in a fifth-semester Spanish grammar course (fall 1997).

We began with the course with the highest student demand, Spanish 122, an intensive course that covers the first two semesters in one. This course is for "false beginners": students who have had two or more years of Spanish in high school but who need review before they can move to the third-semester level.

The technology-enhanced format allowed us to reduce the number of weekly class meetings by half, from four to two. During the class meetings, students work only on communication skills. The rest of the course is done online. Online work in vocabulary, grammar, and reading is presented using Mallard, a Web-based tool that provides automatic grading and feedback, maintains deadlines for completion of the material, and automatically sends students' scores to the instructors and course coordinators. Asynchronous conferencing is done through WebBoard, in which students post twice-weekly messages in Spanish, with one message being a reply to other students' posts.

Graduate teaching assistants provide the in-class instruction. In the conventional format, they met with one group of twenty-four students four times per week. In the technology-enhanced format, they meet with two groups of twenty students two times per week each. Although teaching assistants are teaching almost twice as many students, they are responsible for much less instruction. Preparations are eliminated because the teaching assistants are given daily lesson plans. Grading has been almost eliminated. The only grading that instructors do is partial grading of the midterm and final exams (over 50 percent of the exams are scantron-graded) and providing comments on (but not correcting) the students' online writing.

Through the introduction of technology, we have been able to almost double the enrollment in Spanish 122, as well as in two additional courses, with no increase in staffing. The table below represents actual enrollment figures and staff FTEs for fall 1999.

Course	Conventional Format	Tech-Enhanced Format
Spanish 122	387 (2.1)	599 (2.0)
Spanish 103	423 (2.4)	658 (2.1)
Spanish 210	172 (1.1)	278 (0.9)

We looked at students' performance on both the university's placement exam and departmental exams. Students' pre- and post-scores were compared under both instructional formats for Spanish 122. Students in the technology-enhanced format made significantly greater gains in scores on the placement exam (a more robust measure than departmental exams) than did students in the conventional format. We also compared students' scores on departmental exams. There were no significant differences in their scores on listening comprehension, the midterm exam, written skills, or final grades for the course. (Because we had no valid data on speaking skills in the conventional format, we could not compare abilities on that variable.)

Our model was specifically designed to allow greater access to Spanish-language instruction, impossible within the conventional framework. Through the use of instructional technology, we have been able to teach almost twice as many students without increasing FTEs. Moreover, we are using our human resources more efficiently, asking them to provide the kind of instruction that requires human interaction and not to spend their time on things that are better managed by technology (e.g., presentation of basic material, routine grading, and record-keeping). The success of the Spanish Project permitted the implementation of the university graduation requirement by fall 2000.

quality control over course delivery, these institutions have failed to exploit fully IT's disaggregating capabilities. For examples of how this can be done, we turn next to the new pacesetters.

The New Pacesetters

Encouraged by the Pew Grant Program in Course Redesign, several institutions are pursuing an alternative to large, up-front investments in course development. This model takes advantage of existing materials that have been developed commercially or by other universities. In its online college algebra courses, Rio Salado College, for example, requires students to purchase Academic Systems mathematics software just as they would purchase textbooks. Rio then uses this commercially produced software as the foundation for its online mathematics courses. In addition to defraying the cost of materials development, basing the course design on sophisticated software enables instructors to handle a higher number of students (from 25–30 to 125) in their courses, thus further reducing the overall cost per student.

Like the groundbreakers, the new pacesetters reduce course-delivery costs by using technology to serve large numbers of students. Their efforts are differentiated by the further disaggregation of the faculty role and the substitution of technology-based interactions for human labor. Though appearing more traditional than the groundbreaker model in many ways—especially since full-time, tenured faculty frequently serve as lead faculty in course delivery—the new pacesetter model is, in fact, more radical and thus offers greater possibilities for both cost savings and quality improvements.

A straightforward example of this approach is how the University of Illinois at Urbana-Champaign (UIUC) has doubled enrollment in foreign language courses by relying heavily on Mallard, a UIUC-developed intelligent assessment software program that automates the grading of homework exercises and quizzes (see page 25).

Pacesetting institutions are breaking through the small-seminar model for online instruction and are creating new paradigms that are both high-quality and cost-effective. Once again, individualization is the key idea. Our buffet metaphor is appropriate here. Rather than serving a "fixed meal" of instructional resources, these new designs allow students to take advantage of resources according to their own needs. Redesign involves moving from an expensive and inefficient *push* strategy, which presents all material to all students in the same way and at the same time regardless of their particular needs, to a *pull* strategy. Students access the material they need when they need it, an approach that takes into account differences in learning preferences and abilities. The latter strategy is not only more effective in dealing with learning issues but also more economical in dealing with resource issues because students use only as much resource as they need. Organized around computer-based assignments, with on-demand tutorial assistance provided as required, these new designs are dramatically reducing both student failure rates and instructional costs.

High-cost, full-time faculty members are no longer the only resource. Instead, resources are matched to the level of difficulty and type of instructional task. Different types of personnel are employed to do different kinds of tasks. In its redesign of its college algebra course, Rio Salado, for example, has found that 90 percent of students' questions were not math-related and did not require a faculty member to respond. Rio hired an aide to answer these questions, leaving the faculty member free to respond to content-related questions and consequently to handle more students. Possible substitutions used in pacesetting courses include nontenured for tenured faculty, adjuncts for full-time faculty, graduate teaching assistants for various kinds of faculty, undergraduate teaching assistants for faculty or for graduate teaching assistants, and professional staff for traditional faculty.

As an example, Virginia Tech has redesigned its linear algebra course, taken each year by 2,000 first-year students majoring in engineering, physical science, and mathematics. Virginia Tech, like most other higher education institutions, tried to control costs in the traditional mode by employing a mix of tenure-track faculty (ten), instructors (thirteen), and graduate teaching assistants (fifteen) to teach thirty-eight sections of the course. The redesign radically changed the mix of human and technological resources, resulting in a two-thirds reduction in the cost per student (see page 27).

Although many believe that learning environments targeted to particular learning styles and individual learning needs are more expensive than traditional one-size-fits-all methodologies, the introduction of new designs based on information technology can allow for more cost-effective ways of learning—cost-effective for both the institution and the student. As noted above, the new pacesetters' buffet-style courses have five key features that can improve the quality of student learning. These five features are also major contributors to cost reduction.

Virginia Polytechnic Institute and State University

The Math Emporium: Student-paced Mathematics 24x7

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When I became department chair in 1994, the math department was teaching math the "Baskin-Robbins" way: if there was any way of teaching math, somebody was doing it in the department. First, I issued the edict that every freshman and sophomore course would have a common final exam. I was hearing all different views about how technology should be used, so I decided that we needed to have some way of judging what students are learning. I hired an assessment coordinator in the department to help us. Now each course has a list of goals and objectives that were approved by the Undergraduate Program Committee, and each question on every common exam is coded against those goals and objectives.

We had begun using Mathematica in two of our first-year calculus courses in the spring of 1993. Assessments showed that students in this new information technology initiative were performing at or above the level of students taking the traditional course. The "IT" students' final grades were half a grade higher that the "traditional" students, and later longitudinal assessments showed that IT students taking other mathematics or engineering courses were doing better than students who had taken traditional math classes.

The core idea behind the Math Emporium was that the best time to teach mathematics is when the student wants to do it. The Math Emporium is open twenty-four hours a day, seven days a week. The facility holds five hundred workstations as well as other specialized spaces and equipment. Instructors are available twenty-four hours per day, seven days per week. Information.

The redesign of the linear algebra course eliminates all class meetings and replaces them with Web-based resources developed by experienced faculty, such as interactive tutorials, computational exercises, an electronic hypertextbook, practice exercises with video solutions to frequently asked questions, applications, and online quizzes. Multiple sections are treated as one course. Course material is organized into units that students cover at the rate of one or two per week, each unit ending with a short, electronically graded quiz. Faculty point students toward appropriate resources and strategies. Students communicate on a completely flexible time schedule through e-mail or in person with faculty, graduate teaching assistants, and peer tutors in the Emporium. The redesigned course 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 them.

Students can still move through the course in the traditional way; there's a lecture hall and an area for traditional tutors. Students can go to lectures, do their exercises, go to a tutor lab, and take tests. Although some students start with the lecture format because that's the way they were taught, very few continue that way. They see their peers having successes and they say, "Why am I going to lectures when I can do it another way?"

We spend the first two weeks holding students' hands. We tell them, "The most important thing you can do at Tech is become an active learner and know how you learn." Then we have them do all kinds of exercises so they become familiar with all the resources in the building. At first the students are not particularly impressed. Some are excited about being on their own, but others feel that we are abandoning them to a sea of computers. By the end of the semester, after they have had successes, their attitudes begin to change.

We can demonstrate in a variety of very concrete ways that our students achieve a high level of consistent outcomes that are equivalent to those in traditional methods. These measures include

- direct measures of students' knowledge, skills, and abilities on assessment instruments designed by faculty panels and subjected to the most rigorous test-development procedures and psychometric analysis;
- direct measures of students' general education outcomes benchmarked against other similarly positioned institutions; and
- longitudinal graduate follow-up studies including self-reported outcomes and evaluations by students' employers and graduate school advisors.

Although changes and adjustments are being made each semester, we expect the long-term configuration to involve only two faculty members for the entire 1,520-student enrollment. One instructor and one tenure-track faculty member will share duties in approximately a 2:1 ratio of hours. The instructor will handle most of the day-to-day activities in course delivery, and the tenure-track faculty member will take the lead in planning and preparation. The new cost structure associated with the redesigned course also includes the graduate and undergraduate Math Emporium helpers, as well as two technical support people for database management and software upkeep.

Virginia Tech has produced savings of about $53 per student (from $77 to $24), or $79,730 for the heavily enrolled fall semester. Annual savings for all sections of Math 1114 are $97,400. Increased success rates are yielding additional savings by reducing the average number of course attempts per student.

The Math Emporium has been so successful that many institutions are building these facilities now. Funded by the Pew Grant Program in Course Redesign, the Universities of Alabama and Idaho are each building one, and a couple of other projects are in the works around the country. Math departments are catching on to this cost-effective way of solving the "math problem."

1. Assessment of Knowledge/Skill Level and Learning Style

A first step in implementing a pull strategy in which students use as much instructional resource as they need is to assess their knowledge and skill level as they enter the course or program and determine their preferred learning style. Based on those assessments, students can then elect the most efficient path through the required course materials. Drexel's modular approach to its introductory computer programming course, for example, allows students to earn from one to three credits based on their performance on a knowledge and skills placement test. Students do not need to spend time covering material they already know and can move on to other studies. Drexel can reduce the amount of instructional resources to correspond more accurately to students' needs. Similarly, Ohio State's modular format will enable it to eliminate one-fourth of the course repetitions, thereby opening slots for an additional 150 students per year.

2. An Array of Interactive Materials and Activities

Each of these new learning environments reduces the number of lectures and/or class meetings, replacing presentations of content with a variety of activities supported by interactive software. Some eliminate several lectures; others eliminate all lectures. The premise is that faculty do not need to spend as much time (or any time) presenting information. Lectures are replaced with a variety of learning resources, all of which involve more-active forms of student learning or more-individualized assistance. In many instances, computer-based tutorials and feedback substitute for instructor-based tutorials and feedback. Such a strategy is not only more effective in dealing with learning issues but also more economical in dealing with resource issues because students use only as much resource as they need. Savings occur from reducing the number of instructors required and also from freeing up classroom space. Reducing classroom contact hours, for example, from three to one or two through the use of virtual instruction makes it possible for up to three courses to use the classroom hours previously reserved for one class.

3. Individualized Study Plans

Without the availability of information technology tools, creating and managing individualized study plans for students would be highly labor-intensive and hence costly. Sophisticated course-management software, however, enables faculty to monitor students' performance, track students' time on task and overall progress, and intervene when necessary to correct a student's deviation from planned study on an individualized basis. Students can create a definite learning plan requiring periodic log-ins (e.g., students have to take a quiz by—not at!—a fixed time every week and an exam by a scheduled date at the end of each module). Many types of communication can be automatically generated to provide needed information to students. Instructors can use e-mail to communicate with students as a way to encourage students to "come to class" with online materials. Regular weekly, computer-generated e-mails can inform students about their progress and, if necessary, suggest additional activities based on homework and quiz performance.

4. Built-in Continuous Assessment

The automated grading of homework (exercises, problems), low-stakes quizzes, and tests and exams for those subjects that have correct or easily assessed outcomes not only increases the level of student feedback but also offloads these rote activities from faculty and other instructional personnel. The result is either a reduction in the number of required instructors or the ability to increase the number of students in any given course. Michigan State has shown that the application of technology can reduce the instructional costs of large traditional lecture courses from 10 percent to 30 percent. The largest cost savings was due to the reduced need for teaching assistants for grading and recitation sections.

5. Appropriate, Varied Human Interaction

Faculty who teach traditional online courses frequently complain about overload due to the difficulty of responding to numerous e-mails or managing complicated listservs. The best of today's threaded discussion technologies enable easy-to-access and easy-to-manage communication among students and between students and their instructors. Wise instructors may seed class-wide discussions and monitor these discussions, but they seldom take responsibility for responding to every posting by a student. They emphasize student-to-student interaction and interaction with the material in ways that force students to formulate most of their postings for peer review and response by their fellow students. Instructors who use these technologies and pedagogies ask students to take more responsibility for their own learning. By emphasizing student-to-student mentorship and interaction as much as possible, we can increase student involvement and improve learning outcomes. This not only is effective but also saves expensive faculty time.

Michigan State University
CAPA: Computer-assisted Personalized Assignment System

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At Michigan State University, the Computer-Assisted Personalized Approach (CAPA) has been used for homework, quizzes, and exams in large face-to-face lecture courses since 1992. Currently, more than sixty colleges and universities around the world have implemented CAPA. CAPA is an integrated software system that has been used (1) to prepare, deliver, and grade personalized homework, quizzes, and examinations, (2) to provide feedback to students and instructors, (3) to communicate with students in a class and provide a discussion forum for students, (4) to provide links for student help via the Internet, and (5) to handle course management. The most significant difference between CAPA and most other homework-delivery systems such as Mallard at the University of Illinois is its ability to handle sophisticated conceptual problems as well as highly randomized qualitative questions.

With CAPA, an instructor can create and/or assemble personalized assignments with a large variety of conceptual questions and quantitative problems. These can include pictures, animations, graphics, tables, links, etc. The writing and development of questions and problems is facilitated by numerous templates, which encourage students to collaborate and discuss concepts and also ensure that problems differ for each student, thus inhibiting rote copying. Students work offline and then enter their answers online for grading. Students are given instant feedback and relevant hints via the Internet and may correct errors without penalty before an assignment's due date. The system keeps track of students' participation and performance, and records are available in real time both to the instructor and to the individual student. Statistical tools and graphical displays facilitate assessment and course administration.

For homework assignments, students have an infinite number of opportunities to submit their answers. Knowing that they have the chance to get 100 percent correct is a strong incentive for students to do the work; most students strive to get all the work done correctly. We have been able to increase students' success rates while maintaining high standards. The time that students spend working on assignments and other course requirements has nearly doubled and approaches the recommended two hours outside of class per lecture hour. More time on task means better performance. Tests are now more difficult than they used to be because students are better prepared and more able to complete them. Scores on examinations show a substantial increase, even with higher standards and harder problems.

Most of the development has been done in physics and chemistry, but CAPA is not limited to natural science courses. It has been applied, for example, to human nutrition and business. The use of CAPA also allows us to implement more of an active-learning environment in the classroom, eliminate teaching assistants (grading of homework is done automatically), and increase the personal interaction with students, both face-to-face and online. With the computer doing the grading, students view the instructor as more of a mentor than a judge.

Our current goals are to study the cost-effectiveness of using technology to improve traditional on-campus courses and to expand the methods and techniques to fully online courses.

V. Sustaining Innovation

Throughout this paper, we have reiterated the view that individualization is the key to moving beyond the "no significant difference" phenomenon. 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 are the same). The conclusion reached by symposium participants is that we need to do just the opposite: individualize student learning and standardize faculty practice.

It is curious that most academics react with horror at the thought of standardizing faculty practice but do not think twice about standardizing the student learning experience. With its connotations of words like *regulate, regiment,* and *homogenize,* the word *standardize* does not precisely capture what we mean. What we need is greater consistency in academic practice that builds on our accumulated knowledge about improving quality, increasing access, and reducing costs. 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.

The Internet offers unprecedented opportunities to collect, organize, and analyze large, real-time research. Online environments provide enormous information-capturing potential because every move that every student and every faculty member makes is potentially recoverable and able to be analyzed. Sources include responses to online surveys regarding student satisfaction and perceptions; tracking of learner behavior on site (On what learning points do students spend the most time? What is the sequence and pattern of interest? What questions do students ask?); transactional data on student registrations, dropouts, and completions; and interaction and outcome data generated from baseline assessments, exercises, and exams.

To take advantage of these capabilities, we need a new kind of "institutional research" designed to determine which are the most efficient and effective paths for different kinds of learners in particular curricula or courses, so that we can make active adjustments in learning designs. We also need to be much more sophisticated about monitoring and measuring costs. Students, instructors, institutions, accreditors, and consumer agencies all have access to this data, enabling benchmarking and competency assessment. Because of the feedback available, digital products and services can be fine-tuned, and product development can be accelerated. The ultimate vision here is the kind of continuous quality improvement systems used by automated industrial production systems that are for the most part self-monitoring.

It is not coincidental that the new providers discussed above have taken the first steps toward implementing this vision. At the institutional level, Excelsior College, Rio Salado College, the University of Phoenix, and the British Open University are known for building a continuous assessment loop through the collection, analysis, and dissemination of data. In monitoring the quality and effectiveness of its academic program—the strengths and weaknesses of the materials and services provided—each keeps an eye primarily on two things: student learning outcomes and customer and student satisfaction with all experiences at the institution. Excelsior College, for example, does a major student-satisfaction survey every three years. For each graduate, the college does a six-month follow-up survey and a three-year follow-up, as well as an additional three-year follow-up for students who complete graduate school. The University of Phoenix conducts end-of-course surveys among both students and faculty in order to gauge the success of both the individual class and the individual instructor. The British Open University tests and edits its courses based on assessment data that is collected throughout the course-development process.

At the course level, Virginia Tech, Michigan State, the University of Illinois at Urbana-Champaign, and all of the projects involved in the Pew Grant Program in Course Redesign treat the course not as a "one-off" but as a set of products and services that can be continuously worked on and improved. Two factors in their design strategies are key: the collective commitment of all faculty teaching the course and 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 new pacesetters? 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. IT enables best practices to be captured in the form of interactive Web-based materials and sophisticated course-management software. Rather than reinventing the wheel at the start of each term, the new pacesetters can add to, replace, correct, and improve an ever-growing, ever-improving body of learning materials. This, in turn, leads to greater possibilities for individualization.

Earlier in this paper, we commented that the leading institutions described in the cases do not offer full-blown solutions to the question of how to move beyond the "no significant difference" phenomenon but instead illustrate pieces of the puzzle. Because they share a commitment to continuous quality improvement, all are in an excellent position to incorporate ideas from others. Already committed to a rolling-cohort strategy, the University of Phoenix, for example, could enrich its approach by assessing students' learning styles, creating cohorts based on those assessments (either homogeneous or heterogeneous), and designing course variations to correspond accordingly. Virginia Tech's math courses and UIUC's foreign language courses could incorporate the credit and content modularization ideas pioneered by Ohio State and Drexel. Groundbreakers in distance learning, Rio Salado and the British Open University could learn from the on-campus buffet providers and set new standards of excellence for off-campus learners. In each case, the systemic approach of the new providers enables them to incorporate the best of online academic practice.

This symposium was the fourth of the Pew Symposia in Learning and Technology. The purpose of this symposia series is to conduct an ongoing national conversation about issues related to the intersection of technology and student learning and ways to achieve this learning cost-effectively. The new providers who participated and others cited in the paper are creating a new higher education paradigm, which includes new boundaries for behavior, new guides to action, and new rules for success. As we continue to develop online courses and programs, let's follow their lead, building on the strengths of the Internet to create new learning environments that surpass traditional modes of instruction.

Notes

1. Charles D. Dziuban, Patsy D. Moskal, and Emily K. Dziuban, "Reactive Behavior Patterns Go Online," *Journal of Staff, Program, and Organizational Development 17,* no. 3 (fall 2000): 171–82.

2. The Pew Grant Program in Course Redesign is a three-year, $6 million program conducted by the Center for Academic Transformation at Rensselaer Polytechnic Institute with support from the Pew Charitable Trusts. The purpose of this institutional grant program is to encourage colleges and universities to redesign their instructional approaches using technology to achieve cost savings as well as quality enhancements. The program is supporting 30 large-scale redesigns that focus on large-enrollment, introductory courses and that have the potential to influence significant numbers of students and to generate substantial cost savings. For complete information about the program, including individual project descriptions and cost savings data, please see http://www.center.rpi.edu/fundproj.html.

3. Goldie Blumenstyk, "Temple U. Shuts Down For-Profit Distance-Education Company," *Chronicle of Higher Education,* July 20, 2001.

4. Thomas D. Snyder and Charlene M. Hoffman, *Digest of Education Statistics, 2000* (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 2001), 193–94 , http://www.nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001034 (accessed October 4, 2001).

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