After decades of promises based on overhead projectors, video distribution, and other instructional technologies, the ability to improve instruction using information technology has now become a reality. By incorporating a wide range of digitized media into the myriad of curriculum-related activities fundamental to teaching and learning, the quality of both can rise.

A paradigm shift is taking place in higher education instruction, from a mode of faculty—student interaction occurring in fixed locations at specified times to one in which students can access the same instructional resources in a variety of forms, regardless of location, at their convenience. This is possible because several technologies have matured, supporting major changes in how instruction can be delivered to students on the campus, in their homes, or in their workplaces.

Escalating costs, declining support, increasing demand, and diverse demographics have placed significant pressures on higher education to become more productive. Careful analysis shows that the productivity improvements required cannot be achieved by increasing the workload of the faculty; in fact, any significant movement in this direction will only decrease the quality of instruction. There is simply no room left in the workday of a faculty member to teach more students. Rather, the focus for productivity improvement must be on learning resources that will improve retention and decrease the time needed to earn a degree.

It is this realization that is leading to the paradigm shift towards an instructional model in which students gain access to information resources, faculty lectures and demonstrations, library and research materials, and conferencing and tutorials over networks from digital information organized in servers by the faculty. Students and faculty can “talk” electronically whenever they like. Assignments can be given and received electronically. Faculty can hold “virtual” office hours, freeing them from rigid schedules, and enabling students to obtain information with little waste of time and without sacrificing the fundamental, close-knit quality of the student-mentor relationship. In this developing model, faculty can become facilitators and guides for individual learners rather than simple conduits for transmitting information.

"...the focus for productivity improvement must be on learning resources that will improve retention and decrease the time needed to earn a degree."

Productivity gains can occur in greater retention, more efficient use of the student’s time, easy access to group study over networks, better feedback to faculty, and organized self-assessment and self-pacing. Faculty and traditional classrooms are not replaced, but another dimension is added that greatly improves the efficiency of learning. Studies have shown that students supported by technology-mediated instruction required about one-third less instructional time than students using traditional lecture/textbook methods. Not only did college students using technology learn faster, six months after completing their studies, they tested better on the subject than their peers who had been taught in traditional settings. Other studies have shown that people reluctant to speak in a group are often less inhibited by electronic communications. By increasing opportunities for interaction and participation, electronic scholarship offers a whole new range of pedagogical techniques with which to reach people who have been left out. As this new process of using technology to improve learning develops, more students at every level,
from elementary student to adult learner, will be able to take advantage of this type of instruction.

Technological advances to deliver entertainment or “video on demand” are progressing rapidly. The opportunity exists today to take that technology and apply it to education to overcome economic, cultural, and physical barriers to learning facing the nation as a whole, including continuous retraining of the workforce. This will require colleges and universities to mirror business and industry by delivering “just-in-time” rather than “just-in-case” education, and to pursue cooperative efforts with the private sector to achieve this vision.

California Polytechnic State University, San Luis Obispo (Cal Poly) is exploring several cost-effective technology solutions aimed at improving learning productivity, reducing labor intensity, and providing new ways to deliver education and better services to students while enhancing the quality of instruction. This article shares Cal Poly’s experiences to date in creating a vision and plan to develop the infrastructure needed to transform the way education is delivered, presents steps that have been taken or are about to be taken to implement that vision, and details some of the many partnerships that have contributed to the plan’s success thus far.

**Cal Poly: Becoming an Electronic Campus**

The University provides access to all major resources through its Fiber Distributed Data Interface (FDDI) backbone network that links thirty-nine core campus buildings and residence halls.

- The network serves more than 2,400 student residents on campus and provides connectivity to most of the University’s 900 faculty and 1,200 staff.
- More than 13,000 of Cal Poly’s 15,000 students have electronic mail accounts.
- More than one-third of the fall 1994 applications for admission were submitted in electronic form by incoming students.
- Online administrative systems provide timely access to student records, class schedules, financial aid, grades, and other information.
- Increased use of electronic mail, calendaring, online reporting and requisitioning, and tools such as Gopher and other online services has reduced costs and changed the way departments and individuals communicate and request information.

**Strategic plans, goals, and issues**

Since the mid-1980s, when the University decided to upgrade its administrative computing systems, Cal Poly has aggressively pursued the use of information technology to transform educational services. By the early 1990s, strategic plans for an integrated, online administrative system (OASIS), voice-response registration, online library services, improved telephone service, a campus-wide fiber optic data network, and instructional access to UNIX had all been realized.5

Two years ago, Cal Poly’s computing advisory committees embarked on another strategic planning effort to define the future role of technology in support of the University’s instructional program. This effort coincided with a campus-wide reassessment of the University mission and academic calendar, adoption of a new strategic plan for the campus, CSU system-wide initiatives for using technology to support instruction (see Project Delta below), and a decision to upgrade the central mainframe.

**The CSU’s Project DELTA**

The California Master Plan for Higher Education, initiated in 1960, calls for access by all eligible students to the three tiered higher education system in California. For the California State University, this means that all high school students graduating in the top third of their class are eligible for admission. Given current economic conditions in the state, it is unlikely that the CSU system will be able to expand its physical facilities to meet the increased enrollment demand generated by the master plan. Instead, the system must meet that demand by offering new ways
to deliver the required education to students both on- and off-campus.\(^6\)

The CSU Commission on Learning Resources and Instructional Technology (CLRIT) was created to investigate options for using electronic technology in education. Its first major initiative, Project DELTA (Direct Enhancement of Learning Through Technology Assistance and Alternatives), provided seed money for multi-campus projects designed to:

- improve instructional quality and effectiveness;
- increase student access to higher education, by making access more convenient; and
- promote greater productivity and accountability in the use of public funds.

CLRIT is also providing oversight and guidance in the development of systemwide library planning through “Knowledge and Information for the 21st Century,” a strategic plan for CSU libraries being prepared by the CSU Council of Library Directors, and in telecommunications planning through “Leveraging the Future: The Telecommunications Plan for CSU,” being developed by the CSU Academic Communications Network Committee.

This planning effort was led by the University’s Information Resource Management Policy and Planning Committee (IRMPPC) and the Instructional Advisory Committee on Computing (IACC). The IACC includes one faculty member from each of the University’s six academic colleges, and representatives from the library, student association, and academic computing services. The IACC chair acts as liaison to the Academic Senate on instructional computing issues and also serves on the IRMPPC along with several faculty members and vice presidents, the library dean, an academic dean, a student representative, and the chair of the Administrative Advisory Committee on Computing.

After consulting with their respective college computing committees, academic departments, the Senate, and other constituency groups, the IACC produced a strategic plan outlining four major goals for academic computing:

- a networked instructional environment, based on universal electronic mail, shared information resources, and computerized classrooms;
- easy access to workstations and networked information services;
- institutional support for faculty and student development of computer-based communication skills; and
- simplified interfaces, procedures, and documentation for accessing networked information services.

The vision that emerged recognizes that technology can benefit learning when it (1) allows a student to take a more active role, (2) allows a teacher to express the content of a course in more than one format, (3) broadens the array of resources brought to a classroom or the student’s workstation, (4) increases the opportunities for interaction between teacher and student and for interaction among students, (5) reduces barriers to University services, and (6) increases the productivity of those who support the learning environment.

As envisioned by the IACC, this “next revolution” will cross all disciplines, especially those which have not traditionally used computing in the past, and will emphasize content development, easy access, and information sharing, rather than focusing on the technology itself. Beyond the obvious need for technology enhancements, the IACC strongly recommended providing incentives and support to enable the faculty as a whole to develop the necessary skills and methodologies to conduct and publish research, create and deliver lectures, and interact with students in this new environment. Other policy/support issues included:

- considering professional development in the technology area when evaluating faculty for retention, promotion, and tenure purposes;
- supporting faculty with well-defined projects for experimenting with new technologies and innovative ways of employing them in the teaching, learning, and research processes; and
- providing instructional designers and technical support to assist faculty in developing content and integrating technology into the curriculum.

In addition, a number of infrastructure issues were identified:

- adequate network connections to faculty offices and classrooms;
- network ports for students to connect portable computers;
- adequate network access from off-campus sites or residences;
- appropriately configured workstations;
- classrooms equipped with systems for displaying prepared lecture materials and sharing information resources; and
- online search and retrieval tools with graphical user interface.
The IACC plan was generally accepted by the faculty, despite reservations by some as to how it would be achieved technically, and what the impact might be on University resources and faculty workloads.

Implementing the vision: a MegaServer approach

After receiving the plan, the IRM Policy and Planning Committee began an intensive study of how to implement the vision. They spent several months analyzing the capacity of existing resources to support the vision and considering various alternatives before recommending going ahead with a plan to develop a multimedia “MegaServer” as part of the planned mainframe upgrade for the campus.

This MegaServer will provide faculty and students with on- and off-campus access to a full range of information technology resources (voice, data, video) in an integrated, networked educational environment. It will also facilitate local and statewide access to full-text articles and publications, electronic library services, databases, and digitized instructional materials, including slides, graphics, and full-motion video. It will also serve as an important node in a client/server arrangement, supporting campus-wide administrative services and functions.

Cal Poly envisions using this MegaServer approach to support its concept of a “virtual university” (see Figure 1), with many potential applications (see sidebar next page). The benefits for the University include (1) improved access by students enrolled in traditional programs offered by Cal Poly, (2) increased access to academic programs by non-traditional students, (3) better prepared students in K-12 and community college programs, (4) improved effectiveness in uses of limited human, program, and financial resources, (5) new revenue streams to offset infrastructure and operating costs, and (6) incentives for faculty to develop new educational materials.

Figure 1: The virtual university

“The IACC plan was generally accepted by the faculty, despite reservations by some as to what the impact might be on University resources and faculty workloads.”