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ABSTRACT

This final report describes results of a planning grant for the "Flashlight" project, an effort to develop, test, and disseminate evaluation procedures that a postsecondary institution or department could use to periodically assess its evolving educational strategies, in particular strategies supported by use of computing, video, and telecommunications. This planning grant supported the project's first phase: discussion among five potential "testbed" institutions, the potential contractor, and the Annenberg/Corporation for Public Broadcasting (CPB)Project. Discussion was initiated via e-mail and a Delphi survey, and concluded with a two-day meeting. The group concluded that Flashlight should develop five families of procedures. The first three would help institutions monitor their ability to meet the following challenges: (1) improving learning outcomes for people completing courses of study; (2) extending enrollment and retention; and (3) controlling the spiraling costs of education. The group also proposed that Flashlight develop evaluative procedures to monitor changes in teaching-learning strategies that are especially well supported by uses of computing, video, and telecommunications, and to monitor changes in faculty roles and attitudes. The project was ultimately fully approved by the Annenberg/CPB Project. Information is provided on the project's purpose, background, description, and conclusions. Appendices include the Delphi instrument used. (Contains 26 references.)(DB)

The Flashlight Project, Planning Grant: Final Report

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"Flashlight" Planning Grant

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SUMMARY

The Flashlight Project is developing, testing and disseminating evaluation procedures that a postsecondary institution or department could use to periodically assess its evolving educational strategies, in particular those educational strategies supported by its uses of computing, video and telecommunications.

The FIPSE grant supported the first phase of Flashlight: discussion among the five potential "testbed" institutions that would initially be studying their strategies, the potential contractor (the Western Cooperative for Educational Telecommunications of the Western Interstate Commission for Higher Education), and the Annenberg/CPB Project. The discussion's aim was to identify those educational strategies and outcomes that are most important to monitor. Discussion was carried on initially by e-mail and a Delphi survey; it concluded with a two-day working meeting. This report summarizes the group's choices of strategies and outcomes. Following the end of the planning phase, the Annenberg/CPB Project has decided to support the full implementation of the Flashlight Project and to make it the keystone of a new Educational Strategies Program.

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Project Reports other than this document:
Proposal to implement Flashlight, April 1994.
"Asking the Right Question: What Does Research Tell Us About Technology and Higher Learning?" to appear in the March 1995 issue of *Change*.
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Project Presentations:
Educom '94, AAHE Assessment conference (upcoming), Educom '95 (upcoming) and 4 other talks in this country and abroad

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EXECUTIVE SUMMARY

Project Overview: The Flashlight Project is developing, testing and disseminating evaluation procedures that a postsecondary institution or department could use to periodically assess its evolving educational strategies, in particular those educational strategies supported by its uses of computing, video and telecommunications.

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Purpose: Why "Flashlight?" The goal of this planning activity was to discover whether many different types of postsecondary institutions were in fact using comparable educational *strategies* to deal with some of their most serious problems, and using technologies in a comparable way to implement those strategies. [By "strategy" we refer to patterns of teaching and organizational characteristics that are meant to help attain certain goals important to a department or institution, e.g., educate graduates who can do certain things, enroll and retain certain types of students, etc.] If different types of institutions were indeed beginning to use similar educational strategies because of their expanding use of similar technologies, then we should be able to develop a small yet widely useful set of evaluative procedures.

The purpose of this planning grant was to see whether our teams would agree that their institutions were beginning to solve comparable problem s using comparable strategies because of their ripening investments in a small number of common technologies.

Background and Origins: The Annenberg/CPB Project of the Corporation for Public Broadcasting sponsored a program of seven projects in 1990 that demonstrated how to develop and institutionalize "New Pathways to a Degree." Each used computing, video and telecommunications to support a rich, accessible degree path for students learning off-campus. As the program and its evaluation were reaching their conclusion in 1993, it had become clear that the evaluative issues inherent in New Pathways were complex and general. Meanwhile I had been giving a series of invited talks on what is known about how best to use information technology to improve postsecondary education. When the Maricopa Community Colleges invited me to help lead a district wide staff retreat on the subject of technology, education, and evaluation, these factors came together in the idea of Flashlight. We would seek funding to develop and test the kinds of evaluative procedures that Maricopa and the New Pathways institutions needed. Later Washington State University joined the group.

Project Description: The FIPSE grant supported the first phase of Flashlight: discussion among the five potential "testbed" institutions that would initially be studying their strategies, the initial development institution (the Western Cooperative for Educational Telecommunications of the Western Interstate Commission for Higher Education), and the Annenberg/CPB Project. The discussion's aim was to identify those strategies and potential outcomes that are most important to monitor. The discussion was initiated with e-mail conversation and then a detailed Delphi survey by the author that sketched out, element by element, a draft set of evaluation procedures. After two rounds of feedback in the Delphi cycle, the planning project concluded with a two-day working meeting and the writing of a detailed proposal for implementing Flashlight.

Results: Flashlight should develop five families of procedures, we decided. The first three should help institutions monitor their ability to deal with a Triple Challenge facing most institutions of postsecondary education:

1) the need to improve learning outcomes for people completing courses of study;
2) the need to extend enrollment and retention; and
3) the need to control the spiraling costs of education.

Outcomes are important to monitor, but one also needs to know the reasons for success and failure. Thus it is important to study changing strategies -- not just what the institution's announced intentions are, but how its behavior and structure are actually changing. Therefore Flashlight will also develop evaluative procedures to monitor changes in

4) teaching-learning strategies that are especially well supported by uses of computing, video and telecommunications and
5) changes in faculty roles and attitudes.

Aside from countless changes in the details of the model resulting from the Delphi process and the meeting, two major changes were made. The "costs" procedures were added and a contractor identified to develop them, and proposed procedures to assess the degree of student access to needed technologies were dropped.

Summary: In addition to the modifications of the model summarized above, the grant helped convince the Annenberg/CPB Project that Flashlight was worth its full support. Flashlight has now become the heart of a new Educational Strategies Program whose goal is to help postsecondary education use technology effectively to implement the kinds of educational strategies needed to improve outcomes, extend access, and control spiraling costs -- the Triple Challenge.

I. PROJECT FLASHLIGHT -- OVERVIEW

Institutions of postsecondary education have begun to invest vast sums in computing, video and telecommunications in hopes that this will help them cope with the triple challenge of improving educational outcomes, extending equitable access, and controlling rising costs per graduate. But there is little consensus as to how this is to happen, and little information for each institution about whether it is happening and, if not, why not.

II. PURPOSE

Institutions are investing enormous amounts of scarce dollars in computing, video and telecommunications, and so are their students. One major reason for this investment is to make possible changes in their educational strategies, e.g., more emphasis on students using technological tools to work on realistic, open-ended projects; more emphasis on vivid illustrations for lectures; a more far-reaching program of distance learning. By "strategy" we refer to patterns of teaching and organizational characteristics that are meant to help attain certain goals important to a department or institution, e.g., educate graduates who can do certain things, enroll and retain certain types of students, etc.

Many educators, learners, and benefactors urgently need to know whether their investments in technology actually are supporting changes in their strategies, and, if so, whether these changed educational strategies are having the desired results. Because global statements about "what works" are of limited utility and validity, and because the local situation changes on a regular basis, there is no substitute for local evaluation of one's own strategies: how are they really changing? What are they really accomplishing? .

Doing an educational evaluation is like using a small, dim flashlight to find one's way in a large dark cave. The relative brightness (rigor) of the flashlight (evaluation) is much less important than where one points it (asking the right question). Any evaluative procedure is designed to answer some specific question in a particular way. It is useless to ask "How successful is technology in improving education" because that curiosity is too broad to translate into a meaningful evaluative study. Thus, in order to help institutions make the most (and understand the most) of their investments in technology for education it was crucial to first become very specific about what they needed to know.

The goal of this planning project was to discover whether five very different postsecondary institutions were in fact using comparable educational strategies to deal with some of their most serious problems, and using technologies in a comparable way to implement those strategies. If that were true, then it should be possible to develop a limited set of evaluative procedures that would be of wide usefulness. We wanted to see whether we could agree on a set of outcomes limited enough and specific enough to provide the foundation for such a set of evaluative procedures.

III. Background and Origins

The Annenberg/CPB Project sponsored a program of seven projects in 1990 that demonstrated how to develop and institutionalize "New Pathways to a Degree." Each used computing, video and telecommunications to support a rich, accessible degree path for students learning off-campus.

The Western Cooperative for Educational Telecommunications (WCET) of the Western Interstate Commission for Higher Education (WICHE) won the competition to evaluate New Pathways. By the time the program and its evaluation reached their conclusion in 1993, it had become clear that the evaluative issues reached beyond New Pathways and that the WCET study had only begun to explore them. Meanwhile I had been giving a series of invited talks on what is known about how best to use information technology to improve postsecondary education. When the Maricopa Community Colleges invited me to help lead a district staff retreat on the subject of technology, education, and evaluation, these factors came together in the idea of Flashlight. We would seek funding for a project to develop and test the kinds of evaluative procedures that Maricopa and the New Pathways institutions needed. Initial discussions were held with a number of parties and, as a result, three of the New Pathways institutions, Maricopa, and Washington State University joined with WCET and the Annenberg/CPB Project to begin planning Flashlight. All five of these institutions were already interested in increasing their investment in program evaluation and were eager for better tools to do that job.

These five distinguished and distinctively different institutions of higher education were:

- one of the largest community college districts in the country (Maricopa Community Colleges),
- a public institution that offers a state-wide, virtual community college program supported by a combination of video, computing, and telecommunications (University of Maine, Augusta - UMA);
- a major land grant institution with innovative programs exploiting technology for students on- and off-campus (Washington State University -WSU);
- an institute of technology with a national record in both distance learning and services for the handicapped (Rochester Institute of Technology -RIT; and

- a public university that exemplifies institutional partnership at virtually every level (Indiana University - Purdue University at Indianapolis - IUPUI).

The consultants to the planning activity were Sally Johnstone and Robin Zuniga of the Western Cooperative: the team that had lead the New Pathways evaluation. Also providing valued advice was Trudy Banta, Vice Chancellor for Institutional Planning and Improvement at IUPUI and one of the nation's experts on program evaluation.

IV. PROJECT DESCRIPTION

After a small initial meeting of the WICHE staff, Trudy Banta of IUPUI and this author, a Delphi process was begun to help the group prepare for its main working meeting.

In a Delphi process, a group of individuals are each sent a set of questions or possibilities, in this case a set of possible outcomes and practices that each might (or might not) be included in the Flashlight procedures that would be developed for their institutions to use, as well as some questions about the basic structure and process of the Flashlight Project. These surveys are appended. The feedback on the surveys was complemented by a continuing e-mail conversation on a private Internet discussion group (listserv) hosted by Washington State University. We wanted to identify a set of technology investments, changes in practice and organization that they enabled, and intended results of the changed practice and organization. We also needed to pinpoint a few elements of this strategy that were the key points to watch. If we identified too few points or the wrong points, the resulting evaluative procedures would not produce the right data to guide debate and decision. If we picked too many points, the resulting evaluative procedures would be too expensive and cumbersome to administer. We were designing our flashlight.

The responses to this second Delphi round were used to create an agenda for an intensive two-day workshop in Boulder, Colorado. Our discussion continued until the group had articulated a multi-faceted educational strategy that, they all agreed, their institutions were beginning to use, and that was so crucial, expensive and risky as to require the expense of periodic evaluation. We also agreed on a small subset of points within this strategy that were the crucial issues that had to be periodically monitored and evaluated. The strategy and the points chosen for evaluation are described in the next section of this report. During and following the meeting, each institution created a separate action plan, which became part of the Flashlight proposal. Each plan described the institution's current evaluative work, and how the Flashlight tools would be initially employed. These plans have already been submitted to FIPSE as part of the full proposal. (Note: FIPSE decided not to fund Flashlight, so the Annenberg/CPB Project has funded it instead. The Project is now underway, and the five institutions have continued to develop and modify their plans. Flashlight procedures are being developed during the spring and summer of 1995; initial testing will occur in Fall 1995.)

V. The Planning Project's Conclusions

A. Criteria for Developing and Implementing Strategy

Before developing our specifications in detail, the Flashlight team first had to agree on some ground rules. "Educational strategies" have little or no objective existence. They are constructs that we use to conceptualize what practitioners are doing and should do. We had to decide what sort of construct was worth our effort. We record our criteria here because, if you engage in a strategic planning or evaluation process of your own, you too might find such criteria useful.

1. **It is self-defeating to begin by thinking about what the newest technology can do best.** As you will see, the applications of technology described here are neither especially new nor, in technological terms, especially exciting. That's just the point. *One cannot build cutting edge education on cutting edge technology.* Cutting edge technology is ordinarily too expensive (relative to its lesser price several years later), too brittle, and too difficult to learn to use. That's the bad news.

The good news is that every year brings new "old hat" technologies. Through extensive use in and outside education, these applications of computing, video and telecommunications have become affordable, reliable, familiar (almost to the point of invisibility), and invaluable.

2. **Focus only on the most important challenges that institutions and courses of study must meet in order to fulfill their missions — challenges with tangible consequences for the institution.** Having decided to focus on educational, rather than technological, opportunities, our teams agreed that their institutions face a *Triple Challenge* of immediate and obvious urgency:

   1. 21st century learning outcomes: these colleges and universities need to help their graduates lead better lives, especially in ways that also support and enrich the communities in which their graduates will live.[1]

   2. accessibility: these five institutions need to enroll, retain and graduate more, and different types of students, increasing the equity of educational opportunity;

[1] In this essay the term "graduate" will denote anyone who has completed a course of study. In a community college, for example, students may complete a course of study and receive a certificate.

3. costs per graduate: these institutions must somehow meet the first two challenges and control their costs per graduate in an austere fiscal environment.

This Triple Challenge is an important target because institutional success or failure in meeting each challenge can result in gains or losses in financial and political support. If the institution begins to succeed, resulting gains could be used to institutionalize new practices, to reward faculty, and so on. We'll describe this Triple Challenge in more depth later on.

3. In order to deal with such challenges, one must **focus on programmatic teaching-learning practices and organizational structures because nothing less can change programmatic learning outcomes, accessibility and costs.** Improvements in single assignments or even in single courses almost never have an impact on the average graduate. Such isolated improvements may affect a few students a lot, or many students a tiny bit, but rarely do changes in a single assignment (thanks to new software) or course meaningfully affect ultimate learning outcomes, access chances, or costs -- the Triple Challenge.

In contrast, institutionalized practices can have a measurable, predictable impact on the capabilities of graduates, on accessibility, and on costs. For example, some colleges seem to be suffused with values that promote inquiry; their bachelor's degree winners go on to earn Ph.D.s in disproportionate numbers, decade after decade (Hardy, 1974). Some institutions have distance learning structures and practices that make them exceptionally able to enroll and educate working adults.

4. Ironically, when it comes to technology, attention usually focuses either on hardware (computer clusters, the Internet, etc.), on particular pieces of software that often are only good for one or two assignments. **Thus we decided to focus only on uses of technology that could suffuse a student's education by making possible pervasive changes in teaching-learning practice and the organization of education.**

In other words we decided to focus on a three element vision of strategy:

institutional patterns of use of technology --> change in organization of learning --> improvements in learning outcomes, access and costs on a departmental or institutional scale.

Technology does *not* affect the Triple Challenge issues of outcomes, access and costs directly. Technology creates new options and constraints for administrators, faculty and students; the key is how they individually and collectively respond to those new possibilities. That's what Flashlight needs to illuminate -- that and the consequences of their responses.

5. We also had decided beforehand to **discuss only those changes that could and should be evaluated on a regular basis.** The history of educational innovation is marked by periodic calls for revolution followed by systematic inattention to whether practice is really changing and outcomes are really improving. Our institutions are unlikely to be able to make a sustained effort to improve education unless they are continually monitoring progress and identifying barriers impeding that progress. Even the effort to decide which data to gather should provoke constructive conversation among faculty members and administrators, discussions about the missing links.

We commend this set of ground rules to institutions reviewing this report; they seem to have a value of their own, even beyond the conclusions we drew by using them.

B. An Emergent, Technology-Enabled Strategy for Responding to the Triple Challenge

We clarified, with the aid of those ground rules, a strategy that is already being pursued by all five of the participating institutions. We believe that many other institutions are pursuing their own versions of this same strategy.

Not all elements of this strategy (technology; changes in organization of learning; changes in the Triple Challenge) will be evaluated by the proposed Flashlight instruments. The following narrative will indicate which particular elements will be targeted by the procedures to be developed during the next phase of work (1995-1996).

1. Which Technologies, and Why?

Our group concluded that there are five important patterns of investment in technology and related infrastructure needed for a strategy that would fit our ground rules:

1) **Use of hardware, software and technology-based learning resources that come from the worlds of work and research.** Such *worldware*[2] includes personal computers and camcorders, spreadsheets and sophisticated molecular modeling software, on-line control of interlibrary loan and the Internet. None of these technologies were designed for instructional use, and none are marketed primarily for instructional use. However, worldware has become the dominant type of technology in the curriculum, primarily because of its usefulness as a working tool for faculty and students. Student

[2] See Morris et.al.,1994. This EDUCOM-sponsored study of valuable viable software coined the term "worldware," details the reasons why this software is so widely used and so long-lived, and analyzes the history of several examples of worldware.

editions of worldware (software or hardware developed for instructional purposes that strongly resembles worldware) is also of great use.

2) **Electronic mail and computer conferencing**. Asynchronous technology can support discourse that proceeds at a slower and more thoughtful pace than in the face to face classroom where students have only a second to decide whether and how to respond to a faculty member's question. Electronic mail can also be swifter and more efficient than the exchange of homework written on pieces of paper. FAX machines and voice mail are also useful for these purposes, especially for students studying "off-campus."

3) For those institutions serving students who study off-campus, it's important to provide **video and audio transmission of live and prerecorded presentations** , as well as **real-time conferencing for small groups of scattered individuals** (these days audio- and audiographic conferencing seem most cost-effective). These same systems can also be used to include new instructors and off-campus experts, and they can help on-campus students get more from lectures, but the investment is usually justified by its obvious benefits of increased enrollment.

4) **Networked educational partnerships** enable institutions (including government, research laboratories, libraries, schools, and businesses) to share resources and services electronically. Examples include systems of interlibrary loan and coordinated purchasing based on the assumption of such a system of sharing information. The University of Maine at Augusta, one of our five institutions, is part of a university-school network that ties colleges and schools together by a video, audio and computer network. The colleges can offer classes that are electronically available at high schools; the high schools provide a broader array of services for their rural communities and use their facilities more hours of the day, and days of the week.

5) Policies and practices to **assure that all students in a course of study have access to the hardware, software and materials they need for their coursework.** If only 90% of the students can get the technology they need, faculty can't confidently require students to use technologies to do assignments; thus our five institutions, and others like them, have devised a mix of policies to increase student access to technology.

   Networked educational partnerships can sometimes aid in providing technology access; the Educational Network of Maine enables college students to use computers, fax machines, and its network by coming to nearby high schools.

To repeat, these five types of investment in technology are not being made merely for their own sake. Our five institutions, and others like them, are making such investments in order to enable the following kinds of instructional practices and organizational changes. The group ultimately decided not to develop measures of these investments, not because such measures would not be valuable but simply because our resources for developing and testing evaluative procedures would be limited.

2. Changes in the Organization of Learning

The technological investments identified above are worth making (and monitoring) **because** they make the following teaching practices and organizational changes more feasible (and thus should help the institution respond to the Triple Challenge). The changes in teaching practice include more emphasis on complex projects, collaboration, and the pace of academic conversation. The changes in organizational structure include structures to support study off-campus and changes in faculty roles.

a) Changes in Teaching and Learning Practices

What elements of teaching and learning are most important to promote? We were interested in improvements that would help meet the Triple Challenge and we had our ground rules (e.g., the practice had to be capable of being institutionalized so that it would pervade a student's education). After long discussion, faculty-administrator teams from our five institutions agreed on several points.

First we decided that all such teaching practices would have to foster **greater engagement in learning and more productive time on task** by students. There are two ways to do this:

1) by attracting students to spend more and better quality time in study and

2) wasting less of their time (e.g., in commuting).

As Astin (1993) indicates, virtually all research indicates that, the more time students spend studying, the more they learn.

Our teams agreed that several teaching-learning strategies meet all our goals and ground rules, and are thus worth specific evaluative monitoring. These short summaries describe them, and indicate how the five institutions' investments in technology make these practices more feasible:

- **Project-based learning**, i.e., student learning by working on complex, open-ended, realistic (or real world) projects. Doing scientific research, composing music, writing an interpretive essay, and diagnosing a case are all examples of project-based learning.

Worldware can provide students with crucial tools and resources for tackling such projects, e.g., statistical software for data analysis, computer aided composition and performance for music, on-line research libraries for scholarship, and, of course, word processing for large written assignments.

Off-campus students should and can learn by working on such projects, too. For example, students from all across Maine can register for a meteorology course, studying at nearby high schools which are linked: a) by video to all of Maine's public college and university campuses , b) by computer to a unified catalogue of libraries across the state, and c) by computer to the global Internet. These students, many in the rural north of Maine, can analyze same-day weather data and images downloaded from the United States Weather Service via the Internet.

- **Collaborative learning.** Our teams all pointed to the increasing importance of learning in teams at their institutions. They also value learning to communicate and work across cultural barriers, something becoming increasingly common these days.

  The ease with which students work in teams around computers is well-documented: their projects and even their problems seem to pull them together. *Worldware* enables courses to focus on the kind of large real-world problems that in turn require teamwork to be resolved. *Electronic mail and computer conferencing* enable students who live some distance from one another and from campus to collaborate.

- **Learning at paces and times of student's choosing.** Traditional education can be constraining, especially in seminars (where students have to respond quickly or not at all) and on commuter institutions (where group work and lab work have to be done during narrow windows of time when students are on campus).

  Our institutions' five investments in technology are, in contrast, liberating. For example *videotaped lectures* can be rewound and reviewed as often as needed. *Electronic mail* offers an alternative pace for intellectual exchange. *Audioconferencing* makes it possible for small groups or teacher-student conferences to occur at a wide range of times, even when one of the parties is traveling. The *worldware*-based projects can be done wherever there are computers.

- Learning marked by **continuous improvement of a piece of work.** Computer-based projects such as essays are mechanically easier to revise, giving both faculty and students an opening to rethink the work. The FIPSE Technology Study Group report, *Ivory Towers,* *Silicon Basements* (1988) spotlighted this growing phenomenon almost seven years ago, and called it "doing it again, thoughtfully." Our institutions want to find out how commonly faculty are building revision and rethinking of work into course syllabi and, as we'll see, whether there are observable consequences in the skills of graduates.

- **Improved student-faculty and student-student interaction, and enhanced feedback**. Faculty from our institutions have noticed that project-based, collaborative learning seems to stimulate interaction and feedback. *Electronic mail* lowers barriers of role (teacher-student) and ethnicity that can sometimes interfere with honest communication even in conventional classrooms. Electronic mail is proving especially important where the interaction is between people from different cultural backgrounds. For example, it has been often observed how readily Native American students open up when conversations are carried on by electronic mail. (e.g., Arias and Bellman, 1990)

Each of these elements will be targeted by Flashlight procedures for monitored changes in teaching-learning practices in degree programs and across institutions.

b) Structures for Education in Virtual Space

Using technology to extend and enrich education simultaneously is nothing new. Consider the printed book: a technology that 1) opens learning to new students while 2) giving each student access to more, richer resources. The book, to be successful, requires increasing the distance between the student and the master, to give the student time and space to reflect. The book also increases the author-master's reach over distance, and across time.

Recently there has been explosive growth in this use of newer technologies to further enrich education while increasing distance among students, faculty members and the resources of study. This is sometimes called educating students in "virtual space" but in colleges and universities today it is far more routine than that futuristic label implies. When students learn in virtual space, each of the four facets of the teaching-learning process can include more students, while giving each student more control and more resources:

1) **Direct instruction**, offered via *live or pretaped video*. Use of video is good for students, and not just because it means that more students can learn. The lecturer can be rewound at will if the student has a tape of the presentation. The faculty member can include primary source video from outside the institution. The public colleges and universities in Utah, Oregon and other states use statewide video networks, for example, while the Rochester Institute of Technology (RIT) prepares videotaped lectures in advance and lease students the cassettes.

Institutions need not always produce their own video presentations. In the world of video and computer courseware, the Annenberg/CPB Project is an interesting case in point. Most of its course materials were developed at costs of $2-$7 million each. Interestingly enough the cost per student to develop these materials is relatively low because their use is so widespread (an estimated 2 million students a year use Annenberg/CPB materials). When these course materials are adopted as the foundation of a course, substituting for locally developed lectures, faculty members are freed to focus more attention on student projects, discussion, and individualized support.

2) Technology-based tools and resources for **"learning by doing (and reflecting)"** are also becoming available in virtual space, most notably the *on-line library catalogue* of an international "collection" of resources. Some institutions, such as the University of Maine System, then mail students the library materials they request from a multi-institution collection. Shared library catalogues are a good metaphor for the larger problem of supporting "learning by doing" on a large scale. Such support requires organizational change, in this case, new infrastructure that enables libraries to work together. The Internet is often seen as an environment where unbridled spontaneity is sufficient to support learning. "Need pen pals from French-speaking countries for your students? Use the Internet!" That works fine for a few students, but to support large numbers of learners, universities will need to develop stable, networked educational partnerships with other institutions, partnerships that benefit all participating parties. The development of such large scale partnerships (college-college, college-school, college-business, and so on) is one of the next challenges facing educators.

3) **Conversation in real time** for small groups is more frequently available by *audio* and *audiographic conferencing*. Organizationally, institutions need to support student use of equipment; the Rochester Institute of Technology (RIT) makes extensive use of these technologies, and has a system for leasing students needed equipment for the duration of the course.

4) **Time-delayed exchange of conversation and academic work** can be carried on through electronic mail and fax. The networked educational partnership in Maine illustrates how students in distant rural areas can be given access to needed computers, modems and fax machines.

Supporting these four types of interaction for students in a large number of courses requires not only technology but also organizational changes. Once made, these changes also enable support of richer, more accessible student services, from the research library, to counseling and financial aid, to that hard-to-define but crucial service known as supporting "academic community" for a far-flung and diverse student body and instructional staff.

Although we assume that institutions using Flashlight procedures will be using virtual space, and we intend to help them monitor the outcomes of this effort, we decided against immediate development of measures of change in practice in this area, e.g., measures of the extent to which all four conversations are supported or other indicators of how virtual space is being used for teaching and learning. Once again, such measures could be of significant value, but we knew we would lack the resources for their development at this time. This area is a priority for future funding.

c) *Implications for Faculty and their Work*

To make these changes happen, our five teams pointed to important changes needed in patterns of faculty work. Here are some of the faculty issues they hope to monitor on a regular basis:

- "Positive addiction" by faculty to teaching in the transformed setting.[3] Faculty long ago became positively addicted to paperback books and photocopying; they rely on them for good reason, and would find it painful to be deprived of them, especially if their students still had to take the same exams and do the same term projects. Our teams want to monitor positive addiction by faculty and their students to the five key investments in technology.

- To what extent are their faculty changing their roles from "sage on the stage" to "guide on the side?"

- To what extent are faculty members getting constructive feedback on their teaching, thanks to use of technologies such as videotaped lectures and electronic mail?

In addition to those priority issues, our institutions are also interested in monitoring:

- Any shift in faculty work style from "lone ranger" in classroom to "team member" working with instructional and student support personnel;

- Incidence of faculty who feel burned out by technology, and faculty whose careers are revitalized.

[3] For a fuller description of "positive addiction" as an indicator of how thoroughly faculty or students have come to depend on information technology, see Ehrmann(1991).

At this writing, we intend that our procedures will help institutions monitor their status in the first three areas; it may not be possible to do so for the latter two.

3. Resulting Responses to the Triple Challenge

To sum up, our five institutions, different as they are, are using their own variations on those five investments in technology (worldware, computer conferencing, presentations and real-time conferencing for students off-campus, networked educational partnerships, and universal access to needed technology) to foster three families of strategic changes in: a) teaching and learning practice, b) structures to support learning in virtual space, and c) faculty work. Each of those strategic changes in practice and structure is in turn meant to help them meet the Triple Challenge of providing 21st century learning, expanding access, and dealing with austerity.

Investments in Technology	**Changes in Teaching-Learning and Organization**	**The Triple Challenge**
Worldware	Project-based, collaborative learning, more flexibility, and more feedback	Need for 21st century skills
Computer conferencing & e-mail		
Presentations and real-time conferencing for students off-campus	Structures for education in virtual space	Increasing accessibility to education for a diverse population of adults
Networked educational partnerships		
Universal student access to needed technologies, networks	Changes in faculty work, e.g., shift from sage on stage to guide on side, shift from Lone Ranger to team leader.	Controlling costs per graduate (relates to all investments in tech, all change in practice and structure)

Let's return to the Triple Challenge (column three in the figure, above) and see how these changes in practice and structure (made more feasible by strategic investments in technology) can help institutions make tangible progress. It turns out that each of the new practices has implications for all three of the Challenges.

a) *The Challenge of Educating Adults for the 21st Century*

Change in the organization of work is increasing demand for higher level skills in all workers. The 1991 report by the Labor Secretary's Commission on Achieving Necessary Skills (SCANS) concludes, "...good jobs will increasingly depend on people who can put knowledge to work" (U.S. Department of Labor, 1991) All workers need to acquire proficiency in basic skills (reading, writing, computation, listening, speaking) but almost everyone also needs to be able to think creatively, collaborate, and adapt readily to changes in their work, including technological changes. (Reich, 1991; Commission on the Skills of the American Workforce, 1990, Carnevale et.al., 1988) Arguably the most important, most neglected skills are those needed to work in groups and coalitions (Boyatzis, 1982; Klemp, 1977) Nor or all these teams in the work world going to be composed of people of all the same gender, race and cultural background. Learners need to create and function within teams with diverse members.

Our five teams agreed that it was most important to foster the following four "21st century abilities" and then monitor their use by graduates who are now at work or in further education:

- Ability to use information technologies to learn, think, rethink (revise) and act in their fields;
- Ability to apply college learning to problems of their current work (content mastery, basic skills), including ability to identify appropriate tools and information (including the use of Internet);
- Ability to identify a learning need and how to deal with it, especially where learning involves use of information technology; and
- Ability to form, work in, and lead teams

b) *The Challenge of Raising the Doorway: Equitable Access*

Colleges want to educate all the students they can (within the constraints of their goals, mission, and selectivity), but the pool of potential learners has grown. Its composition has shifted toward adults who are distant from the campus offering the program they need, who have schedules that clash with those of the faculty and with other students', who are physically challenged, and who have extremely varied preparation and learning styles. In fact a "new majority" of today's current students fall into this category (Pew..., 1990). Still more such adults would like to enroll but are prevented from doing so.

The problem is not simply one of disadvantage (a label that points the finger of responsibility and blame at the learner and the learner's home community) but of accessibility. Imagine a school with doorways 5' 5" feet high. It would soon have two populations of students: normal students and head-injured (nontraditional) students, otherwise (privately) called "weeds." Some faculty would believe in providing each weed with a raft of compensatory medical and educational services, while others would argue that this special treatment would be unfair to normal students (those who coincidentally were less than 5' 5" high). However, there is a third option: invest in raising the height of the doorways. Once the brain-damaged weeds graduate, there would be only one type of student: normal.

We think of many types of students today as disadvantaged or marginal because of what is wrong with our educational institutions, not with them. Traditional technologies of learning have only been available at one place at one time, and could serve limited numbers of students; anyone else, no matter how motivated or capable, who couldn't learn inside the cloistered walls, was defined as nontraditional. The five investments in technology, and the changes in practice and structure they make possible, should enable institutions to attract, retain and graduate many types of students previously on the margins of higher education. (Western Cooperative..., 1994)

Our five teams think it is particularly important (and feasible) to help more students enroll, persist, and graduate — adults who otherwise wouldn't because of the following six issues:

- location
- family/work responsibilities
- physical disability
- being a non-native speaker of English (there is evidence that computer conferencing enables such students to excel because they have more time to interpret what they hear and to compose what they want to say. (Hiltz, 1989; Arias and Bellman, 1990)
- varied learning styles (e.g., students who might not enter, persist or excel without aids such as computer conferencing, the ability to "rewind" a lecture, and the ability to take computer-administered practice tests)
- economic disadvantage.

In each of these six areas, our teams would like to monitor progress year by year, testing whether the spotlighted changes in practice and organizational structure are aiding equity of access.

c) Controlling Costs per Graduate: The Challenge of Austerity

Colleges and universities are competing with health care, programs for the aging, and other growing elements of the public sector for a share of the nation's discretionary spending.

There have been many promises that technology would cut educational costs, presumably by substituting itself for faculty members. That hasn't happened and probably won't. However, our five institutions do see the possibility of controlling costs per graduate. The most likely mechanisms include:

- possible savings in capital costs and operating expenses, and possible increases in income, gained by offering a high quality education offered wholly or partially in virtual space rather than in expensive brick-and-mortar facilities. The entire Educational Network of Maine cost less to create than one new high school;

- increased enrollment and retention (resulting in decreased costs per graduate). Retention should be aided by project-based collaborative learning (engaging instruction) and by education in virtual space (less wasted time, resulting in high course loads and quicker graduation); and

- stronger public and alumni/ae support, due to improved performance (measured and publicized by assessing the performance of graduates) and to participation in networked educational partnerships, so that cogent appeals for resources can be based on the needs of the larger partnership.

We decided to tackle the first job of learning to monitor the first two issues, but not the third one at this time.

VI. SUMMARY AND CONCLUSION: "THE PARABLE OF THE SHIPS AT SEA"

There is nothing new under the sun. Elting Morison[4] recounts what happened to the United States Navy when, in the middle of the last century, it collided with advances in *its* basic technologies, during a period when the nation and its military faced new challenges.

Up to the middle of the nineteenth century, nations relied on warships that were constructed of wood, powered by sail, and armed with guns that could shoot neither far nor accurately. As Morison put it admiringly, the ship of the line "was a demonstration of the use of limits...The designers intended to build a machine that would do as much work as possible within the restricting scales, proportions, tempos, strengths of materials, and structural simplicities imposed upon them by the knowledge and means available to them."[5] Furthermore, because the technology of the ship had changed little over the centuries, neither had the strategy and tactics for using those ships.

Those technologies changed dramatically and permanently midway through the nineteenth century: the old ways were challenged by steam power, iron hulls, and rifled cannon of greater size and power. But what should such ships do, and what should they look like?

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[4]Morison, Elting E., *From Know-how to Nowhere: The Development of American Technology*, New York: Basic Books, 1974.
[5]*Ibid*, p. 150.

In our own age, colleges and universities are struggling to fit new challenges and new technologies. So too was the late nineteenth century a time "of disordering confusion in the United States Navy...Naval officers did not know what to do with what they had. There was in fact a great and raging debate about the use of naval vessels in those days. Was the purpose of men-of-war to run down freighters and so starve the enemy; was it to lie in a line off a foreign coast and blockade the commerce of the enemy; was it to show the flag in an impressive way in distant ports?"[6] Each purpose implied a different family of designs for ships. Many ships were built by the U.S. Navy during that period, few of them alike. Some were begun, put in mothballs, rebuilt, laid up again, and rebuilt again before ever being launched, while civilian and military authorities struggled to figure out what type of ship they wanted to build.

The hero of Morison's story is a historian, Captain (later Admiral) Alfred Thayer Mahan, who wrote *The Influence of Sea Power on History* in 1890,[7] a volume that used history as the basis for its assertion of simple, lasting principles governing the proper construction and use of navies. Unlike many academic treatises, the book was written for a wide public, and it was widely read.

Morison writes, "[W]ithin a year or two, the confusing arguments over the merits of blockade, harbor protection, and commerce destruction ceased. Within two or three years, the problems of ship type, ship design, gun size and distribution, weight or armor, and size and composition of the fleet were all moving toward resolution....For the first time in half a century, men had a clear idea of what they were trying to do with their mechanical structures and how they might shape and use them in support of their purpose. It was a remarkable demonstration of the power of a governing idea."[8] Paradoxically the budget for the Navy could be cut even as its fighting power was increased, because its purpose and strategy were now clear.

We face a similar situation in our use of technology for educational purposes. Every year floods us with new ways to exploit computing, video and telecommunications. Like the navies of the 1880s we seem to be sinking in a bog of new ways to do things and to spend money. It's a dangerous time to be answering the wrong question. The question facing higher education today is not "How do we restore the conditions of the 1960s?" nor is it "How do we use technology to do what it does best and thus, somehow, revolutionize higher education?" Instead, we must ask, "How can our institutions best respond to their Triple Challenge? What investments in computing, video, telecommunications might make the difference between institutional health and decline?"

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[6]*Ibid.* pp.155-6.
[7]Mahan, Alfred Thayer, *The Influence of Sea Power Upon History, 1660-1783,* Boston: Little, Brown and Company, 1890.
[8]Morison, p. 159.

As a result of this planning grant, the Annenberg/CPB Project has decided to develop, test, and disseminate the first round of Flashlight evaluation procedures, subcontracting some development work to the Western Cooperative for Educational Telecommunications and to Indiana University, Bloomington, and testing the measures at our five partner colleges and universities. Interest in the Project is enormous. A listserv designed to deliver periodic bulletins about Flashlight already has approximately 200 participants.

In addition, the Project has become convinced of the value of the construct of "educational strategies" and has created an Educational Strategies Program. Its linchpin is Flashlight. In the evaluation area we have taken part in an evaluation of government strategy for supporting computing in Portuguese schools, and may soon play a leading role in an international evaluation of the costs of distance education. Complementing the evaluation segment of the Educational Strategies Program is faculty and program development; we are funding teams of faculty who are gathering information about emerging practices to exploit computing, video and telecommunications in courses in their fields; after analyzing this information (e.g., about new materials, new types of assignments, new approaches to assessment, new designs for majors and minors, and the problems associated with implementing all this new stuff), the teams will make it available through the Internet and workshops. In some instances they are producing video case studies of faculty struggling to reform teaching in their institutions. We hope these two elements of the Educational Strategies Program -- faculty/program development on a national scale and evaluation -- will become increasingly complementary. We are grateful to FIPSE for aiding indirectly in the initiation of this ambitious program and hope to have an opportunity to work with the Fund again.

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VIII. APPENDICES

Delphi Instruments (Round 1 and 2)
"Asking the Right Questions" (due for publication in *Change Magazine*, March/April 1995.

A. Delphi Instrument (Round 1)

The Annenberg/CPB Project

Memorandum

TO: Trudy Banta, IUPUI
Janet Kendall, Washington State
Cindy Leshin, Maricopa
Joe Nairn, RIT
Pam MacBrayne, Maine

FROM: Flashlight planning team

SUBJECT: Survey of Flashlight Priorities

DATE: January 24, 1994

It's time to take the next big step in our planning grant. This survey will help us decide which evaluation measures and procedures are most needed by the five institutions. Please meet with the other person/people coming to the Colorado meeting **soon**, fill in this survey, and fax it back to Steve Ehrmann (202-783-1036). If you can't meet, then give each person a copy of this and return multiple copies.

We're asking you to rank order possible topics that might be foci of the FIPSE grant we're going to ask for. Your answers will help determine the shape of that grant proposal and, if we're funded, the kinds of studies you'll be able to do at your institution in the next several years. This first survey tells you about our ideas, asks for yours, and asks you to rank order the set of possible topics.

We'll collect and analyze your responses, summarize them, and use them to create the second round of the survey. That second round, which will reach you in mid February, will show how you all responded the first time, and will give you the opportunity to change your answers based on what you learn from how the other institutions responded to the same questions. We'll also use the results to design the agenda for our meeting on February 19-21.

Please fax me your choices at 202-783-1036 by Friday, February 4 at the latest, earlier if possible.

BACKGROUND: INSTRUMENTS AND PROCEDURES TO BE DEVELOPED

We're currently planning to develop five groups of measures and procedures:

A. The "completer instruments" will consist of a survey form and interview protocol (focus groups?) for "completers" (graduates and others who have taken the designated course clusters) and a parallel survey and interview protocol for their supervisors (a total of 2 surveys, 2 interview protocols).

B. The "student/faculty instruments" will consist of survey measures and interview procedures for students in, and of faculty teaching, courses in the designated clusters. (2 surveys, 2 interview protocols)

C. Guidelines for study of enrollment patterns and attrition

D. Model survey for the study of availability of computing, worldware (licenses), telecommunications, video equipment to students in the course clusters (1 survey)

E. Guidelines and example study for allocating costs of academic programs using technology

Flashlight Project. Delphi Study, Round 1

Your name(s) (please print):

____

Your institution: ____________________

TOPICS FOR EVALUATION STUDIES

Candidate Degree Programs and Other Course Clusters

In order to do studies, we need to make two interdependent choices: which questions to study, and which degree programs or other course clusters of which to ask them. There are at least three things to consider in choosing degree programs or course clusters:

a) has there been an investment of technology of a scope that would help the institution respond to the triple challenge (glance through the candidate studies in this Delphi to get a more concrete idea of what we'll be looking for)?

b) are the faculty and students likely to be interested and cooperative in gathering and interpreting this kind of data?

c) is the program or the institution likely to need the kind of data and findings that we can produce in order to make important decisions?

At our February meeting, we'll work together to help each institution pick two clusters, and we'll look for clusters that are common to different institutions; for now, just think about your own needs. For now, however, consider the three issues above, and below please list any degree programs and other course clusters that would be good candidates for Flashlight study at your institution:

1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

Place a star beside any of your current favorites for study. (Thus, you might currently have spotted eight good candidates for study, but you might also feel that 1-3 of them are especially promising candidates for inclusion; star those.)

A. Learning outcomes studies

As a whole we trying to help you study the usefulness of technology in aiding your institution's response to the triple challenge of educating graduates to excel in work, civic and personal life, of attracting and retaining a large and diverse student body, and of responding to the challenges of austerity. This first set of candidate topics has to do with the first of those three challenges.

1. Candidate learning outcomes (completers)

Please rank order these learning outcomes for completers according to how important each is for you to study. Think in terms of your chosen degree programs or other course clusters. For example you might rank learning outcome X highly because you think it quite likely to be happening and you need data to prove it, or you might rank it highly because it's often claimed as an objective but you suspect it's not happening nearly as much as it should and it's important to find out. You might rank learning outcome Y low because it's not as important an objective for your course clusters, or because achievement of this important outcome (or lack of achievement of it) is already so obvious that little further study is needed.

First study this list but don't rank order the items. Second, add any additional learning outcomes that you like which are missing from this list and which you intend to rank in your top 3 candidates. Finally, rank order the full list.

"**HYP(othesis): Completers should exhibit:...**"

Outcome O.1) Ability to relate what they learned in college to real world problems with which they are now dealing (thanks in significant degree to the ways that technologies are used in their program).
I rank this outcome # ___ because ____
____.

Outcome O.2) Ability to work in, form, and lead teams (thanks in significant degree to the ways that technologies are used in their program).
I rank this outcome # ___ because ____
____.

Outcome O.3) Mastery of the following content or skill that could not have been taught without use of technology (________________________________
____)
I rank this outcome # ___ because ____
____.

Outcome O.4) Important contacts with people in the work world: contacts that they made during their academic program. (thanks in significant degree to the ways that technologies are used in their program).

I rank this outcome # ___ because ______________________________

______________________________.

Outcome O.5) Positive addiction to technologies as tools and resources for thinking and action, due to education and /or due to job setting

I rank this outcome # ___ because ______________________________

______________________________.

Outcome O.6) Tendency to learn well on their own (at their own initiative, using methods of their choosing) (thanks in significant degree to the ways that technologies are used in their program).

I rank this outcome # ___ because ______________________________

______________________________.

Outcome O.7) Tendency to go through multiple drafts of computer-based documents or projects

I rank this outcome # ___ because ______________________________

______________________________.

Outcome O.8) ______________________________:

I rank this outcome # ___ because ______________________________

______________________________.

Outcome O.9) ______________________________:

I rank this outcome # ___ because ______________________________

______________________________.

2. Candidate pRocess indicators

In similar fashion, rank the importance of developing measures and procedures to study the following indicators of learning process.

HYP R.1)Time on task, as related to uses of technology or use of practices made possible by technology
I rank this process # ___ because ____
____.

HYP R.2) Positive addiction by students to technologies as tools & resources for thinking
I rank this outcome # ___ because ____
____.

HYP R.3): When computer conferencing is used as a medium of conversation, students are generally more thoughtful and more students (often those who tend to be silent during face to face classes) take part .
I rank this process indicator # ___ because______________________________
____.

*HYP R.4):*____
I rank this process indicator # ___ because______________________________
____.

*HYP R.5):*____
I rank this process indicator # ___ because______________________________
____.

3. Candidate Practices to monitor through studies of alumns, current students and faculty in the clusters of courses

The preceding questions concerned outcomes for graduates and important process outcomes. Now we shift focus to the teaching/learning practices through which those outcomes are achieved, and the role technology may (or may not) play in making those practices more feasible.

Each of the items below is a study you might do (with measures and procedures provided by the FIPSE grant), looking into the usefulness of technology for helping teachers teach and students learn in a particular way.

Please rank most highly the studies you'd most like to do.

HYP P.1): Project-centered learning is more feasible when students are using worldware[1]*(e.g., productivity tools, research tools, electronic access to libraries and databases, etc.);*
I rank this hypothesis # ___ because ____
____.

HYP P.2) Assuming that P.1 is true, students are developing their skills in a systematic way during several courses they take (Counter hypothesis: there is little or no systematic development of student skill Each course is doing something completely different).
I rank this hypothesis # ___ because ____
____.

HYP: P.3) Collaborative learning is more feasible when students are using technology to work on complex, realistic, open-ended projects
I rank this hypothesis # ___ because ____
____.

---

[1]Worldware is any hardware or software that is developed and marketed mainly for purposes other than undergraduate instruction. Thus computers, word processors, faculty research software, the Internet, and research libraries are all worldware; textbooks and computer-assisted instructional packages are not worldware (they're courseware).

HYP P.4) Computer conferencing in courses is an important support for work on projects, especially by student teams
I rank this hypothesis # ___ because ____
____.

HYP P.5) Networked educational partners provide key resources for projects
I rank this hypothesis # ___ because ____
____.

HYP P.6) Use of real time communication helps students working on projects
I rank this hypothesis # ___ because ____
____.

HYP P.7) Use of prepackaged didactic resources and network access to outside expertise is important for students working on divergent projects in areas where faculty are not as expert or where faculty don't have time to give live-mini-lectures
I rank this hypothesis # ___ because ____
____.

HYP P.8): ____
____.
I rank this hypothesis # ___ because ____
____.

HYP P.9): ____
____.
I rank this hypothesis # ___ because ____
____.

B. Enrollment/retention studies

The second challenge has to do with enrolling and retaining a sufficiently large and diverse student body.

Importance of project-centered, collaborative learning for engagement, and thus for retention

HYP E.1) Students who are exposed to such a course are more likely to be enthused about a course, to spend time in study, and to complete the course.
I rank this hypothesis # ___ because ______________________________________
______________________________.

Importance of technology-enabled accessibility to enrollment and retention
This includes but is not limited to "distance learning." Study time use, especially percentage of time spent in real studying rather than in wasting time (e.g., commuting, standing in line, etc.)

HYP.E.2) Significant numbers of students enroll and graduate who for reasons of location would otherwise be unlikely to do so
I rank this hypothesis # ___ because ______________________________________
______________________________.

HYP.E.3) Significant numbers of students enroll and graduate who for reasons of physical disability would be otherwise be unlikely to do so.
I rank this hypothesis # ___ because ______________________________________
______________________________.

HYP.E.4) Significant numbers of students whose native language is not English can achieve as well as others
I rank this hypothesis # ___ because ______________________________________
______________________________.

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HYP.E.5) Students in courses that feature significant exchange by way of electronic mail and computer conferencing (and other asynchronous media?) are significantly more likely to complete the course than students in courses that offer only real-time conversation and homework exchange, for students studying on- and off-campus.
I rank this hypothesis # ___ because ______________________________
______________________________.

HYP. E.6) about enrollment and/or retention: ______________________________
______________________________.
I rank this hypothesis # ___ because ______________________________
______________________________.

HYP. E.7) about enrollment and/or retention: ______________________________
______________________________.
I rank this hypothesis # ___ because ______________________________
______________________________.

C. Studies relating technology use to the institution's ability to respond to an austere fiscal climate

This third group of hypotheses relates to the third of the three challenges: austerity. Are there ways in which technology-enabled programs or teaching practices are helping the institution control costs?

Once again rank most highly those hypotheses that it's most important that we develop tools for, so that you can do them. Also remember that a high ranking of a hypothesis does not necessarily mean that you believe it, just that you think it important that you study it locally.

HYP A.1: Capital costs of virtual space tend to be less than bricks and mortar for traditional space
I rank this hypothesis # ___ because ____
____.

HYP A.2: Because our institution is sharing resources with other institutions on networks, richer resources are available than our institution could otherwise afford. Our institution more often shares and exchanges staff, library, other resources with other organizations. The reality and importance of this gain is recognized through altered purchasing practices (e.g., partners agreeing to split the tasks of acquisition, and then sharing the acquisitions).
I rank this hypothesis # ___ because ____
____.

HYP A.3: Our institution gains support by serving students in politically important but under-served areas of the state
I rank this hypothesis # ___ because ____
____.

HYP A.4: Our costs/student are less because of good student retention and/or graduation rates
I rank this hypothesis # ___ because ____
____.

HYP A.5: Because our institution's reach is longer, few courses are so small that they must be canceled, so average student/faculty ratio can be increased while we maintain diversity of offerings.

I rank this hypothesis # ___ because ______________________________

______________________________.

HYP A.6: Our students remain with us sometimes because they can use technology to take selected courses from other institutions, rather than transferring to other institution or dropping out.

I rank this hypothesis # ___ because ______________________________

______________________________.

HYP A.7 Our institution gains support through coalition with its networked institutional partners, e.g., working with schools to support development or operation of network that they then share (If you rank this high, please give an example of such a partnership and how it is supposed to help your institution get what it needs.)

____

I rank this hypothesis # ___ because ______________________________

______________________________.

HYP A.8 ______________________________

I rank this hypothesis # ___ because ______________________________

______________________________.

HYP A.9 ______________________________

I rank this hypothesis # ___ because ______________________________

______________________________.

B. Delphi Instrument (Round 2)

The Annenberg/CPB Project

Memorandum

TO: Trudy Banta, IUPUI
Janet Kendall, Washington State
Mary Day or Cindy Leshin, Maricopa
Joe Nairn, RIT
Glenn LeBlanc, Maine

CC: Sally Johnstone and Robin Zuniga, WICHE
Joe Lovrinic, IU

FROM: Steve Ehrmann

SUBJECT: Round 2 Survey of Flashlight Priorities

Happy Valentine's Day! Here's the second round of our survey. We've modified the choices, based on your responses to the first round. **The two people coming to Denver should fill this out and bring it with them to Denver. The first thing we'll do on Saturday afternoon is to ask for and discuss the issues you've chosen. If at all possible, I'd like to talk to at least one of you by phone *before you fill this out* so we're clear on its purpose, etc. Call me and we'll talk right away or set up a time to do so. My number is 202-879-9643.**

Your job is to select the ten issues from this list of 35 that are the most important for your organization[1] to study: for making important decisions, stimulating the right kinds of internal debate, informing external constituencies and so on. Once we get to Denver, we'll compare notes and see which issues are getting real interest from several of you, and narrow the list further. When our Denver meeting is over, Sally, Robin and I will write the Flashlight final proposal to FIPSE and it will probably focus on just 4-7 of the issues in this list. Remember that the grant is to develop the measures and procedures, and also provide your institution with consulting assistance; it will be up to your folks to do the studies, so pick only those that collectively could help shape your institution's future.

[1] Question: I teach an academic program for which this would be very valuable, but the issue isn't as valuable for the institution as a whole. How should I rank it?" Answer: your team needs to figure that one out. In the end, the pragmatic issue is that, assuming we're funded, we'll be offering you measures and procedures, and someone at your institution will need to use them. Does that help you decide?

Flashlight Project. Delphi Study, Round 2
Your name(s) (please print):

____

Your institution: ____________________
Our top ten issues (drawn from the list on the following pages) are:[2]
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

ISSUES INVOLVED IN INSTITUTIONAL RESPONSE TO TRIPLE CHALLENGE

CHALLENGE #1: Improve learning so that graduates can excel

1. Candidate learning outcomes (for 'graduates' of course cluster)

"HYP(othesis): Completers should exhibit:..."

Outcome O.1) Ability to apply what they learned in college to real world problems with which they are now dealing (thanks in significant degree to the ways that technologies are used in their program).
Ranks in first round: 1, 2, 2, 6, NR[3]

Outcome O.2) Ability to work in, form, and lead teams (thanks in significant degree to the ways that technologies are used in their program).
Ranks in first round: 2, 3, 5, NR, NR

Outcome O.3) Mastery of the following content or skill that could not have been taught without use of technology: ____________________
(Respondent comments: "master content, then work with others to solve problems," "writing" "all content, since video is a necessity for distant learners[4]")
Ranks in first round: 1, 2, 3, 4, NR

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[2] Identify each hypothesis with its label and a phrase to help you remember it, e.g., "HYP O.1: ability to apply learning to real world problems after graduation"
[3] This line indicates how each of the five institutions ranked this item the first time around. "NR" means that the item was not ranked by one of the institutions.
[4] The research doesn't agree with this hypothesis. Various forms of directed instruction are all about the same when it comes to learning, especially for memorization and simple problem solving. Print (correspondence) can teach many topics very well. Are there ones that it can't teach well enough?

Outcome O.4) Important contacts with people in the work world: contacts that they made during their academic program. (thanks in significant degree to the ways that technologies are used in their program).
Ranks in first round: 3, 7, NR, NR, NR

Outcome O.5) Positive addiction to technologies as tools and resources for thinking and action, due to education and/or due to job setting
Ranks in first round: 1, 3, "low", NR, NR

Outcome O.6) Tendency to learn well on their own (at their own initiative, using methods of their choosing) (thanks in significant degree to the ways that technologies are used in their program).
Ranks in first round: 1, 1, 1, 3, 4

Outcome O.7) Graduates have learned that it's last version of a project that counts, not the brilliance of the first draft. They therefore are unusually good and thoughtful in revising their work. (role of technology: ease the mechanics of revising, so that it becomes more feasible to rethink, revise)[5]
Ranks in first round: 1, 1, low, NR, NR

Other Learning Outcomes Suggested by Respondents to the First Round Survey

Outcome 0.8) Help students master course content and apply it to problems.

Outcome 0.9) Student ability to discriminate between tools and information that are useful and useless for a given task, and use them, especially in the presence of large amounts of information.

Outcome 0.10) Learning how to search for information on the Internet (related to O.6)

2. Candidate process indicators

This section deals with "process" outcomes such as the time and attention that the student is attracted to spend on the tasks of learning: the immediate outcomes of good teaching – process outcomes that in turn help foster the learning outcomes were dealt with in section #1.

[5] Comments indicated that this item was poorly worded. What you see here is a rewording. The ranks, of course, come from the prior wording of the item, "Tendency to go through multiple drafts of computer-based documents or projects"

HYP R.1) Time on task, as related to uses of technology or use of practices made possible by technology
Ranks in first round: 1, 1, 1, 2, NR
Steve: Your comments made it clear that this is a multi-faceted phenomenon: how much time does the technology-enabled teaching attract students to spend on the real task? How much does the technology distract from learning (e.g., while learning to use the technology or fooling around with it?) How much time does it save (commuting time? time doing tasks of learning such as writing).

HYP R.2) Positive addiction by students to technologies as tools & resources for thinking
Ranks in first round: 2, 3, NR, NR, NR

HYP R.3): When computer conferencing is used as a medium of conversation, students are generally more thoughtful and more students (often those who tend to be silent during face to face classes) take part .
Ranks in first round: 1, 1, 2, 3, 5

Other Changes in Process Outcomes Suggested by Respondents to the First Round Survey
HYP R.4): Does our use of technology in learning increase interaction? isolation?

HYP R.5): Collaborative learning can be increased because of the nature of required assignments based on multimedia

HYP R.6): - Faculty collaboration and faculty development are enhanced by the process of using new technologies the way we do.

3. Teaching Practices to monitor through studies of alumns, current students and faculty in the clusters of courses

HYP P.1): Project-centered learning is more feasible when students are using worldware[6](e.g., productivity tools, research tools, electronic access to libraries and databases, etc.);
Ranks in first round: 1, 2, 2, 2, 4

[6]Worldware is any hardware or software that is developed and marketed mainly for purposes other than undergraduate instruction. Thus computers, word processors, faculty research software, the Internet, and research libraries are all worldware; textbooks and computer-assisted instructional packages are not worldware (they're courseware).

HYP P.2) Assuming that P.1 is true, students are developing their skills in a systematic way during several courses they take (Counter hypothesis: there is little or no systematic development of student skill Each course is doing something completely different).
Ranks in first round: 1, 1, 2, 4, 5
Steve: at least two of you assumed that we meant "skills (of using technology)." We meant this hypothesis to include a wide range of cognitive skills, especially those in which use of technology was supposed to be important in developing the skill (e.g., people arguing for increased investment in on-line library services might argue that they can help students learn skills of doing social science research)

HYP: P.3) Collaborative learning is more feasible when students are using technology to work on complex, realistic, open-ended projects
Ranks in first round: 1, 3, 4, NR, NR

HYP P.4) Computer conferencing in courses is an important support for work on projects, especially by student teams
Ranks in first round: 1, 2, 5, NR, NR

Other hypotheses suggested by respondents to first round

HYP P.8):[7] - what kind of support/resources does an institution need to help faculty change their role from information provider ("sage on the stage") to "guide on the side"
SCE: We're only going to investigate specific outcomes institutions are already trying to achieve and practices they're implementing. (We call the project "Flashlight" because we're only going to ask very pointed, informed questions.) Is your institution doing things that ought to be helping faculty make this shift? If so, and if this is one of your "Top 10," what are they?

HYP P.9): Faculty are making appropriate assignments. Comment by author: We rank this #3 in this section because, for example, one faculty member assigned a computer physics lab she thought would take students 45 minutes to complete. It actually took students 6 hours to do. Faculty may not understand the tools well enough to make them effective.

[7] Hypotheses P.5 , P.6, and P.7 were eliminated (along with a couple others) due to lack of interest. We're retaining the original numbering of hypotheses, however. That's why there is a "skip" from P.4 to P.8.

B. CHALLENGE #2: Improve enrollment and retention; equity of access

Importance of project-centered, collaborative learning for engagement, and thus for retention

HYP E.1) Students who are exposed to a technology-enabled, project-intensive course are more likely to spend time in study, and to complete the course. This hypothesis applies to students studying on- and off-campus.[8]

Ranks in first round: 1, 1, 2, 2, 3

Importance of technology-enabled accessibility to enrollment and retention

HYP.E.2) Significant numbers of students enroll and graduate who for reasons of location would otherwise be unlikely to do so

Ranks in first round: 1, 1, 2, 3, NR

Steve: Has your institution already developed ways to study this issue?

HYP.E.3) Significant numbers of students enroll and graduate who for reasons of physical disability would be otherwise be unlikely to do so.

Ranks in first round: 3, 4, 5, 6, NR

Steve: No one mentioned that there is a new law (ADA) that prohibits discrimination because of disability. Technology can either increase or decrease access, depending on how it's used.

HYP.E.4) Significant numbers of students whose native language is not English can achieve as well as others because electronic mail and related, asynchronous media enable them to comprehend and "speak" on an even footing.

Ranks in first round: 3, 4, 6, NR, NR

Steve: The comments on the first round made it clear that at least some of you thought we meant students who couldn't speak English at all (we actually meant students who can comprehend and speak English but not as quickly and fluently as a native). It's been said that computer conferencing and fax might provide a better conversational medium for these folks than real-time conversation in person or over an audio system. The question is how important it is for your institution to investigate this possibility.

HYP.E.5) Students in courses that feature significant exchange by way of electronic mail and computer conferencing (and other asynchronous media?) are significantly more likely to complete the course than students in courses that offer only real-time conversation and homework exchange, for students studying on- and off-campus.

Ranks in first round: 1, 2, 2, 2, 6

IUPUI: 1 (corollary of E.1)

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[8] This hypothesis has been reworded for clarity since Round 1.

Other hypotheses suggested by respondents to first round

HYP E.6): Which kinds of learners at our institution benefit most from using technology to assist learning?

HYP E.7): Technology may create additional access problems for poor students. More affluent students have computers and modems in their homes and in our state have had greater exposure to technology in elementary and secondary schools. So some students must learn to use a computer or other technology before they can complete assignments; others can already use these tools. Some have access in their homes, others must go to a computer lab to complete an assignment.

C. CHALLENGE #3: Respond to an austere fiscal climate

HYP A.1: Capital costs of virtual space tend to be less than bricks and mortar for traditional space
Ranks in first round: 1, 1, 1, 3, 4
Comment from a respondent: The tuition for a student to attend our college, full-time, for two years is less than a modestly priced computer. When w e use virtual space, many students can't join. It's important not only to consider the costs but also who pays them.

HYP A.2: Because our institution is sharing resources with other institutions on networks, richer resources are available than our institution could otherwise afford. Our institution more often shares and exchanges staff, library, other resources with other organizations. The reality and importance of this gain is recognized through altered purchasing practices (e.g., partners agreeing to split the tasks of acquisition, and then sharing the acquisitions).
Ranks in first round: 1, 2, 6, 7, NR

HYP A.3: Our institution gains support by serving students in politically important but under-served areas of the state
Ranks in first round: 2, 3, 6, 7, NR

HYP A.4: Our costs/student are less because of good student retention and/or graduation rates
Ranks in first round: 1, 2, 4, NR, NR

HYP A.5: Because our institution's reach is longer, few courses are so small that they must be canceled, so average student/faculty ratio can be increased while we maintain diversity of offerings.
Ranks in first round: 2, 4, 5, NR, NR

HYP A.7 Our institution gains support through coalition with its networked institutional partners, e.g., working with schools to support development or operation of network that they then share (If you rank this high, please give an example of such a partnership and how it is supposed to help your institution get what it needs.)
Ranks in first round: 1, 1, 2, 4, 5

<u>WHERE WE MIGHT DO OUR RESEARCH: SUGGESTED COURSE CLUSTERS</u>
Here, for your information, are the course clusters suggested by each of the five institutions. Areas named by more than one institution are marked with **.

Maricopa
Math (college algebra)
** English (first year)

U Maine, Augusta (UMA)
Social services (AA)
Science
** Nursing

IUPUI
** Nursing telecourses, inc. writing
** Writing - first year

Washington State
World Civilization (WC) (multimedia course; 1st yr students)
Extended Degree Program in social sciences (EDP) (BA level)
Various grad courses taught over WHETS (ITV system)
** Writing lab

RIT
Applied computing
Telecommunications
Health Systems Administration
Electrical/Mechanical Engineering
Management
Emergency Management
Information Technology
Software engineering
Liberal arts

Asking the Right Question:
What Does Research Tell Us
About Technology and Higher Learning?[1]

Stephen C. Ehrmann
The Annenberg/CPB Projects

'I've got two pieces of bad news about the experimental English composition course where students used computer conferencing.

The first bad news is that, over the course of the semester, the experimental group showed no progress in their ability to compose an essay.

The second piece of bad news is that the control group, taught by traditional methods, showed no progress either.'

- Paraphrased from a talk by Roxanne Hiltz reporting on an early use of computer conferencing

I've been involved with innovation in higher education -- its funding, its evaluation, and research about it -- for twenty years, especially innovations having to do with computing, video and telecommunications. During that time I've often been asked "What do computers teach best?" "Does video encourage passive learning?" and "Is it cheaper to teach with telecommunications?" I don't have answers to those questions. I don't think they *can* be answered in any reliable, valid way.

It takes just as much effort to answer a useless question as a useful one. The quest for useful information about technology begins with an exacting search for the right questions. This essay discusses some useless questions, a few useful ones (and the findings that have resulted), and one type of question that ought to be asked next about our uses of computing, video and telecommunications for learning.

1. Bad Questions About The Higher Education Machine

The first group of useless questions seek universal answers to questions about the comparative teaching effectiveness and costs of technology. These kinds of evaluative questions are phrased like, "Do computers do a better job

[1] This article will appear in the March/April issue of *Change Magazine*. Comments can be directed to the author who is manager of the Educational Strategies Program, The Annenberg/CPB Projects, 901 E Street, NW, Washington, DC 20004-2037, USA. On the Internet: Ehrmann@SOUL.CPB.ORG

of teaching English composition than traditional methods?"

Think about it. That question assumes that education operates something like a machine, and that each college is a slightly different version of the same "ideal" machine. Questions like these use the phrase "traditional methods" to represent some widely practiced method that presumably has predictable acceptable results. "If technology performs better than traditional methods," such questions imply, "everyone should use it." A neat picture, but "traditional methods" doesn't define the higher education that I know and love, nor is it the higher education that research reveals.

Postsecondary learning is not usually so well-structured, uniform or stable that one can compare an innovation against "traditional" processes without specifying in explicit detail just what those processes are. And by specifying in detail what "traditional" means (what materials, what methods, what motives), you limit your study to a very small and temporary universe.

Organizationally our institutions don't behave like machines, either. Cohen and March did a classic study of presidential decisionmaking some years back, coining the term "organized anarchy" to describe how our institutions function. The term describes any institution, they said, which, like the typical college or university, has

1) problematic goals (it "appears to operate on a variety of inconsistent and ill-defined preferences"),
2) unclear technology (i.e., methods) ("Although the organization manages to survive and (where relevant) produce, it does not understand its own processes."), and
3) fluid participation in decision making ("the boundaries of the organization appear to be uncertain and changing").

Sound like a machine being fine tuned toward a Platonic ideal of efficiency? To me it sounds not only like what colleges are (and ought to be) but also like what college courses are (and ought to be). Unfortunately this means one can't ask"How well is this technology-based approach working, relative to the norm?" since there usually isn't a norm.

It also seems useless to search for global generalizations about the costs of technology relative to "traditional methods." Howard Bowen, a noted economist of higher education, found that institutions of higher education each raise all the money they can, spend all they get, and spend it in ways that relate closely to the way they spent the money last year. His 1980 study found little relationship in patterns of spending even among institutions that appeared on the surface quite similar. They spent rather different amounts per student, and they spent each dollar differently. Bowen found no way to state rationally what it ought to cost to educate a student properly. Tougher economic times may have forced some convergence in costs among institutions. But we still have no rational way of describing what traditional education *should* cost per student.

Platonic ideals aside, it's also difficult to determine what education *does* cost. Prices and accounting methods vary by institution and situation. Services that are inexpensive to some institutions are quite expensive for others. Complicating the cost question still further is the rapid and not always predictable change in technology prices and performance.

None of this suggests that we should ignore issues of cost in looking at new investments in technology. But caution flags should go up whenever you hear someone say "The nation can teach English composition more cheaply if it uses technology X," be that technology old or new.

2. If You're Headed in the Wrong Direction, Technology Won't Help You Get to the Right Place

Questions are also be useless if we fail to ask them. Many advocates of technology want to improve current teaching. But too often they fail to ask whether "traditional education" has been teaching the right content. They seek to change the means of education but don't ask hard questions first about its objectives.

What makes me uneasy about the content goals of undergraduate education is grades, and what research tells us about them.

Any undergraduate can tell you that grades are the key to interpreting the mysteries of higher education. Faculty give you high grades when you learn what they value, right? We tell students repeatedly, "Study hard, get good grades and you will learn what you need in order to do better in life."

But is that true? Let's assume that the curriculum teaches knowledge, skills and wisdom that is of advantage to graduates. We'll also assume that faculty members are grading rationally. And although higher education has many goals, not all of them professional or vocational, at least some of them are meant to foster later success in the workplace (e.g., salaries, chances of winning a Nobel Prize, etc.) In that case, research ought to reveal a positive correlation between cumulative grade point average and work outcomes. In other words, your "A" graduates should have learned enough to do better in their work life than your "C" graduates. (I'll use "graduate" to denote anyone who has completed a course of study, whether or not the person receives a degree.) In contrast, if the curriculum were irrelevant to work outcomes (or if grading were random), then the correlation would be zero. It wouldn't matter how efficiently we taught the wrong stuff, or whether we used technology to teach it three times as well. The correlation between GPA and life outcomes would still be zero.

In 1991 Pascarella and Terenzini synthesized all the research they could find bearing on higher learning. Going to college and graduating pays off in many ways, they found. Choice of major makes a difference in life outcomes. All that is good news. But while Pascarella and Terenzini discovered many studies finding a tiny positive correlation between grades and work achievement after graduation, the correlation is so small (about 1-2% of the total variation) as to be meaningless for the individual student.

Why do grades not predict how well our graduates perform? Is it because we are not even trying to teach them certain knowledge, skills and wisdom that they need? Or does the problem lie in the way that faculty assess learning?

Are Students Being Taught the Right Stuff?

One possibility is that the curriculum is failing to focus on the knowledge, skills and wisdom that graduates need. For example, some studies of GPA and work outcomes focus just on MBA graduates and their success in their first jobs (e.g., starting salaries, likelihood of promotion, etc.). Findings about MBA graduates by Crooks and by Livingston are consistent with Pascarella and Terenzini's: little relationship between GPAs for business school grads and their work achievement.

Perhaps the reason for the tiny relationship is that there are important skills that the curriculum fails to teach or reward. That's the implicit message of *The Competent Manager* by Richard Boyatzis, a classic work published in 1982. The volume summarizes many empirical studies of the cognitive skills of effective managers. Each study compared the patterns of thinking of superlative managers to those of average managers.

Boyatzis found that the cognitive skills of highly successful managers didn't seem to bear much relationship to what business schools were teaching. For example, one of the key skills is the ability to shape and achieve goals by working through coalitions of peers. The habits of thought and action needed to be a good coalition builder need to be developed over many courses and extracurricular activities. Do today's business schools do that, so much so that their highest GPAs are usually earned by students who are best at organizing teams?

Boyatzis' findings have broader significance. Skills of working with people and in organizations are important for just about every graduate, not just business school types. Most forms of work, citizenship and even family life require such skills, knowledge and wisdom.

If you study your own graduates and find that there is no apparent difference in the fate of those who got A's and those who got C's. Perhaps it is because your program is not teaching the right stuff.

Or Is Grading the Problem?

A second way to account for Pascarella and Terenzini's finding is to infer that grading is irrational. Let's assume that most faculty members have no idea what their students think or have learned. By this argument, the students who learn the most may be as likely to get a C as an A. One of the most devastating studies in support of that notion is embodied in a video. "A Private Universe" opens in Harvard Yard during Commencement in the late 1980s. Twenty-two graduating seniors, faculty and alumni were asked one of two questions, "Why is it warmer in the summer than in the winter?" or "Why does the moon seem to have a different shape each night?" Only two of them answered their question correctly. Yet they should have learned about both these phenomena repeatedly while still in school.

The scene then shifts to a good high school nearby. We see ninth graders answering those same two questions incorrectly in the same ways the Harvard seniors did. The ninth graders are interviewed before they're taught the material that year, and then again right afterward. The instruction looks good. But the teacher does not seem to be learning anything about what students believe about these phenomena, despite the fact that she repeatedly asks them canned questions and gets canned answers back. The videotaped interviews show that the students' preexisting theories remained invisible to the teacher, and often untouched by instruction.

"A Private Universe" is not the only study that shows that students can get A's without truly understanding the material or being able to apply it. When faculty don't understand what students believe, know and can do, they are unlikely to teach or to grade appropriately.

So we have two pieces of bad news. We're probably failing to teach the right stuff but even if we were trying to teach the right stuff, many instructors wouldn't notice whether their students were learning it or not.

I'm not suggesting that we rush out and faddishly transform our curricula. But I do believe that most institutions of higher education are facing a Triple Challenge of outcomes, accessibility, and costs. If not now then in the next few years they will find it increasingly difficult to offer a modern, effective academic program that reaches and retains the students they should be serving for a price that those students and their benefactors can afford. For many institutions, these three issues of outcomes, accessibility, and costs pose real threats to their reputation and well-being.

I see no evidence that most institutions will be able to meet this Triple Challenge without substantial use of computers, video and telecommunication. (In fact this Triple Challenge is one reason why technology has been rising to the top of budgets and presidential agendas for the last few years. One can no longer afford to ignore technology and still maintain institutional health.) However, if we rush out and buy new technologies without first asking hard questions about appropriate educational goals, the results are likely to be disappointing and wasteful.

3. THE MEDIUM ISN'T THE MESSAGE

Several decades ago, as educators began to think seriously about using the new technology of the day for teaching, you'd hear things like "Television will ruin learning" and "Computers will revolutionize instruction." (Twenty-five hundred years earlier in Greece you'd have heard the same debate about the written word and its impact on dialogue-based education.) In other words they were asking whether a technology could teach without specifying anything about the teaching methods involved.

Richard Clark responded to that type of assertion by arguing, in effect, that the medium is not the message. Communications media and other technologies are so flexible that they do not dictate methods of teaching and learning. All the benefits attributed by previous research to "computers" or "video," Clark asserted, could be explained by the teaching methods they supported. Research, Clark said, should focus on specific teaching-learning methods, not on questions of media.

Clark's studies provoked a blaze of responses because he seemed to be saying that technology was irrelevant. A good set of these attacks, with rejoinders by Clark, can be found in two recent issues of *Educational Technology Research and Development*, cited in the reading list at the close of this essay. Robert Kozma argues, for example, that any particular technology is not irrelevant. Any particular technology may be well or poorly suited to support a specific teaching-learning method. There may indeed be a choice of technologies for carrying out a particular teaching task, he argues, but it isn't necessarily a large choice. There are several tools that can be used to turn a screw, but most tools can't do it, and some that can are better for the job than others. Kozma suggests that we do research on which technologies are best for supporting the best methods of teaching and learning.

I agree with both of them. Clark's message is the more important, however. Too many observers assume that if they know what the "hardware" is (computers, seminar rooms), they know whether student learning will occur. They assume that if faculty get this hardware, they easily, automatically and quickly change their teaching tactics and course materials to take advantage of it. Thus technology budgets usually include almost no money for helping faculty and staff upgrade the instructional programs.

As for useful research, we have both the Clark and the Kozma agendas before us: 1) to study which teaching learning strategies are best (especially those that would not even be feasible without the newer technologies) and 2) to study which technologies are best for supporting those strategies.

4. COMPUTER BASED TUTORIALS ARE VALUABLE BUT...

At this point it may seem like all the research and evaluation are useless.

It's time to turn to some questions that have yielded important information.

Since the 1960s the popular image of the computer revolution has rested on individualized computer-assisted instruction. This type of software teaches by offering some text or multimedia instruction, asking the student questions, and providing feedback and new instructional material based on the student's answers. Each student moves through the materials in a different way, and at a different rate.

James Kulik and his colleagues at the University of Michigan have summarized the vast research about such software. They reanalyzed data from large numbers of small studies in order to draw more general conclusions. Their basic finding: this method results in a substantial improvement in learning outcomes and speed, perhaps around 20% or more on average. Such instruction works best, of course, in content areas where the computer can tell the difference between a student's right answer and wrong answer, e.g., in mathematics or grammar exercises. *Few other teaching methods have demonstrated such consistently strong results as this type of self-paced instruction.*

The news is not all good, however.

Studies such as those analyzed by Kulik and his colleagues have focused purely on the educational value of software, not on factors influencing its viability. Unfortunately, even the best computer assisted instruction of this type has often not found a substantial number of users in higher education. Software intended for educational use often fades away, its revolutionary promise unfulfilled.

A group of us led by Paul Morris created a casebook that analyzed twenty pieces of software developed in the 1980s and early 1990s. These software packages had already demonstrated not only *value* (educational power, as evidenced by evaluations and awards) but also *viability* (extensive use over many years). If software is not widely used by many faculty over many years, it is unlikely to foster lasting, national improvement in the way one or more courses are taught. We wanted to understand why a few software packages had proven viable, while so many others were not.

Perhaps our most important finding was that it usually takes years for curricular software to be developed and then to become widely accepted. There are many reasons for this. Support services are often under-funded, so faculty couldn't be certain that the basic hardware and software would be consistently available and in working order. Changing a course involves shifts to unfamiliar materials, creation of new types of assignments, and inventing new ways to assess student learning. It's almost impossible for an isolated faculty member to find the time and resources to do all these things, and to take all these risks. Few institutions provide the resources and rewards for faculty to take such risks. For these and other reasons, the pace of curricular change is slow.

The more revolutionary the software, the longer and more arduous was the task of getting a critical mass of users. For large pieces of curricular software, the journey from conception to wide use might take ten years or more.

Unfortunately, long before most curricular software found such wide use, computer operating systems and interfaces had changed. Instead of looking revolutionary, the software began looking obsolete. Use, instead of growing, began to decline. The lack of obvious returns discouraged funders and publishers from investing in the creation of version 2.0. The original developers had often lost interest, too. Faculty knew that making uninteresting upgrades would win them few rewards. Thus many valuable curricular software packages died without ever fulfilling their promise.

We did find a few small families of curricular software that found a niche. However many of these packages gained use because they were inexpensive to develop (and thus inexpensive to update regularly) and familiar. They got into use by comfortable, not by making instructional waves. Hardly the stuff of revolution.

That doesn't mean that software isn't used for learning. Ironically, while software designed for learning has had a hard time finding a postsecondary market, most software used for learning was *not* designed for that purpose.

5. SOFTWARE THAT ISN'T DESIGNED FOR INSTRUCTION CAN BE GOOD FOR LEARNING

"Worldware" is the name we gave such software. Worldware is developed for purposes other than instruction but is also used for teaching and learning. Word processors are worldware. So are computer-aided design packages. So are electronic mail and the Internet.

Worldware packages are educationally *valuable* because they enable several important facets of instructional improvement. For example on-line libraries and molecular modeling software can support experiential learning. Electronic mail, conferencing systems and voice mail can support collaborative learning by non-residential students.

Worldware packages are *viable* for many reasons. They are in instructional demand because students know they need to learn to use them and to think with them. Faculty already are familiar with them from their own work. Vendors have a large enough market to earn the money for continual upgrades and relatively good product support. New versions of worldware are usually compatible with old files. Thus faculty can gradually update and transform their courses, year after year, without last year's assignment becoming obsolete.

For reasons like these worldware has often proven to have great educational potential (value) and wide use for a long period of time (viability).

Has that educational potential been realized in improved learning outcomes? There is no substitute for each faculty member asking that question about his or her own students. Here are two such studies.

Karen Smith pioneered what is now an increasingly common application of electronic mail -- as an important element in teaching foreign languages. Students of Spanish at the University of Arizona were told to write to one another using a form of electronic mail called computer conferencing. The faculty suggested some topics, e.g., the film the class had just seen, reviews for upcoming quizzes. Other topics came from the learners, e.g., an upcoming party and one student's existential angst. Some of these e-mail conversations were private. Conversation in the public conferences was graded but only for fluency of expression, not for content or grammar.

I met the first cohort of students taking this course. I've never seen a group, before or since, so excited about their course's use of technology. In part they were pleased because computer conferencing was more accessible than a language lab; they could participate from any computer at any time. More important, as several put it, "I'm *using* Spanish for the first time." And they didn't need to feel self-conscious about speaking quickly or with a good accent. All they needed to do was take the time to interpret what had been said (i.e., written) to them and then decide how to express their replies.

Surprisingly Smith's study showed that, relative to a class taught using a traditional language laboratory, the *oral* performance of these students excelled. In the slower paced, more anonymous world of the computer conference, they were "speaking" Spanish with a purpose, and learning to express themselves. The evaluation proved that worldware had been used in a way that opened a new dimension of learning for these students.

Another of my favorite evaluations of teaching tactics was never published. The faculty member was simply interested in seeing whether his use of technology was improving his student's learning. Bob Gross, a professor of Biology at Dartmouth College, was an early user of personal computers to create animations. In the late 1980s, he became impatient about a bottleneck in his teaching. It was taking him two class hours to teach about a complex series of interactions in biochemistry -- "48 blackboards worth" as he put it. He would draw the molecules, talk, erase some, draw some, and talk some more. Gross wanted to speed up the process and make it more effective. In several weeks of work with an undergraduate student, he used worldware to create an animation that enabled him to teach the same material in half an hour. The students could also study the computer-based animation outside class, frame by frame if need be. "I was initially disappointed," he told me the day I visited him at Dartmouth, some months afterward. "There was very little excitement or discussion when I showed it in class. But later, when I gave them my regular exam on the subject, they did better than any previous class."

These two studies show that each faculty member can do his or her own research, asking the kinds of questions about what students are learning. That's what Schneps and others have shown is so important: know thy own students and what they are learning. Without asking hard questions about learning, technology remains an unguided missile.

6. STRATEGIES MATTER MOST

Studies by individual faculty of their own students and their own teaching methods and resources are necessary. But such studies are not enough.

I suggest the following hypothesis:

> Education can affect the lives of its graduates when they have mastered large, coherent bodies of knowledge, skill and wisdom. Such coherent patterns of learning usually must accumulate over a series of courses and extracurricular experience.
>
> **Thus, to make visible improvements in learning outcomes using technology, use that technology to enable large scale changes in the methods and resources of learning. That usually requires hardware and software that faculty and students use repeatedly, with increasing sophistication and power.** Single pieces of software, used for only a few hours, are unlikely to have much affect on graduates' lives or the cost-effectiveness of education (unless that single piece of software is somehow used to foster a much larger pattern of improved teaching).

Thus far few educators, evaluators and researchers have paid much attention to educational strategies for using technologies. Too often they've been victims of "rapture of the technologies." Mesmerized, they focus on individual pieces of software and hardware, individual assignments and, occasionally, to individual courses. [Enrolling more adult learners has been a more powerful motive to change strategies, and to study those strategies. For a fine strategic evaluation of seven institutional projects to transform whole degree programs, I suggest Markwood and Johnstone's study, *New Pathways to a Degree: Technology Opens the College.]*

Few educators are thinking much about educational strategies for using technology to improve learning outcomes. Does that mean we're not employing such strategies yet? Quite the contrary. Here's an example.

Back in 1987 Raymond J. Lewis and I were looking for faculty members who had had at least two years of teaching in an environment where students had unfettered access to personal computing.

One place we visited was Reed College in Portland, Oregon, where the current seniors had had four years of easy access to Macintosh computers. I talked to faculty members from eight departments, asking what they liked about teaching in this environment.

Surprisingly, there was one thing that all of them had noticed. As two of them put it, "I'm no longer embarrassed to ask the student to do it over again." Because computer-based documents and projects are mechanically easier to revise, their students pressed to get a second chance to improve their work and their grade. Gradually the texture of the curriculum in each course was changing: toward projects developed in stages -- plan, draft, conversation, another draft, final version. Each stage of work was marked by rethinking, and by learning. We called this strategy "Doing It Again, Thoughtfully (DIATing)."

I also talked asked a couple of seniors if they thought their education had been influenced by their use of computers. One of them replied that he'd learned that it's not one's first draft or thought that matters, but the final version. In what course had he learned that, I asked. He replied that it had been over a series of courses. Similarly, several faculty members and the director of the writing program independently suggested that the most tangible impact of computer availability would be at the capstone of the curriculum, in the intellectual tightness and coherence of bachelor's theses.

The day at Reed had a surprise ending. When Ray and I sat down with several of the College's educational and technology leaders, they were astonished by what we'd heard that day. The growth of DIATing had been an ecological change, not directed centrally. They hadn't known that their technology was being used in that way or with those kinds of outcomes. That's because their institutional strategy was the sum of large numbers of independent actions by many faculty members and students across the college.

From this story (and my other experiences with educational uses of information technology). I'd suggest three lessons:

1) Technology can enable important changes in curriculum, even when it has no curricular content itself. Worldware can be used, for example, to provoke active learning through work on complex projects, rethinking of assumptions, and discussion.
2) What matters most are educational *strategies* for using technology, strategies that can influence the student's total course of study.
3) If such strategies emerge from independent choices made by faculty members and students, the cumulative effect can be significant and yet still remain invisible. (Unfortunately, the converse can also be true. We may be convinced that we have implemented a new strategy of teaching across the curriculum, and yet be kidding ourselves.) As usual, there is no substitute for opening our eyes and looking.

7. Tools for Evaluating Strategy: The Flashlight Project

Ordinarily what matters most is:

- not the technology *per se* but how it is used,
- not so much what happens in the moments when the student is using the technology, but more how those uses promote larger improvements in the fabric of the student's education, and
- not so much what we can discover about the average truth for education at all institutions but more what we can learn about our own degree programs and our own students.

How can departments and institutions study their educational *strategies* for using technologies? A faculty can't do this alone by looking at just one course. As we saw in the DIATing example from Reed, a strategy is a pattern of teaching and learning that extends over many courses. Only a college, university or department has the range of responsibility and resources to study strategy.

The Annenberg/CPB Project is taking some steps to make it easier for educators to obey the commandment "Know thy students and what they are learning." January 1995 saw the birth of the Flashlight Project. It's a three year effort to develop and share evaluation procedures. Colleges and universities will be able to use these procedures to assess their educational strategies for using technology. We're working with the Western Interstate Commission on Higher Education (WICHE), Indiana University Purdue University at Indianapolis (IUPUI). IUPUI, the University of Maine at Augusta, the Maricopa Community Colleges, the Rochester Institute of Technology, and Washington State University will test the new procedures.

In a previous planning phase, supported by the Fund for the Improvement of Postsecondary Education (FIPSE), our group identified the educational strategies that their institutions most needed to study. Developing good evaluation procedures is expensive. We wanted our procedures to be widely used and important, so we focused them on educational strategies for using technology that are widely used and important.

The chosen educational strategies include:

- project-based learning in an information-rich, tool-rich environment;
- collaborative learning when communication can be synchronous and asynchronous;
- learning at paces and times of student's choosing;
- learning marked by continuous improvement of a piece of work; and
- improved student-faculty and student-student interaction, and enhanced feedback.

Now Flashlight is developing procedures that institutions can use to monitor the evolution, successes and failures of those strategies locally. Flashlight outcomes measures will focus on graduates' capabilities, changing patterns of enrollment and retention, and the influence of changes in education on total patterns of costs.

As its name indicates, Flashlight's evaluative procedures will not answer all questions that an institution might have. Nor will it be easy or inexpensive to ask these evaluative questions. We do hope that the answers will prove unusually useful for transforming teaching and setting policy.

If you would like to follow the development of the Flashlight Project over the next several years, there is a new listserv on which we discuss project progress and strategy. We invite questions about evaluation and suggestions about where Flashlight should go. The way to subscribe is to address an Internet message to LISTSERV@WSUVM1.CSC.WSU.EDU with the one line message SUBSCRIBE F-LIGHT yourfirstname yourlastname

Another way to engage in a more general discussion with almost 2000 other educators interested in issues of technology, teaching and learning is to sign on to the American Association of Higher Education's listserv on technology, AAHESGIT. To subscribe, address an Internet message to LISTPROC@LIST.CREN.NET with the one line message SUBSCRIBE AAHESGIT yourfirstname yourlastname

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