

Teaching And Technology:
Promising Directions for Research on
Online Learning and Distance Education in the Selective Institutions*

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Introduction

This is a time of great growth in development and deployment of instructional technologies in American colleges and universities—as well as in non-traditional enterprises in the higher education sector, including a number of for-profit ventures. It is also a time of growing awareness of both the promises and problems of instructional technology, particularly in online teaching and distance learning. For American institutions of higher education—among the selective institutions as much as among other institutions—there are difficulties and difficult choices ahead. One underlying problem is the lack of rigorous studies of these technologies, their diverse consequences, and the economic choices underlying their most fruitful uses. This paper outlines promising directions for more rigorous scholarly research and policy studies.

The outline for a research agenda presented here has three bases: an assessment of the present developments in instructional technology on the university level, and current research on the use of such technology; lessons from allied investigations pursued under a recent Mellon Foundation program; and a survey of college and university chief academic officers (at selective institutions around the US and Canada) undertaken by the author in the Spring of 2001.

I begin with an overview of the Mellon Foundation’s Cost-Effective Uses of Technology in Teaching (CEUTT) program, which has supported twenty-five evaluative studies of the use of instructional technology. I then summarize recent growth and trends in online education and distance learning, with particular attention to selective institutions—and I report on the concerns and priorities of leading colleges and universities in this area, based on the survey of chief academic officers. After considering the current state of scholarship in related areas, I close by suggesting promising directions for research in this sphere, including recommendations for social, economic, organizational, and technical investigations on the uses and development of online education and distance learning.¹

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¹ In this paper, ‘instructional technology’ refers to technologies employed in teaching and learning (and not to technologies otherwise employed for academic computing purposes); ‘online education’ refers to the use of web-based courses or course components on-campus and off-campus; and ‘distance learning’ refers to courses available off-campus. Such distance learning courses are increasingly (though by no means exclusively) offered online, and this medium of distance learning is of primary interest in the present context. While strong attention is paid to distance learning as a subject for research at various places in this paper, online education *on-campus* turns out to be a much more prominent target for important—and presently viable—research.

I. The Mellon CEUTT Studies

For almost a decade, the Andrew W. Mellon Foundation has supported development of, and research on, instructional technology in American higher education.² An important part of this work has been carried out under the auspices of the Mellon Foundation's Liberal Arts College program, culminating most recently in the proposal to help establish regional centers to assist colleges in this domain. A second significant source of funding has been the Mellon Foundation's Cost-Effective Uses of Technology in Teaching (CEUTT) program, which has supported twenty-five projects from 1996 to 2001.

The Mellon CEUTT program was motivated by the advent of internet-based technologies for instruction and the suggestion by some economists that such technologies could be fruitfully deployed to promote productivity and reduce costs in college-level teaching. Early on in the development of internet-based instructional technologies it became apparent that, while exciting new teaching tools were being created, little attention was being paid to how such tools might be designed or utilized in ways that save money. As Gil Whitaker (Senior Advisor to the Foundation and Dean of the Jones Graduate School of Management at Rice University) noted in the initial statement of purpose for the CEUTT program: "The concern here is...to discover ways to use technology in traditional university settings which can reduce costs while maintaining or increasing educational quality."³

In pursuit of this objective, the CEUTT investigations have taken the form of experiments to help determine circumstances under which cost savings—or reductions in cost growth—might be attained by using technology to enhance instruction, with no loss in (or improvement in) pedagogic outcomes. Such experiments optimally should aid efforts beyond the participating institutions to gauge whether particular approaches can be justified, by comparing their effectiveness and costs. The CEUTT program has aimed for high standards of social science research—wherever possible, the studies have employed randomized selection in controlled experiments—to find out whether use of technology is truly a causal factor in lowering instructional costs or improving learning outcomes. In each project, the same course or set of courses was taught with and without a particular use of technology. While not all studies met the most rigorous experimental standards, each focused on measures that compare instruction with the new technologies to instruction of the traditional form.

Many of the instructional technologies studied under the CEUTT program have been quite innovative. One example is a Web-based engineering tutor developed at Rice University to help guide students through design problems and monitor their performance. In this study, investigators are judging whether instructional costs are reduced by enhancing automation of the problem-set component of engineering instruction (a large element of such instruction). Another

² The first grant by the Andrew W. Mellon Foundation for instructional technology was made to Connecticut College in 1993.

³ See <http://www.ceutt.org/ceutt.html>.

example is an instructional technology developed at Georgia Tech that attempts to mimic in an online environment those elements of a traditional classroom that can promote collaborative learning. The software, called ‘CoWeb’, allows students to develop and edit webpages with minimum effort, and thereby instantly build and enhance collaborative websites which in turn provide easy-to-use forums for exchanging ideas.⁴

The general approach and target data is generally uniform across these studies. Teams of investigators expert in measuring pedagogic effectiveness and costs of teaching sought to determine cost-effectiveness ratios in order to identify tradeoffs, equilibria, and optimal states for using instructional technologies under varying circumstances. The diversity of experimental setups across different schools, disciplines, classes, and technologies should generate local lessons concerning the fit of technologies to particular classroom and campus environments, as well as general conclusions regarding productivity and cost-effectiveness.

Taken together, the CEUTT projects have helped to create a body of research studies of high caliber in an area where comparable data and scholarly rigor have been missing.⁵ Answering questions about when, if at all, and under what conditions, the use of instructional technology is cost-effective requires viable measures, robust data, and sturdy analysis.⁶ To a large degree, these objectives have been attained in the CEUTT studies.

In addition to weighing costs against pedagogic outcomes, some of the CEUTT studies have drawn attention to a number of other intriguing issues concerning the use of technology in on-campus instruction. Are students using their time any differently than they do in courses taught by traditional means? Are student or faculty attitudes towards instruction or learning shaped in new ways? How are teaching and learning changing? Are the institutions undergoing any systematic transformations, for example, in defining what constitutes a ‘course’? These issues, while peripheral to the main focus on cost-effectiveness, are important in understanding

⁴ See Appendix A for a complete list of the CEUTT projects. Further information is available on the program website (<http://www.ceutt.org>), and a monograph being co-authored by Saul Fisher (Andrew W. Mellon Foundation) and David Stern (University of California, Berkeley) will summarize results to date from the various projects.

⁵ For a critique of the previously existing body of research on costs, benefits, and effects of instructional technology, see Ronald A. Phipps and James P. Merisotis (1999), “What’s the Difference? A Review of Contemporary Research on the Effectiveness of Distance Learning in Higher Education”, The Institute for Higher Education Policy, April 1999 (<http://www.ihep.com/difference.pdf>). It is widely held that it is either not possible or else not valuable to compare learning outcomes across settings with and without the use of instructional technology (see Richard E. Clark (1994), “Media Will Never Influence Learning”, in Educational Technology Research and Development (42) 2: 21-29; and Robert Kozma (1994), “Will Media Influence Learning: Reframing the Debate”, Educational Technology Research and Development, (42) 2: 7-19). I say why these views are wrong in “Medium, Method, and Message: Why We *Can* Measure the Pedagogic Effectiveness of Instructional Technology”, Fifteenth Annual Conference on Computing and Philosophy (CAP), Carnegie Mellon University, August, 2000.

⁶ Another accomplishment has been to improve underlying measures of costs and pedagogic outcomes. Under the CEUTT program, the Andrew W. Mellon Foundation supported the development, enhancement, and refinement of instruments for assessing costs and gauging learning outcomes; these projects include the TLT Flashlight™ Cost Analysis Handbook (see <http://www.tltgroup.org/programs/fcai.html>) and the WICHE Technology Costing Methodology Project (see <http://www.wiche.edu/telecom/projects/tcm>). These traditionally weak areas of institutional research have been helped along in ways that, optimally, will be useful beyond the CEUTT projects.

the broader educational and organizational benefits or drawbacks associated with the use of instructional technology. These issues also underline the need for a broader research agenda—one that will provide academic administrators, education economists, institutional researchers, and others with empirically-supported analysis and guidance concerning the difficult choices facing higher education institutions as they try to make the most judicious uses of instructional technology.

II. Recent developments in instructional technology and distance learning in higher education

Five years after the CEUTT program was started, the need for such broad research is all the greater because new uses of instructional technology have generated “outreach” programs of unanticipated dimensions.⁷ These technologies have enabled schools to offer online education in programs that extend beyond campus walls—and even across borders—to reach new groups of students as well as alumni. Perhaps the most dramatic breaching of borders is the crossing of the nonprofit divide and the emergence of for-profit purveyors of distance education through the Internet. It is easy to overstate what may happen within traditional higher education institutions, and easier still to overestimate what changes have been wrought so far. This is because there have been, to date, few sensible, calm, or carefully researched assessments of the new and transforming landscape. While a thorough assessment is beyond the scope of this paper, what follows is a brief review of trademark characteristics of higher education in an age of online instruction.

The same family of technological developments that has driven experimentation in the classroom over the last decade has now brought worlds of changes, actual and possible, to the higher education sector as a whole. To grasp these different sorts of changes, it is useful to map out ways in which old and new institutions in higher education have proposed to make use of instructional technologies:

Old institutions pursuing traditional goals, but differently

At a minimum, the online medium presents a new mode of delivering instruction of a traditional character. Such traditional teaching materials and presentations may only need to be slightly altered to be offered over the Internet. Three prominent examples of such programs among selective institutions are Stanford University’s online masters degree in electrical engineering (see <http://scpd.stanford.edu/ce/telecom/onlinedegree.html>), Penn’s PennAdvance program (see <http://www.advance.upenn.edu>), and the Duke University Fuqua School of Business’s Global Executive MBA—of which over 80 percent of the meeting time is online (see <http://www.fuqua.duke.edu/admin/gemba>). The Stanford program replicates the pre-existing traditionally-taught program, the Penn program features online courses that correspond to identical general studies offerings, and the Duke program is closely modeled on the pre-existing Executive MBA program, with an increased emphasis on international business. In each case, courses have been ported over to the Internet with few or no innovations in curriculum or pedagogy.

⁷ Even the baseline for on-campus uses of instructional technology has changed. Whereas course webpages with syllabi, class requirements, and associated readings were novelties some five years ago, at present they are commonplace and even required by some institutions.

Old institutions pursuing new goals

Other sorts of programs pursued by traditional schools depart more dramatically from the usual organization or curriculum of elite higher education—though in some cases, these same schools also are pursuing more traditional goals through online education. A common feature of these programs is their orientation towards continuing education, either for members of the existing communities associated with those schools, or for new audiences. For example, Princeton, Stanford, Yale, and Oxford joined together in the Fall of 2000 to form the “University Alliance for Life-Long Learning”, which is designed to offer courses for enhancement or for credit to alumni⁸ and possibly other interested non-matriculating students. The novelty and strength of the Alliance plan consists in the creation of a continuing education program that draws on the teaching and curricular assets of four renowned institutions. A more conventional approach, limited to a single school, is being pursued by Columbia University, which offers online courses in IT training and business writing through its Columbia Interactive Arts and Sciences program (<http://www.as.columbia.edu>). While these courses are only available in professional and technical fields at present, Columbia plans on expanding into more mainstream disciplines in the arts and sciences. The audience will continue, however, to be non-matriculants.⁹

New institutions pursuing traditional goals

Perhaps one of the most unexpected consequences of the dramatic growth of online instruction has been the emergence of new schools and other ventures that are run as for-profit enterprises. Some of the prominent new institutions include the University of Phoenix Online (<http://online.phoenix.edu>), Cardean University (a division of UNext) (<http://www.cardean.edu>), and GEN, or General Education Network (<http://www.gen.com>). Each of these ventures offers courses delivered across the web that meet traditional curricular and pedagogic standards and are intended for matriculants, either within the context of the online school or else towards credit that might be granted by a student’s host institution. The University of Phoenix Online—like the brick-and-mortar University of Phoenix—aims its programs at non-traditional students who are typically adult learners and full-time employees; the courses tend to be in professional areas, with a strong focus on business courses. Cardean University courses have been designed by faculty from the University of Chicago, Carnegie Mellon University, Stanford University, LSE, and the Columbia Business School, under contract with UNext. Its business courses and degrees are marketed to individuals and businesses, with the aim of capturing the market for high-end

⁸ Ira Fuchs (Andrew W. Mellon Foundation) has suggested that such online courses for alumni serve as ‘maintenance contracts’ on traditional undergraduate degrees.

⁹ A different sort of novel effort by traditional schools is the establishment of international consortia. Thus, MIT is pursuing a collaboration with two Singaporean schools in the MIT-Singapore Alliance (<http://web.mit.edu/sma>), and some eighteen universities around the world are participating in a consortium called Universitas 21 (<http://www.universitas.edu.au>), which is working with Thomson Publishing to create an entity offering online courses.

professional enhancement courses offered by companies to their employees.¹⁰ GEN is tackling what is often considered a difficult area for development or deployment in online education—liberal arts courses. It hopes to attract an audience that includes continuing education and current undergraduate students, the latter taking GEN courses as convenient supplements to their on-campus course loads, or as a means of studying with particular professors of renown.

Each of these institutions ostensibly competes directly with traditional higher education institutions. GEN is unusual, however, in that it intends to offer high quality courses in traditional subjects for undergraduate credit. Most ventures of the sort represented by the University of Phoenix Online or Cardean are focused instead on curricular offerings intended to attract student populations for whom the ‘classic’ university or college education in a standard setting is an unlikely option. These target populations include single mothers, nighttime and weekend students, and members of rural or even suburban communities underserved by existing nonprofit schools.¹¹ Whatever their various curricula, what joins *all* these institutions is their attempts to provide at least some traditional educational offerings through the new technologies and with the goal of meeting a bottom line.¹²

Several traditional institutions have given birth to for-profit subsidiaries charged with delivering courses typical to continuing education programs—these are hybrids, in a sense, of old and new institutions. Such hybrids include e-Cornell (<http://www.ecornell.com>) and NYUonline (<http://www.nyuonline.com>), which offer executive and professional education in fields that correspond to established strengths of their respective institutions (management and finance at NYU, and hotel management and labor relations at Cornell). These spin-offs leverage the brand name of the parent schools yet feature a flexibility and ability to raise capital that are characteristic of for-profit ventures.¹³

¹⁰ UNext also offers mini-courses without credit and not towards the MBA granted by Cardean. See Sarah Carr, “Rich in Cash and Prestige, UNext Struggles in Its Search for Sales”, *The Chronicle of Higher Education*, A33, May 4, 2001, <http://chronicle.com/free/v47/i34/34a03301.htm>.

¹¹ Other non-traditional student populations—less sought after by online education ventures but representing great numbers of potential learners—include the handicapped and retirees.

¹² A common suggestion regarding these new competitors in the higher education marketplace is that the market share of traditional institutions may be threatened by nimble for-profit distance learning institutions that unbundle and discard the unprofitable elements of university-level instruction. See David Collis, “When Industries Change: Scenarios for Higher Education”, 47-70, in Maureen E. Devlin and Joel W. Meyerson, (eds.), *Forum Strategy Series, Forum Futures: 1999 Papers*, vol. 2. Forum Publishing: Washington, DC, 1999, http://emcc.mit.edu/forum/pdf/1999_book/collis99book.pdf; and Lloyd Armstrong, “Distance Learning: An Academic Leader’s Perspective on a Disruptive Product”, *Change* 32 (2000) 6: 20-27, and “A New Game in Town: Competitive Higher Education”, unpublished manuscript. Armstrong suggests that distance learning institutions will be most competitive when they challenge the integrated functions of traditional institutions—teaching, research, and social community—and offer teaching alone at high enough quality to make the other functions look superfluous and not worth the price of tuition (he cites the UK Open University in this regard). The response to such a challenge, he suggests, is to strengthen those traditional functions and their integration, and so offer education that continues to represent a clear advantage for the ‘education consumer’, the potential student.

¹³ With the recent collapse of the dot-com market, there have been doubts cast on the ability of the new for-profits to survive, much less pose a challenge to traditional institutions (see Ann Grimes, “The Hope...and the Reality”, *The Wall Street Journal*, Special Report on E-Commerce: Pass or Fail, March 12, 2001, <http://interactive.wsj.com/public/current/articles/SB984067378945390493.htm>). Yet some observers also suggest

New institutions pursuing new goals

The riskiest new ventures in online distance education are those trying to use the new digital media to invent or extend novel concepts of post-secondary education, particularly with respect to pedagogy or curriculum. By doing so, they hope to capture the attention of new student audiences, or compete with existing institutions through their new ‘product lines’. Two such ventures are Fathom (<http://www.fathom.com>)—a for-profit—and Western Governors University (<http://www.wgu.edu>)—a nonprofit. The primary partner in Fathom is Columbia University which, along with some ten institutional partners, is creating a wide range of mini-courses for delivery to non-matriculating students and alumni, with the goal of selling continuing education directly as well as acting as an online clearinghouse for other distance education courses provided by other institutions (for which Fathom receives a percentage of tuition revenues).¹⁴ Fathom’s educational services are aimed at a post-secondary audience but in bits and pieces that are perhaps most analogous to alumni courses offered at some traditional institutions in ‘Deans Day’ or ‘Alumni College’ formats. Western Governors University (WGU) is more radical still—the institution proposes to do away with credit-based curricular structures, and substitute competency-based degrees. Students who succeed at competency tests—either on the basis of course materials delivered over the web, or without having reviewed such materials—are eligible to pass through a series of gateways until they are judged fit to be awarded a degree or certificate. This sort of curricular structure is not a new invention. Rather, WGU intends to model web-based instruction on the ways training is done in the information technology field, where competency-based certificates are common in the commercial model (as, for example, in the certificates offered by Microsoft or Novell). Such new ventures as Fathom or WGU represent competition for traditional institutions, even though their competitive strategies may not be as clear as those of the new institutions offering educational services of a more familiar stripe. In dividing up traditional course offerings or changing the well-worn rules for acquiring degrees, the new experimental online institutions treat potential students as consumers with a wide variety of needs and preferences regarding the ways to obtain post-secondary education. If these institutions discover a popular ‘formula’, they stand to capture significant numbers of customers.

that, in the technology sector of the economy, the education-oriented firms are most likely to survive recent downturns (see Anne Marie Borrego and Goldie Blumenstyk, “As Wall Street Took a Dive, Higher-Education Stocks Rebounded”, *Chronicle of Higher Education*, May 11, 2001, <http://chronicle.com/free/v47/i35/35a03201.htm>, and Amey Stone, “Education Stocks Are Getting A's Again”, *Business Week*, September 26, 2000, http://www.businessweek.com/bwdaily/dnflash/sep2000/nf20000926_247.htm). In any event, for-profit institutions are hardly new in higher education (the ‘offline’ University of Phoenix was founded in 1976); what is novel is their greatly increased ability to reach large numbers of students with tremendous efficiency through technological means. Careful entry into the online market has rewarded the University of Phoenix, to cite that one particularly successful example, with strong enrollments and profitable returns (see Jennifer Rewick, “Off Campus”, *The Wall Street Journal*, Special Report on E-Commerce: Pass or Fail, March 12, 2001; <http://interactive.wsj.com/public/current/articles/SB984068778432368823.htm>).

¹⁴ The University of Washington has also created a portal for entry to distance learning courses, which is a nonprofit and features only institutions that are AAU members and are classified as ‘Research One’ under the old Carnegie classification; see <http://www.r1edu.org>.

A striking fact about the technologies used across these very different structures is that they are all more or less the same—web-based courses and school portals, databases designed to accommodate assessment, records, and other administrative purposes, email, electronic versions of traditional libraries, and repositories of electronic scholarly and teaching resources. What is distinctive about each is how such technologies have been thought to open up new possible avenues of instruction, promote traditional or innovative teaching missions, capture new student audiences, or sustain longer-term relations with existing and former students. In short, old and new institutions alike have experimented with the ways technology-enhanced instruction can lessen the importance of prior constraints (generally of a physical nature) on all dimensions of traditional teaching, from course structure to enrollment.

A further unifying feature of this diverse new landscape is an overall change in the dynamics of learning and teaching among peer institutions. Previously, individual schools delivered instruction in ‘monadic’ fashion, with near zero commerce among themselves. The new landscape holds the potential of throwing out this old model and encouraging widespread exchange of services, rendering individual schools either net importers or exporters of instructional services. Thus, with their great depth and breadth, Penn or Michigan might be likely net exporters of instruction, whereas neighboring community colleges would probably be net importers. If breadth of offerings is a criterion, though, excellent liberal arts colleges (LACs) could be net importers too. This assumes, however, that such colleges would participate in the broadest available market for educational services, and this assumption may be ill founded.

How are selective schools affected by these new developments? This overview suggests that the new departures in online instruction and distance education have the most dramatic impact no closer than the periphery of elite higher education in America. The new schools created to deliver instruction by digital means are generally associated with service-oriented institutions or else aimed at attracting the students who might otherwise attend such institutions rather than elite colleges and universities. While some selective schools have ventured into technology-enhanced distance education, most of their efforts have been directed towards continuing education, professional enhancement, and alumni courses. Yet there is, at the same time, a great deal of development and deployment of online instruction *on-campus* at the selective schools. Hence one may ask whether the profusion of distance learning experiments raises significant issues for the selective schools—and, if so, how?

There are at least three broad ways in which distance learning through online instruction can have an important impact on the selective schools:

1. *Brand concerns.* The selective schools carry an historically dormant asset in their high quality brands—their names are popularly recognized as standing for excellence in education. In an environment marked by the promise (or threat) of competition, such brands have increased value simply because they are very familiar as compared with those of newer, less-known institutions. With this increased value comes the need to protect the brand, not only as a matter of intellectual property concerns, but in terms of insuring that any instructional services offered in a distance learning context meet the standards widely associated with the brand. Selective schools must compete well in distance learning—and with obvious attention to their reputation—if they are to compete at all.

2. *Special opportunities.* Distance learning provides selective institutions with a range of innovative and useful opportunities. A few examples: new technologies allow instruction to be delivered to underserved student populations, including overseas matriculants; smaller schools with particular scholarly strengths can pool their expertise; and outreach programs for local communities and alumni can be scaled up dramatically.
3. *Breakdown of the campus-distance gap.* For certain sorts of institutions, including research universities and community colleges, there is starting to be a breakdown of the gap between distance education and on-campus instruction. For LACs, on the other hand, this gap still exists, and is likely to persist, because they are centered on residential life as a framework for defining a scholarly community. These institutions generally do not offer distance education. Moreover, most have no plans for it, either.

III. Concerns and priorities regarding online education and distance learning:
institutional perspectives among the selective schools

To find out more about such issues and establish finer points from the perspective of higher education institutions, the author surveyed the chief academic officers (Provosts and Vice Presidents of Academic Affairs) of several dozen research universities, selective liberal arts colleges, and a select group of Historically Black Colleges and Universities (HBCUs). The survey asks a set of questions designed to identify concerns, priorities, and attitudes regarding instructional technology, online education, and distance learning. The survey was informal and respondents were advised that their answers would be reported without direct attribution, in order to generate a large number of responses and elicit their candid and considered answers.¹⁵

Three general remarks are in order.

First, some respondents are reluctant to see too great a difference between the online and in-class worlds, suggesting that the same questions we have about online instruction should be asked about instruction through any medium: does it work, how can we assess it, is teaching in a given way appropriate for a given discipline, and so forth. These parallels are undoubtedly important; yet, as other respondents note, the special character of online education lends a novel aspect to some old questions and introduces wholly distinctive issues in other instances. For example, traditional face-to-face instructors have made attempts to incorporate collaborative learning techniques for the better part of three decades; however, proponents of online

¹⁵ Some one hundred surveys were sent out, of which approximately sixty-five were returned. Considering that no incentive was provided and that chief academic officers are very busy people, this was not a bad response rate. Perhaps half the respondents explicitly drew upon the assistance of their technology officers or staff. This may have increased their familiarity with these issues, and indeed this set of responses best reflected the current state of knowledge in the field. On the other hand, some of the most provocative and intriguing responses came from respondents who apparently answered the questions on their own. This is perhaps because they did not rely upon orthodoxies common to the field of instructional technology. (See Appendix B for a further listing of speculations and attitudes.)

instruction report phenomenal increases in teachers’ abilities to facilitate student collaboration, unmatched in face-to-face instruction.¹⁶

Second, despite the fact that no one really knows as yet which, if any, of the new educational ventures will succeed, distance learning presents significant issues for a number of selective institutions. If the successes of other ‘click-and-mortar’ businesses (traditional businesses with e-commerce divisions) are any guide, then online ventures associated with traditional educational institutions may continue to prosper, though not necessarily at, or for, a profit. Such uses of technology may help to reshape higher education even without the e-commerce component. In the meantime, though, as a number of survey respondents indicated, the e-commerce questions are pressing. Those respondents see the possibility of some schools succeeding at commercial distance learning in the present market, despite recent downturns—perhaps because of a putative correlation between a weak economy and rising enrollments.

Third, the responses broadly indicate that for every apparent answer or solution in this new domain, at least one further question is raised—and often there are many. Thus, if the evidence suggests that new commercial distance learning ventures pose a competitive threat to existing institutions, several natural questions follow: What sort of competition might they introduce? What are likely results of such competition? What should traditional institutions do to plan for such competition? This expanding set of questions is consistent with the survey respondents’ general tendency to express concerns rather than priorities or opportunities when asked about instructional technology. All of this may suggest unease—or at least uncertainty—about a strange new world that lies ahead.¹⁷ With an abundance of unanswered and open questions, one may expect that any thought-out research agenda in this area should be rich and diverse.

A. Concerns.

Concerns about online education and distance learning may be divided into six broad categories: (1) sustaining quality, mission, and market position; (2) finance and economics; (3) faculty and governance issues; (4) IP issues; (5) equity and access issues; and (6) student issues.

(1) Sustaining quality, mission, and market position

The leading question posed by most institutions is how quality is to be maintained in the online world. This question speaks directly to the character of these schools as selective institutions—how can online education and distance learning challenge and engage students in the ways or at least to the degree that they are challenged and engaged by first-class scholars teaching in traditional modes? Sustaining quality is a goal that first must be translated into the many marks of excellent education, for which ways of attaining those marks in an online environment must then be spelled out. There are potential bumps all along this road. Thus, one

¹⁶ See, for example, P. Dillenbourg (ed.), Collaborative Learning: Cognitive and Computational Approaches. Oxford: Pergamon, 1999.

¹⁷ Alternatively, it may simply be an instance of familiarity with new situations in academe breeding worry!

respondent allowed that written communication skills might be taught online yet wondered how oral skills might be dealt with at all. Several respondents worried that online learning communities—well regarded for fostering certain sorts of discussion—nonetheless left behind aspects of face-to-face learning.¹⁸ Even darker fears were expressed that technologies for facilitating online learning might produce undesirable learning styles, or become ends in themselves instead of serving the goals of instruction. To insure that quality is maintained, it is necessary to gauge such changes as online teaching may bring about, and numerous respondents were concerned that it is not well understood how to evaluate and assess any improvement or decline in learning that takes place.

A connected theme is sustaining educational missions and values in online education. Instruction on the internet may provide efficient access to expert knowledge in the arts and sciences. It is less clearly a suitable medium for fostering critical thinking, promoting receptivity to new ideas, stimulating exploration, discovery, and creation, or encouraging values that are most effectively communicated in person, such as respect for other people’s views, responsibility, leadership, and service to society. These are the special charges of residential schools, and numerous respondents doubted that they could be fully discharged in online environments. As a result, many LACs do not anticipate dedicating significant resources to this mode of teaching, and several other selective institutions are waiting to see how others fare in their online projects.

Such hesitation may represent a sound strategy. In an expanding marketplace, holding close to time-honored missions and sustaining quality in a traditional teaching framework may be a crucial way to maintain a competitive advantage against the new ventures and their non-traditional ways. Nonetheless, a number of institutions are choosing to vie (directly or otherwise) with the new ventures, and this raises the question as to what initiatives in distance learning are appropriate for a given institution. This question is all the more pressing given limited resources, and any good answer requires identifying the market’s boundaries as they relate to the institution—what students can the school hope to attract? Responses to the survey note that LACs have little commerce with non-traditional populations—and accordingly, they have few anxieties about having their traditional clientele siphoned off. On the other hand, research universities with continuing education divisions face direct competition from some new distance learning companies. Under such circumstances, it is critical that traditional institutions determine the value they add to their own offerings of courses also offered via distance learning by some other institution. If it turns out that there is no added value, the schools may even see benefits to ceding that element of their curricular offerings to outside parties (as a sort of ‘outsourcing’).¹⁹ A further and related concern, then, is whether there should be competition or partnership with for-profit enterprises, and what sorts of partnerships are appropriate.

¹⁸ Respondents from LACs nearly uniformly recommended that the use of instructional technologies should be balanced with face-to-face learning.

¹⁹ There are, naturally, non-competitive reasons for institutions to pursue uses of instructional technology, particularly in on-campus contexts, where many respondents suggest that such teaching resources are simply requisite elements of contemporary higher education. However, whatever the baseline uses of instructional technology may turn out to be, many schools are opting to develop and deploy further technological enhancements for competitive reasons. Such competitive motivations include vying for students by offering maximal convenience and keeping pace with one’s peer institutions.

(2) Finance

A close second to concern over quality among survey respondents is apprehension regarding financial and economic issues. Paying for purchase, development, or deployment of on-campus instructional technology threatens to increase institutional costs (and costs to students). The risk of wasting resources is great unless scalable campus-wide solutions can be substituted for reliance on discrete efforts by individual champions of particular technologies. The larger the single investment, on the other hand, the greater the possibility of costly mistakes, and several respondents suggested this concern is heightened given the necessity of such expenditures to remain competitive.²⁰

Distance learning ventures may entail even greater costs. It is particularly expensive to deliver multimedia content off-campus, and one of the biggest hurdles to adequate infrastructure for distance learning is the cost of requisite high bandwidth.²¹ Development is another enormous expense. Some respondents were interested in learning how to calculate significant investments for starting up entire programs in a distance mode—and where the capital for such investments might come from. State, federal, and private grants are one possibility, tuition or other internal revenue streams another, and organizing for-profit subsidiaries a third. A number of respondents from state institutions were concerned that they could fall behind in their ability to compete in this market because legislatures look dimly upon funding distance learning, particularly as it increases the institution's service to out-of-state students.²²

Respondents suggested a variety of worrisome possible consequences of distance learning ventures in a newly competitive marketplace.²³ Tuition subsidies of research might be threatened if bidding wars drive down tuitions or even tuition growth, as these represent primary revenue streams for research. Pricing and allocations of revenues could require significant adjustments if the for-profits are successful—yet this would pose a great problem for public institutions in particular, since they face diverse public pressures. Such dire possibilities aside,

²⁰ Respondents from the LACs in particular worried about keeping abreast of the rapidly changing terrain of instructional technology (and information technology on the whole). As their resources are generally more limited than those of large universities, they accordingly run a greater risk of making too great a commitment to the 'wrong' technologies.

²¹ Ira Fuchs (Andrew W. Mellon Foundation) has noted that, as distance learning gains currency, bandwidth costs threaten to create a new digital divide on the institutional level.

²² For public institutions, a related puzzle is deciding whether tuition for distance learning courses is more appropriately set at in-state or out-of-state rates, given that the internet often renders one's physical location insignificant or even undetectable.

²³ While the greatest impact of commercial online education may consist in such ventures taking market share from less selective schools, the selective schools are not entirely isolated from possible effects. One danger in neglecting online education is that neglectful institutions may be viewed as antiquated or simply insufficiently supportive of teaching in the digital era. As the provost of a private research university suggested, "We too may be threatened if we do not assure that the quality of our education takes full advantage of the opportunities afforded by instructional technology."

many respondents expressed a simple need to identify appropriate and beneficial business and financial practices given a more competitive market and its growing distance learning dimension.

(3) Faculty and governance

Respondents noted a variety of faculty-related problems that might arise. There may be imbalances of faculty time spent on distance learning versus time spent teaching on-campus students. Faculty may drift away from institutional loyalty as they increasingly focus on external audiences—and there may be increased tensions *among* faculty if some are teaching at a distance and others are not. Indeed, some faculty could be so successful that a ‘star-system’ could arise, with professors (individually or under the aegis of separate ventures) competing directly for students with traditional institutions. In an even dimmer scenario for the teaching profession, the work-for-hire model of employment—currently a serious problem in the form of adjunct instructors—might grow further still, as schools rely on temporary instructors to lead students through distance learning modules created by regular faculty.

However, these scenarios (and rosier ones as well) assume widespread adoption of instructional technologies, and faculty resistance is still a significant factor on many campuses. The benefits of such technologies are lost until faculty can be moved to make greater use of them. Yet this will not come to pass, so respondents suggest, until there is better recognition of related faculty effort (for the purposes of evaluation, tenure, and promotion), increased technical support, and faculty acceptance of changing roles (particularly as regards use of support staff).²⁴ This last factor is bound to generate governance problems, though, as entrenched powers are unlikely to peaceably surrender authority. A related governance issue is whether it is desirable or reasonable for administrations to mandate adoption of new technologies or the ways in which they should be used. A more foundational problem regarding governance is that numerous schools, particularly among the LACs, feel unequipped structurally to assess and debate such issues.

(4) Intellectual Property (IP) issues

As in many other dimensions of information technology, the equitable and feasible distribution of intellectual property rights is a tremendous concern in online education and distance learning. The biggest potential for difficulties arises where there are no IP policies at all, as is still the case in a number of smaller schools (most research universities have fairly sophisticated IP policies in place—originally created to foster favorable patent regimes). Trailing close behind are those cases where such policies are too old to adequately address recent technological developments. Few IP policies provide guidance regarding faculty rights to content-intensive instructional technologies they have created after they leave the institution where they created them, or the teaching of materials in traditional formats at one institution and

²⁴ The problem of changing roles highlights an additional organizational issue—whether the creation and support of instructional technologies should be the responsibility of the institution’s IT organization, library, or some new unit altogether.

the teaching of the same materials online for another institution.²⁵ Further, although existing IP policies for research (generally premised on the 1980 Bayh-Dole Act) provide useful models, significant questions remain regarding IP rights over course materials given that such materials are usually not patentable, and they are not research *per se*.²⁶ Many institutions lean towards a work-for-hire model for the production of content for instructional technologies—yet this model is generally not a core concern of IP regimes in the academy.²⁷ Rather, the primary driver for such policies has traditionally been establishing fair dealings between the institution and regular full-time faculty. Yet as one survey respondent noted, any new models must be widely discussed—and, one would hope, agreed upon—if fair compensation for distance learning instruction is to be determined.

(5) *Equity and access*

The recent history of many instructional technologies—film, radio, and television—consists of repeated failure to dramatically broaden access to higher education.²⁸ Greater hopes have been popularly invested in web-based technologies and other computer media, though such hopes are generally focused on delivery of professional courses and technical training. Survey respondents were rather uniform in dismissing the likelihood that such technologies could help increase access to higher education at the pedagogic or curricular levels attained by the most selective schools. As some respondents starkly warned, online education may not help

²⁵ One noteworthy case of the latter sort occurred in 1999 when Arthur Miller of the Harvard Law School provided videotaped lectures for a virtual course offered by the Concord University School of Law. See Amy Dockser Marcus, “Seeing Crimson: Why Harvard Law School Wants To Rein In a Star-Struck Professor”, The Wall Street Journal, November 22, 1999.

²⁶ A closer model might be the copyright law governing textbook authoring, but here too the law is murky. A traditional exception granting IP rights to professor/authors is nowhere mentioned in the standing 1976 copyright law, and there is no clear and sure judicial indication of what the law intends in the absence of direct comment. See Pamela A. Kilby, “The Discouragement of Learning: Scholarship Made for Hire”, Journal of College and University Law 21 3 (Winter 1995): 455- 488.

²⁷ Work-for-hire rules generally govern work produced by contractors, and considering full-time faculty as contractors is controversial even when the work performed goes beyond explicit institutional expectations of faculty members. One primary reason for this controversy is that there is often no agreement as to how to draw a line between normal institutional expectations and additional work requirements. The relations between work-for-hire provisions and copyright policies in the academy is addressed in Laura G. Lape, “Ownership of Copyrightable Works of University Professors: The Interplay between the Copyright Act and University Copyright Policies”, Villanova Law Review 37 (1992).

²⁸ In the broader domain of distance learning, the British Open University (OU) has been widely judged a great success in expanding access to excellence in higher education. However, while the OU has made extensive use of various media such as television and radio, it has not yet make widespread use of recent instructional technologies such as the web. Only a handful of courses are taught online, and the OU has resisted rapid and complete entry into online teaching because of sensitivity to a digital divide that might prevent some of their students from participating equally. Recently, though, the OU has been moving progressively towards more online instruction; see Robin Mason, “From distance education to online education”, Internet and Higher Education 3 (2000) 1-2: 63-74. As their online offerings grow, it should be quite interesting to compare these efforts and results with the wealth of data amassed over the last three decades of providing distance education in more traditional formats.

disadvantaged students in the ways they really need to be helped.²⁹ A more promising prospect, widely echoed among respondents, is that on-campus use of instructional technologies could help promote critical technological skills *en route* to a superior college or university education. However, here too some respondents worried that members of disadvantaged groups do not always get the help they need, given lasting effects of a digital divide that begins in primary education.

(6) Student issues

Finally, respondents were concerned about several student-related issues. Instructional technologies are frequently specific to a discipline, and students often are not afforded the training they need to attain technological fluency in their chosen discipline. This is particularly a problem on the graduate level, and is all the worse when graduate students must learn how to teach with technology. Another sort of problem is the need to accommodate new sorts of students who may be primarily or solely learning at a distance. Some state universities in particular are wrestling with managing the boundaries between on-campus and online divisions. One especially sensitive issue is the need for equal support and services for online students; indeed, as such students often do not have physical access to the campus, their need for services is arguably greater than that of on-campus students.

B. Priorities and opportunities.

The priorities and opportunities discussed by survey respondents can be divided among three categories: (1) reaching and retaining student populations, (2) increasing access and equity, and (3) promoting collaboration and achieving other efficiencies

(1) Reaching and retaining student populations

The core asset of any educational project built on internet-based technologies is that one's instructional reach is potentially extended to students in all places and at all times. Thus, some institutions such as Penn State or MIT have or are building substantial online programs that they hope will reach large new audiences around the globe. Other institutions—especially smaller ones—have more modest aspirations, seeking to retain their traditional audiences by adding new dimensions of quality instruction. Respondents cited a number of such small-scale possibilities: bringing lifelong learning experiences to students, enhancing alumni learning opportunities, and facilitating or expanding specialized professional degrees (particular at universities). In addition, some respondents suggested that online education provides special opportunities to sustain or raise the quality of instruction for their current student bodies by helping students benefit from different learning styles, or assisting students from overseas who face cultural barriers in traditional classes.

²⁹ The Vice President for Academic Affairs of one liberal arts college offered this blunt assessment: “To sit disadvantaged people in front of terminals instead of giving them the wherewithal to go to a campus and to have an education in the fullest sense is likely to make them better informed yet still disadvantaged. The top colleges and universities in the country offer much more than just information and course credits. They offer a physical environment in which people learn to get along—in real time and space—with others different from themselves, and to make contacts and form relationships and networks for the future. I simply can't see this happening by having people sit in front of a terminal and crediting their way to a degree.”

(2) Increasing access and equity

Several respondents report that their institutions view online education as a possible way to help meet their commitments to increasing access. Public institutions in particular have an express legal obligation to increase access while maintaining their quality. The University of California, for example, faces a sizable increase in its student numbers (referred to as ‘Tidal Wave II’, a product of growing immigrant populations and the ‘Baby Boomlet’) and sees the use of instructional technologies, on and off campus, as a way of achieving needed efficiencies without sacrificing effectiveness.³⁰ For private institutions as well, there is an obligation to try to employ technologies in order to overcome pointless physical obstacles. Thus, online sections may provide relief in over-crowded courses and students may attend classes though they are not physically able to come to campus. Further, though many respondents wished they knew of ways in which online education could bridge social and racial divides, a number of respondents recognized that the rural/urban divide is much more likely to be addressed by learning through technology-enhanced media.

(3) Promoting collaboration and achieving other efficiencies

The most creative theme developed by survey respondents concerned perceived opportunities to use online education to promote institutional collaboration. Respondents variously saw opportunities to: facilitate international collaboration (with other institutions and for students studying abroad),³¹ aid local consortia by easing course sharing and lessening the need to continually transport students from campus to campus, promote collaboration across disciplines in teaching as well as in research, assist graduate-level studies across schools, extend the reach of faculty *from* (as well as *to*) diverse, remote locations, and share instructional materials widely. The LACs in particular have much to gain from institutional collaboration, and their respondents see great possibilities in sharing online courses or course components with their peer institutions. The flip side of this sentiment is that the LACs are generally less interested in offering or partaking of commercial online courses than are the universities.

Beyond collaboration, other proposed efficiencies include using instructional materials for a variety of pedagogic purposes and at different levels—extending even to secondary education—and customizing teaching and learning on a grand scale. This goal of ‘mass customization’ may afford large universities a way to offer students a LAC-type experience through individual design of curricular trajectories, course schedules, and even parts of courses.

IV. The Current State of Scholarship

Many of these institutional concerns and opportunities prompt a host of research questions regarding both the pedagogically and socially optimal curricular and instructional

³⁰ See the University of California report, at <http://www.ucop.edu/ucophome/commserv/FS0001Enroll1.pdf>.

³¹ One respondent noted that Internet2 capabilities should permit the routine use of videoconferencing in teaching, making collaborative learning across continents a regular affair.

design for online education, and the social, economic, and organizational consequences of such arrangements. Such questions are best addressed by careful empirical study and rigorous policy analysis. Unfortunately, there is a dearth of such studies or analyses in these areas, despite a long history of scholarship in educational technology. Almost every major school of education has a departmental unit or center for educational technology, yet most of these departments or centers are dedicated to technology development, the underlying pedagogical foundations of such development, or the cognitive psychology that in turn is one important source of such pedagogical foundations. The social science perspective on the uses of instructional technology is simply not within their ken.³²

This situation may be remedied if the right sorts of research are pursued by the few instructional technology scholars who take an interest in these matters, or by such scholars in other fields with the relevant sorts of expertise in economics and the other social sciences. Ultimately, such studies should be undertaken, propagated, and taught within the field of educational technology, but for the moment the best work may well be done by those outside that field. In the end, moving this area of research ahead will require the work of both sorts of scholars, in order to gain the relevant cultural and historic expertise that must accompany stellar research on the social scientific aspects of these technologies.

Over the last few years, a number of leading scholars have dedicated themselves to research on internet-related issues—Hal Varian (University of California, Berkeley) has written extensively on internet pricing models, Andrew Whinston (University of Texas) has studied value, productivity, and operational success in e-commerce, and William W. Fisher, III (Harvard) has examined intellectual property in cyberspace, to name a few examples. In addition, a number of first-rate institutions have made strong commitments to promoting internet-related research. Centers dedicated to internet studies have been or will soon be created at Yale, Harvard, MIT, the University of Texas, LSE, and Oxford. The work of these individual researchers and academic centers suggest promising possibilities for good scholarly work on issues regarding higher education and the internet, particularly with regard to online education and distance learning.

V. Areas in need of study

Diverse institutional priorities and pressing research needs yield a wide range of possibilities for investigations related to technology and teaching. One general point governs all such research: it should focus on all modes of online education, and not too narrowly on distance education. In fact, taking past research as a guide, it seems that investigators are likely to find the most pertinent data by looking at on-campus uses of instructional technologies.

³² For a select few exceptions, see S. J. Klees, “Economics of Educational Technology”, 312-320, and I. Conboy and P. B. White, “Social Implications of Educational Technology”, 601-606, in Tjeerd Plomp and Donald P. Ely (ed.s), International Encyclopedia of Educational Technology, Second Edition, Oxford: Pergamon, 1996. The empirical research tradition concerned with distance learning is historically stronger in Europe, where distance learning is generally funded by the state, thereby triggering close policy assessment and social science research.

Another general point is that scholars have an opportunity and obligation to reverse the recent trend, characteristic of many researchers and policy makers, of ‘boosterism’ or global advocacy regarding distance learning and the use of online education. Such researchers have frequently touted the new technologies as a means of remaking higher education—with efficiency as a premier concern. Yet, as survey respondents indicated, there is a need for more studies of online higher education that use the analytic tools of social science to look at the underlying issues—which include, but extend far beyond, the matter of efficiency—in a fair and objective light.

Curricular and instructional design

Many respondents agree with the longstanding notion that the most important things to learn about online education are whether it works, when, and why. These fundamental questions—which constitute one principle theme of the Mellon CEUTT program—demand close, rigorous inquiry. Looking beyond the basic measures of pedagogic effectiveness sought in the CEUTT projects, one useful area of research is learning how to optimize the curricular and instructional design underlying instructional technologies. Important topics for research include identifying optimal modes of pedagogy for online education; determining the fit of distance learning with different subject areas; determining the fit of kinds of students and kinds of teaching technologies; establishing the optimal class size for online courses; developing adequate tools for outcomes assessment in online environments; and identifying causes of student engagement, the development of long-term learning habits, and what promotes socialization and productive mentoring relationships at a distance.

Economics of online education and distance learning

Another worthy area of inquiry is the economics and finance of instructional technology—the other central theme of the Mellon CEUTT studies. Whereas those studies focused narrowly on cost-effectiveness issues, though, much will be learned from rigorous investigations across a broader scope of research that includes other sorts of costing analyses (such as cost benefit and cost-utility studies of various instructional media) and a range of other investigations. These investigations should focus on such topics as identifying cost of delivery and pricing models, determining demand for online education, determining the viability of commercial ventures and partnerships in higher education, analyzing the role of government and private support (e.g. student financial aid), assessing the performance of online degree recipients in the marketplace, and identification of optimal business plans for nonprofit ventures.

Organizational and institutional issues

Another important area for study suggested by survey responses is research on organizational structures requisite to online education and distance learning. This research might encompass studies of how online teaching affects (and should affect) institutional governance, organization, and such traditional facets of university and college life as research and development, provision of library resources,³³ and alumni relations. Other possible research

³³ Don Waters (Andrew W. Mellon Foundation) has highlighted this issue as critical to address if distance learning is to match the quality of on-campus education.

topics concern institutional coordination of online learning efforts, and ways to reduce duplication. Further, careful research could help institutions learn how to reconfigure faculty roles in this new landscape, in part by helping to determine rational expectations for faculty workloads, responsibilities, compensation, and institutional loyalty.

Social, legal, and ethical issues

Another important area for study suggested by representatives of a number of institutions is research on issues of a social, legal, and ethical nature. Such studies might entail navigating the legal and ethical waters of intellectual property rights, addressing issues of access and equity, and defining the role of assessment in institutional accountability. Some think that instructional technologies provide an opportunity to attain greater accountability of instructors through standardized assessment—what are the benefits and costs of this approach? Another social issue of concern is the standardization of curriculum. As excellent instructional technologies win widespread adoption, curricula and instruction may become more standardized. Is this happening in any particular disciplines, and what are the consequences? Also, can instructional technologies be fruitfully deployed across diverse cultures—for example, what utility is there to universities in developing nations using American courseware? On a more local level, it would be valuable to learn whether LACs can make good use of web-based courses produced at large state universities for such courses as introductory chemistry.

Still other significant research questions relate to the experiences of faculty and of students. What are the career patterns of faculty who are heavy users of instructional technology? Is instructional design something that is or should be done by faculty on their own, or as part of team efforts? When faculty serve as facilitators of free-standing course modules, what is their instructional role and how is it perceived by students? What are the dimensions of faculty-student contact in online education? What will we learn from longitudinal comparisons of the life experiences of online and on-campus students?

Institutional missions and quality

A further possible area of research concerns issues related to the missions and quality of institutions offering online courses and distance learning. Does the use of instructional technologies change the objectives or aims of courses, degree programs, or institutions? How can LACs or HBCUs maintain their special niches in the world of online education? A related set of topics concerns accreditation and quality: How should distance-learning ventures be accredited? Can online courses really sustain quality equivalent to that of their traditional counterparts? How is it possible to measure competence, much less excellence, in online academic courses or programs?

In any of these research areas, investigations likely offer the greatest promise where they focus on existing uses of instructional technology—as summative studies. The less promising alternative is to tie formative studies to development projects as assessments of tools that have not yet been refined. We have the most to learn about the use of instructional technology in online education and distance learning when we study how tools we expect to work are employed, and not when we focus our learning experience on how to better those tools.

Conclusion

In sum, future research can best build on past expertise—such as was developed in the Mellon CEUTT program—by careful study of the burgeoning development of online instruction and distance learning in higher education. Much of the research recommended here represents a natural extension of inquiries posed in the Mellon CEUTT projects. Those earlier projects—possessed of a rigor not frequently seen in prior studies of instructional technologies—focused on the economics and effectiveness of such technologies. Now researchers must seize the opportunity to pursue a variety of other studies that range over social, organizational, pedagogic, and technical issues. A fuller research agenda for the study of technology and teaching could further the aim of helping universities and colleges—selective and non-selective schools alike—shape responsible and mission-sensitive programs in these new and uncharted waters.

September, 2001

Appendix A: The CEUTT Projects (1996-2001)

University of Cape Town (1996): An instructional technology center (the Multimedia Education Group) created a package of software templates for a range of courses (archeology, history, English, and numeracy skills), to assist students from disadvantaged educational backgrounds in areas such as critical reasoning, writing, and scholarly documentation. Investigators have been evaluating the modules and their use relative to costs, benefits, effectiveness, and sustainability.

George Mason University (1996): Six courses have been evaluated to gauge the impact of fostering integration of information technology into the curriculum and to test whether readily available technology and infrastructure can be used in cost-effective ways. By evaluating six courses in different areas in one institution, investigators have sought insight into cost measurement while holding constant the institutional framework.

University of Michigan (1997): Instructors of three less commonly taught languages (Hindi, Swahili, and Middle Egyptian) at the University of Michigan collaborated with instructors at the University of Chicago, the University of Wisconsin, and Northwestern University, to develop Web-based instructional materials that can be used across the participating institutions. Investigators have been gauging whether using these jointly developed materials—which no one school could afford to develop or deploy—can spread the burden and share the benefits.

University of Pennsylvania (1997): Web-based pre-laboratory instructional applications have been used in five engineering courses. Investigators have been gauging whether these applications may reduce costly laboratory mishaps and help minimize valuable time spent in class on preparing for laboratory work.

Rice University (1997): A Web-based engineering tutor was designed to help guide students through design problems and monitor their performance. Investigators have been judging whether instructional costs may be reduced by enhancing automation of the problem-set component of engineering instruction—a large element of such instruction.

University of Pennsylvania (1998): A “writing across the curriculum” group has been using existing technologies to conduct electronic “collaborative writing groups.” These groups were designed to enhance compositional and rhetorical skills without substantial investment in instructional personnel—by encouraging peer review among students. Investigators have been gauging whether the asynchronous character of the electronic learning experience increases the volume, quality, or responsiveness of student work.

Michigan State University (1999): Archival and experimental studies have been measuring the costs and pedagogic effectiveness of courses taught in the natural and social sciences at Michigan State University and Texas A&M University that use an application which personalizes problem sets, quizzes, and exams, and records students’ participation and performance. Investigators have been gauging whether this technology can help improve students’ understanding of difficult concepts, lessen classroom anonymity, increase the quantity and quality of feedback to students, or reduce time in generating such feedback.

Drexel University (1999): An entire online Master of Science in Information Sciences (MSIS) program has been assessed relative to costs and pedagogic effectiveness. Since 1996, Drexel has offered an online MSIS program and collected data on its use and effectiveness. For this project, investigators have been examining data from courses taught in the online and traditional classroom-based programs, in order to test the hypothesis that the online courses are more cost-effective than the traditional ones.

Dartmouth College (1999): Commercially available software was used to integrate case studies more fully into a calculus course, facilitate practice of calculus skills, and automate management of the course. It has been hypothesized that using these technologies may cut costs of instruction while sustaining improvements in teaching and learning associated with the case studies approach. Investigators have been gauging the cost-effectiveness of teaching calculus with the technology-enhanced curriculum, as compared with both the traditional and case studies curricula without technological enhancement.

Georgia Institute of Technology (1999): Georgia Tech researchers developed an instructional technology that attempts to mimic in an online environment those elements of a traditional classroom that promote collaborative learning. Called “CoWeb”, the software provides an easy-to-use forum for dialogue, contribution of classwork, and feedback or elaboration from other class participants. CoWeb allows students to instantly develop and edit webpages, and thereby easily build and enhance collaborative websites. For this project, investigators have been examining the use of CoWebs in composition and computer science courses. By using CoWebs, instructors may produce efficiencies by promoting collaborative work among students (and so increasing learning) at negligible cost. This simple-to-use technology may boost students’ performance in composition and computer science at very low cost.

Rutgers, The State University of New Jersey (1999): Investigators have been examining whether eight courses, including biology, geography, communications, Spanish, and engineering, taught with the use of web-based technologies may lower costs by substituting graduate students or junior faculty for senior faculty in tasks not critical to course design or delivery. They also have been investigating whether the frequency of large lectures can be reduced through the use of such tools as self-directed lessons, quizzes, simulated labs (for biology), and 3D visualization applications (for engineering)—and whether these courses may improve pedagogic outcomes by providing more interactive and collaborative learning.

University of California, Davis (1999): Investigators have been testing the sustainability and scalability of using online lectures to offset the ineffectiveness of large lecture courses in ten courses in the natural sciences, including agriculture, biology, computer science, food science, physics, and oenology. Investigators have been evaluating students’ knowledge and skills in traditional and web-enhanced versions of the courses, and measuring the capacity of the web-enhanced courses to reduce costs by off-loading some of the instructors’ tasks to the computer and eliminating the need for large lecture halls.

University of Florida (2000): Investigators have been comparing costs and pedagogic outcomes of web- and lecture-based deliveries of introductory chemistry and mathematics courses over a three-year period. The pedagogic assessment in the study has focused on exam scores and retention rates. Additionally, investigators have been attempting to gauge how different sorts of

student-instructor interactions, including lectures, discussions, and study groups—as conducted online or in traditional classes—advance learning and achievement. This inquiry may help determine the effectiveness of these types of interactions across different media, and so shed light on practicable approaches to teaching conceptual knowledge and problem-solving skills in introductory sciences curricula in a large university setting.

Pennsylvania State University (2000): Investigators have been conducting a cost-effectiveness study of a technology-enhanced introductory biology course and its traditional counterpart. Students were randomly assigned to one of five groups, representing varying levels of technological intervention, and investigators have been measuring retention rates, learning gains, and instructional costs for each of the five groups. In addition, investigators have been conducting a study to determine the characteristics of good learners in online courses. Academic achievement have been correlated with such variables as motivation, desire to learn, self-regulation, computing abilities, and perception of the connection of the biology curriculum with everyday life.

Carnegie Mellon University (2000): A highly interactive online course called “Causal Reasoning with Statistical Data,” which uses teaching assistants instead of a faculty lecturer, was tested at Carnegie Mellon and the University of California at San Diego. For this project, investigators have been pursuing a three-part research plan. First, in the context of a controlled experiment, they have been rigorously assessing the costs and pedagogic effectiveness of the course, as taught online and by traditional means, at Carnegie Mellon and at two to five other universities (including the University of Pittsburgh and UC San Diego). Second, they have been measuring the costs and learning outcomes of delivering only the online version of the course, at twenty other higher education institutions around the country. Third, they have been comparing these last results with a national survey of colleges and universities that they conducted to estimate aggregate costs of delivering lecture courses on similar topics.

Northwestern University (2000): The departments of French, German, and Hispanic studies at Northwestern developed Web-based technologies to advance the intermediate-level study of grammar, listening comprehension, writing, and culture. These technologies may also create efficiencies by reducing the amount of time instructors spend on grading and preparation, as well as cutting down the hours necessary for classroom usage: Web-based instructional materials may enable each instructor to teach two sections for the costs traditionally associated with teaching one section. For this project, investigators have been conducting a cost-effectiveness study of the technology-enhanced courses and their traditional counterparts. Data have been collected on some thirty sections and 450 students, and investigators have been measuring pedagogic outcomes, growth in learning, and instructional costs under each of the teaching scenarios.

University of California, Berkeley (2000): Investigators have been comparing costs and pedagogic outcomes of Web-based and traditional deliveries of introductory chemistry lectures and labs. A variety of technologies (including Web-based quizzes, pre-laboratory exercises, PowerPoint versions of chalk board content, and on-demand streaming video of lectures) may help reduce faculty and graduate student instructional hours and free up classroom and laboratory space in order to make campus resources available for an ever-burgeoning student

body. Investigators have focused their pedagogic assessment on lab quizzes and reports, exam scores, and retention rates. Additionally, they have been examining student attitudes towards learning through a series of pre- and post-course surveys and focus groups. Finally, they have sought data on course completion and attrition, to help understand the role of technology-enhanced instruction in students' decisions to stay in the course.

University of Missouri, Columbia (2000): Investigators have been gauging the merits of teaching a large-enrollment introductory communications course with the use of online discussion groups, exercises, self-tests, and video and audio resources for communications studies. The Web-based instructional materials (built around the use of WebCT) may boost learning outcomes by increasing access to resources for studying and augmenting critical thinking through interactive exercises. Face-to-face class time may be reduced by a third, and the number of students taught each semester may grow substantially. Investigators have been comparing 15 sections using the Web-based tools with 15 additional sections serving as the control group. Costs have been measured for a traditional cost-effectiveness study on the institutional level, and for three supplemental approaches—focusing on departmental spending, opportunity costs for salaried personnel, and 'client costs' (student time and costs).

Hampton University (2000): Investigators have been examining the cost-effectiveness of a statistics for sociology course as taught with and without the use of a Web-based SPSS package. This technology may enhance student performance, while enabling increased course enrollment without increasing faculty numbers and reducing time spent by faculty on grading and one-to-one mentoring. The SPSS package has been used for many years in teaching social science, hence this project represents a prime opportunity to hold constant the pedagogic principles associated with the technology. Data collected have been used to determine relative cost-effectiveness—as well as effects on student study habits and satisfaction with learning—across the different teaching scenarios.

Brown University (2000): Investigators have been gauging the cost-effectiveness of teaching an introductory chemistry course online. On the basis of six years' experience with teaching chemistry online, investigators suggest that students taking the online course may do as well as or better than those taking the same course in a traditional format. Further, this new medium of instruction may reduce costs by facilitating a redesign of the undergraduate chemistry curriculum, which is aimed at shortening the course sequence and reducing the number of students who must repeat courses.

University of Southern California (2000): Investigators have been examining the cost-effectiveness of teaching an electrical engineering course with the use of Web-based instructional modules and tools. The tools allow instant evaluation of online problem-sets and asynchronous discussion capability. The study has focused on effects of teaching with these technologies on student performance, retention of lesson content, access to teaching resources, time spent by the faculty on grading, and classroom usage.

Syracuse University (2000): Investigators have been gauging the cost-effectiveness of using Web-based tools as a medium for applying collaborative pedagogy techniques in instructional design (education), geography, and religion courses. The rationale for using this technology is to

enhance pedagogic outcomes by fostering the real-time exchange of ideas at the core of collaborative learning. The typically intensive efforts of faculty members in nurturing such pedagogic and learning modes may be reduced through use of the technology. Data have been collected regarding learning outcomes, time on tasks for students and teachers, and resources required to plan, implement, and manage these courses.

Virginia Polytechnic Institute and State University (2001): Investigators developed an application for performing classroom-based experiments in market dynamics using portable computing devices (PDAs) and wireless technologies. For this project, they have been gauging the cost-effectiveness of using these technologies to perform such experiments in ways that, without use of the technologies, require extra time out of class (in recitation sections) and the supplementary use of teaching assistants. In addition, costs may be lowered by eliminating the need for special laboratories or time spent in recitation sections to perform the market simulations.

University of Nebraska (2001): Investigators have been gauging the cost-effectiveness of teaching introductory biology and educational psychology courses with a set of technological tools that facilitate online assessment, concept mapping, information gathering, and case study analysis. These tools may effectively broaden and deepen the curriculum in introductory courses, which need to reflect the expanding content of burgeoning disciplines. Costs may be lowered with the use of these tools, which are designed to reduce the time spent by teaching assistants on delivery of course content. In addition to measuring costs and pedagogic effectiveness, investigators have been measuring a variety of affective and attitudinal characteristics of students taking technologically-enhanced and traditional versions of the courses.

San Francisco State University/American Economic Association (2001): A team of economists sponsored by the American Economic Association's Committee of Education has been examining the cost-effectiveness of instructional technologies in economics courses at several dozen institutions of different types and in different regions (including Stanford University, the University of Central Florida, Denison University, and the University of Maryland). Investigators believe that examination of a wide range of technologies and institutions may increase their understanding of when and where such technologies can be efficient. Besides gauging costs and pedagogic outcomes, they have been studying the role of learning styles and time-on-task in student performance.

Appendix B: Speculations and Attitudes Regarding Technology and Teaching

Below is a select group of speculations and attitudes offered by respondents to a survey of chief academic officers regarding instructional technology, online education, and distance learning.

A. Speculations.

- In addition to salary and tenure, faculty incentives will include stock options and royalties. (Private Research 1 University)
- IT will make teaching and the classroom more of a public enterprise. (Liberal Arts College)
- Less selective schools may close. (Liberal Arts College)
- Granting a degree will now entail recognition of credit for courses with online ventures. (Private Research 1 University).
- On-campus use of online instruction will change (i) the time and organization of courses and (ii) the workload of faculty, whose teaching work will be taken on by instructional staff. The latter could include regular staff or graduate students. (Public Research 1 University)
- New ratios of full, part, and adjunct faculty may affect governance. (Public Research 1 University)
- Online materials are becoming available in abundance, and since they offer an alternative to in-class learning, there may be reason for a shifted focus—from what’s learned in a class, to what’s learned overall (not necessarily parsed into classes *per se*). (Private Research 1 University)
- It may come to pass that candidates for teaching jobs will have an advantage if they are technologically advanced [i.e. they are not there yet]. (Private Research 1 University)
- “Online education is likely to put a lot of bricks and mortar institutions out of business. Whether ours is one of them remains to be seen.” (Private Research 1 University)

B. Attitudes.

- Distance education in an online medium is a ‘natural’ extension of distance education by traditional correspondence means. (Public Research 1 University)
- Instructional technologies are not the drivers of change so much as the transformation of students to consumers, who demand greater flexibility in the way education is delivered. (Private Research 1 University)
- Controlled growth has a better chance at succeeding than does rapid, rushed development. (Private Research 1 University)
- The pricing of online courses is generally presumed to be discounted, when cost recovery needs actually suggest premium pricing instead. (Private Research 1 University)
- Instructional technology may be used in ways that lower (‘buy down’) costs of instruction, through oversupply of competent instructors. This is because the threshold is lowered for pure teaching roles once curriculum design is pared off. (Liberal Arts College)¹
- Use of learning technologies by students fosters valuable skills for the job market. (HBCU)

¹ A counterpoint here is that instructional technology raises instructional compensation costs because of the demand for new and difficult skills in instructors.

- Technology benefits should be directed to current students (i.e. as opposed to future students, who represent contingent possibilities). (Public Research 1 University)
- Different modes are likely to be more or less appropriate for different subjects taught. (Private Research 1 University)
- The most important resources for instructional technology are teachers, rather than technical personnel or equipment; only teachers will be able to sustain the humanistic dimension of technology-enhanced pedagogy. (Liberal Arts College)
- For-profit ventures are ‘useful’ for the traditional schools in that they have financial resources needed for experimenting in distance learning, and their lessons are available to all. (Liberal Arts College)
- It may be beneficial for HBCUs to partner with other institutions and consortia. (HBCU)
- Faculty who do not use instructional technology may be less successful at ‘reaching’ their students with their traditional teaching styles. (Private Research 1 University)
- Where students cannot distinguish between high and low quality online courses, the low cost courses will drive out the high cost courses independent of quality. (Liberal Arts College)
- Use of instructional technology by students may lead them to be isolated or become more anonymous than befits the LAC environment. (Liberal Arts College)
- ‘Mass customization’ introduces the possibility of diminishing educational community. (Public Research 1 University)
- Graduate education in traditional institutions may be a good place to find efficiencies through distance learning. (Private Research 1 University)