The Transformation of Instruction by Information Technology: Implications for State Higher Education Policy

Dennis Jones
National Center for Higher Education Management Systems

Dewayne Matthews
Education Commission of the States

May 2002

Sponsored by a grant from FIPSE (Fund for the Improvement for Postsecondary Education) to the WCET (Western Cooperative for Educational Telecommunications) in conjunction with the Technology Costing Methodology: Completing the Toolbox Project

Technology as means, not end

Why are states and higher education institutions so interested in integrating greater use of technology into their higher education systems? There are, of course, many reasons, including specific problems that information technology may be able to help states solve. However, it may be fair to say that the main reason is simply that policymakers and education leaders recognize that information technology is now integral to the world economy and has transformed most U.S. industries, with the exception of education. The realization that higher education has not changed very much in its fundamental forms of organization – whether in how programs are delivered or human resources are utilized – seems increasingly out of touch with what is happening around it.

Certainly higher education has begun to make greater use of information technology, especially on the non-instructional side of the enterprise – administrative functions in particular. The application of information technology to instruction, however, is still in its early stages, even though states and institutions have begun to invest considerable sums to incorporate its use into courses and academic programs. Until now, the main focus on technology has been to tap into its potential to enhance the quality of education. More and more courses incorporate tools such as e-mail or web resources, and a small but growing number use even more advanced techniques such as simulation and multimedia, which expand and diversify the pedagogy traditionally relied upon by higher education. This use of information technology in higher education is, however, almost always an add-on to the traditional delivery system with the primary purpose of enhancing the educational experience. As such, it tends to drive up costs, both for the technology itself and the increased time demands on both faculty and highly skilled technical staff.

The ubiquitous nature of technology and its extraordinary promise are raising expectations among constituents for higher education, state policymakers among them, who see technology as the vehicle by which higher education institutions can respond to a variety of state priorities. A good example is improving the preparation of students for postsecondary education – an issue receiving increasing attention by states, not least because it is part of a strategy of improving the quality of K-12 education. More outreach from higher education to the schools, such as taking college-level or advanced placement courses to high schools, is a preferred strategy in many states. Several states have invested in statewide technology networks to deliver more courses from higher education institutions to schools, and changed policies to encourage this type of outreach.

States are also looking to technology to overcome geographical access barriers to higher education, especially for adult learners. As state economies become increasing dependent upon emerging high technology industries, or as their own local industries (such as agriculture or manufacturing) are transformed by technology, more and more jobs demand levels of education that were previously available to relatively few. As a result, it becomes imperative to the economic vitality of the state that all of its communities have ready access to postsecondary education. While the need for ready access to learning opportunities is widely recognized, the nature of that need is variable and difficult to predict. At various points in time, the need may be for basic literacy training of adults; short-term training in computer applications in allied health fields; or graduate degree programs in business, computer science, engineering, or social work.

This variability places a premium on flexibility – a requirement that makes technology-based distance education an attractive option.

States facing rapidly increasing enrollment demands are starting to expect technology to provide an avenue for expanding capacity – maintaining or increasing access without the costs associated with building new campuses and hiring a proportional number of new faculty members. While the specifics of how this might actually work remain largely a mystery to most policymakers, the expectation that "technology" will help solve this problem is nonetheless real.

Whether their enrollments are expected to grow or not, all states are hoping that technology can help constrain cost increases, for students and states alike. In most of the states expecting enrollment increases, the majority of the growth will come from populations with relatively low income levels for whom college affordability is a critical issue. Financing growth through substantial tuition increases would undermine access for these citizens. Further, with very few states being exempted, the long-expected economic downturn has finally arrived. A very favorable fiscal climate in historical terms over the past five years has allowed states to add capacity to their higher education systems without confronting the thorny problems of restructuring or incorporating greater use of technology. Even worse than the current rapid downturn in the outlook for state revenues is that during the recent expansionary period many states took steps to limit their ability to adjust revenues to meet changing economic conditions. The grim forecast of Harold Hovey's 2000 report for the National Center for Public Policy and Higher Education, *State Spending for Higher Education in the Next Decade: The Battle to Sustain Current Support*, appears to be coming true. Resources are becoming scarce at precisely the time that higher education is facing the need to invest more, not less, in technology—to provide a quality education to students, to pursue state priorities, and to achieve desired efficiencies.

In this environment, states and higher education institutions look to technology as a way to reconcile expanding demand and constrained resources. The alternatives are not very appealing – either for states or higher education institutions. Further limiting access to higher education, increasing tuition rates far beyond increases in personal income, denying communities the educational infrastructure necessary to support economic growth – none of these alternatives are viable state policy options. Just as other industries have looked to technology to improve quality and productivity in an increasing competitive environment, states expect that higher education institutions will more cost-effectively utilize technology to reach and serve a growing and diverse array of student populations, while maintaining or enhancing the quality of the educational experience. However, this change of focus means that unquestioned assumptions about the costs and benefits of technology will be challenged (as will assumptions about the form and structure of traditional higher education). The focus of policy will increasingly be on the purposes for which the use of technology is being prescribed. These discussions will center on the major accountability questions: Who is being served? In what numbers? At what cost? To what end? The analysis will be comparative: How does education that relies heavily on the use of technology stack up against the way we do things now?

Understanding the structure of higher education programs

To make sense of these questions, it is necessary to understand some basics about the structure of higher education programs – how they are organized, staffed, and delivered. These basics are independent of the method of delivery. In all educational programs, whether traditional or technology-mediated, certain activities must be performed.

The basic categories of functional activities related to the development and delivery of higher education programs are the following:

Figure 1: The Unbundling of Higher Education Functions

Instruction	Curriculum and course design/planning
	Materials development
	Content delivery
	Tutoring/mentoring of students
	Assessment of student learning
Academic Support Services	Information resources
	Access to/use of technology
Student Services	Admissions
	Advising
	Counseling
Administrative Support	Recordkeeping
	Budget and finance
	Collection of fees
	Facilities

In a traditional higher education institution, these functional categories create the organizational structure of the institution. The first category, Instruction, is organized around colleges and departments. Likewise, Academic Support Services, Student Services, and Administrative Support are separate organizational units.

Technology can, and has, been incorporated into all of these functions. In the latter three categories, technology has been used in fairly straightforward ways to increase productivity or improve customer service. Library collections have been computerized and card catalogues are remembered with fond nostalgia. Financial and record keeping operations at most campuses are also computerized now, and an increasing number of campuses are using the internet to dramatically improve such functions as admissions, registration, and the paying of bills. However, the application of technology to instruction is the most difficult issue for states and institutions to face, because it gets to the heart of our understanding of the nature of higher education itself.

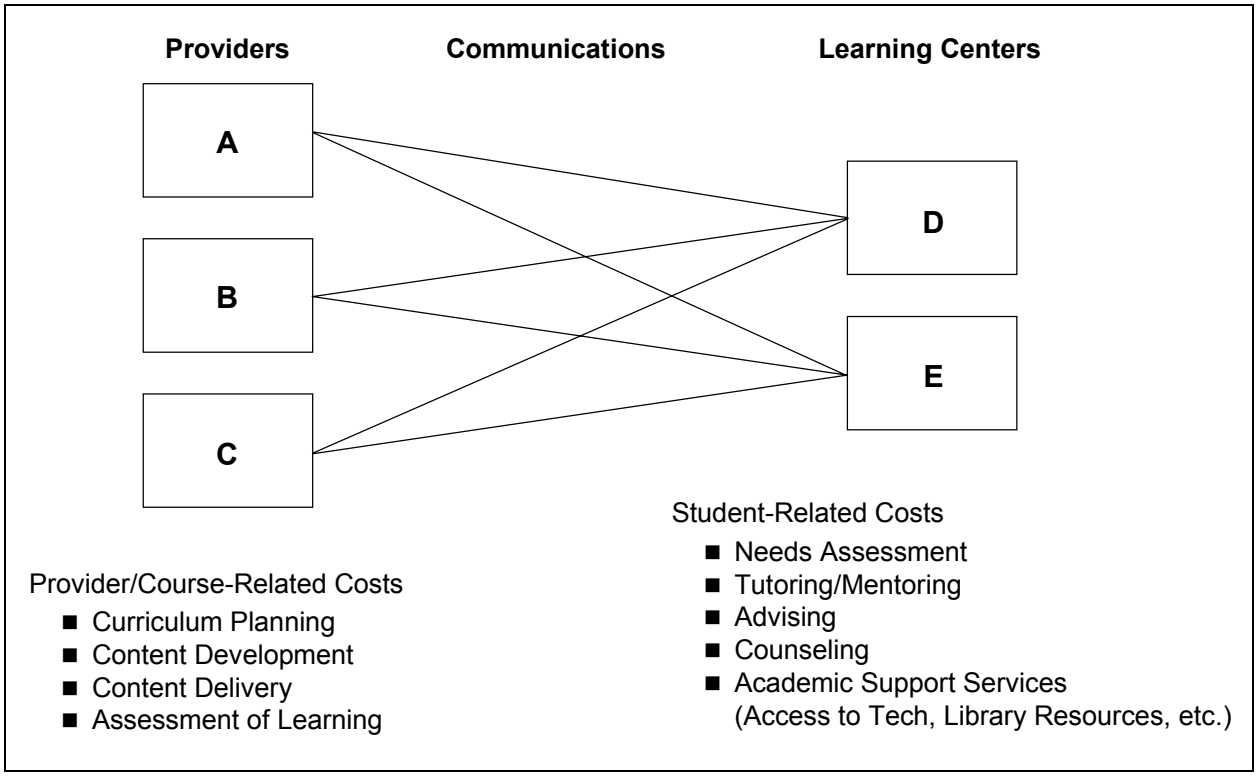
Part of the promise (and, for some, the threat) of the use of technology in education is that it allows the educational process to be organized in a very different way. Traditionally, the functions listed in Figure 1 have been organized within a single institution at a single site. Technology allows these activities to be "unbundled" and geographically distributed. As an example, Figure 2 illustrates a situation in which:

- Those activities that are "provider-centric" – related to the development and distribution of course content – are located in one place, and those that are "student-centric" – related to student support and assistance in acquiring and absorbing course content – are located in a geographically separate place.

- Students located in one geographic area can be served by multiple institutions, not necessarily located in the same state or even the same country. They do not necessarily "belong" to a single institution.

- Institutions located in one place can serve students located at multiple (geographically dispersed) sites, not all of which need to be located in the same state, or even the same country.

Figure 2: Components of Education Costs – Collaborative Model



This set of circumstances, enabled by technology, is what raises expectations regarding delivery of instruction to communities throughout the state on an as-needed basis. It is also the condition

that raises fears that everything held dear by many in the academy is being sacrificed on the altars of economics and convenience.

What do we know about use of technology in instruction?

By any account, incorporating technology into instruction is still in its infancy. However, just in the past few years there has been a dramatic increase in the development and use of technology-based instructional media, including such innovations as web-based courses. In this new environment, many institutions have invested substantial resources in instructional materials development, acquisition of the technology needed to deliver content in new ways, provision for student access to and use of technology, and the faculty and staff professional development needed to ensure that they could use the technology effectively. Based on this experience, it is now possible to draw some conclusions about the effective use of technology in instruction.

- Technology-based instructional **materials must be well designed** to be effective. Materials that meet this test foster active learning by using the technology to emphasize interaction and feedback. However, it has become clear from the early experience of institutions that doing this effectively means that courses have to be reengineered and infused with modules that give students hands-on experiences with the material being studied. This can be very expensive. Experience has shown that up-front investment in design partially offsets the costs of development of instructional programs. However, there is no way to develop truly effective courseware on the cheap.

- Effective use of technology in instruction requires that particular attention be paid to student **tutoring and mentoring**. For many students, success is dependent on personal interaction – both with faculty and other students. It takes special attention to this issue to get course completion rates to the same level as those for classroom instruction. Contrary to some early expectations, expanded use of technology usually increases the amount of interaction between students and faculty. As a result, institutions must either keep classes and course sections small, thus negating achievement of scale, or find less expensive ways to handle the student mentoring component of courses. This latter objective can be accomplished, but only through design and development activities that explicitly recognize this requirement. Referring to Figure 2, the reality is that most attention (and funding) is lavished on the provider-centered activities while little attention is given to the student-centered activities that include tutoring and mentoring.

- **Good design and development** of technology-mediated instruction is expensive and is becoming a major cost driver in some institutional budgets. These costs can be absorbed, but only through the effects of scale – it is necessary to spread these costs over the largest possible number of students. Another necessary strategy is to find ways to use content that has been developed elsewhere, either through outright purchase of modules or entire courses, or through participation in consortia such as Merlot or the Southern Regional Electronic Campus.

- In order to get the scale required to make technology-based delivery cost-effective, it is often necessary to achieve the **collaboration** of two or more institutions. By designing

programs that can be delivered to multiple sites, providers of instruction can achieve the economies of scale that justify the investment in high quality technology-based instructional programs. In the same fashion, economies of scale apply to the providers of telecommunications connections and services, which in many cases is the state. Less obvious is that the same scale effects apply to other elements of instructional delivery, namely academic and student support services including mentoring. Small numbers of students can be cost-effectively served at a given site, if numerous students at other sites are being served simultaneously.

- Another reason for states to expect, and demand, greater levels of collaboration across their institutions is that technology allows institutions to **contribute their particular strengths** to programs. For example, an institution with expertise in a content area may develop a high quality instructional program, but then partner with another institution that has the ability to provide high quality student support services to a population of potential students. Yet another institution (or a state agency) may provide the technology network over which the program can be delivered. Rather than the current case-by-case ad hoc arrangements under which programs are structured today, collaboration across institutions will increasingly be seen as the normal state of affairs in technology-based education, and will be recognized as such in both state policy and institutional decisionmaking.

To summarize, the early experience of states and institutions has shown that in the absence of sufficient economies of scale, technology-based delivery is more expensive than classroom instruction. The higher costs of technology-mediated instruction are a result of both the costs of communications and course and program development. While the obvious focus has been on the direct costs of the instructional technology itself, the major cost driver in technology-based education just as in traditional instruction are the people costs – for both faculty time and technical support. If technology is utilized in such a way that people are utilized differently, it is possible to achieve some of the desired economics. If personnel are utilized in traditional ways and technology is added to the mix, the result is inevitably higher cost instruction.

Implications for Public Policy

The growing incorporation of technology into state higher education systems poses significant new challenges for public policy. Technology is expensive, it remains controversial (especially among faculty), expectations often exceed reality, and the capabilities of technology are constantly changing. In this environment, policymakers need to think clearly about the implications of acting to expand the incorporation of technology into their higher education systems, or of choosing not to act.

One: Defining expectations. The first step in developing sound policies regarding higher education technology is to have a clear, up-front understanding of the purposes of investing in technology. This understanding includes defining expectations regarding who is to be served by technology-based instruction, as well as how and through what functions or activities (such as instruction and its subcategories, student services, etc.) the needs of these populations are to be

met. This process of defining the expectations of the state regarding its higher education system forms the basis of accountability.

Two: Understanding options. Public policymakers need to understand that good content development for technology-based instruction is inevitably expensive. As a result of this reality, states must decide from among the available options for developing programs that incorporate the use of technology. The options for states include:

1. Living with "not-the-best" – establishing a presence on the Web, but using courses and programs that were not designed for the Web.

2. Buying or leasing programs from third-party developers instead of building all courses and programs within the state system.

3. Investing in course and program development only where demonstrable scale effects offset the increased costs.

4. Accepting higher costs as necessary to the achievement of other purposes.

Three: Providing for student services. States need to explicitly recognize the importance of various student-oriented functions, such as mentoring, academic support, and student services. These functions are critical to the success of technology-based programs and tend to be overlooked as states and institutions consider the implications of technology on instructional design. States must insure that these critical support functions are in place, and that finance mechanisms recognize these functions separately from instruction, including content delivery.

Four: Demanding (and allowing) collaboration. States must recognize the roles that numerous actors are required to play in order to effectively deliver education through technology. One of the toughest issues for state policymakers to understand is that technology-based education is often inherently collaborative in nature. As such, effective programs will often require the collaboration of multiple institutions that normally see themselves as competitors – either for students, prestige, or state revenue. As a result, state higher education policy, and especially finance mechanisms, should recognize the contributions of all participants. The main way to accomplish this is for states to provide incentives to institutions to collaborate in the development and delivery of programs. Policymaking is made more challenging by the reality that some of the best – and most cost-effective – partners to the collaboration may reside in other political jurisdictions.

Five: Knowing when to centralize. Along these lines, states must address the question of which assets or functions can most effectively and efficiently be held or conducted centrally instead of being replicated in all or most institutions across the state system. One specific option that states will need to consider is when it may be appropriate for one institution to be staffed and funded to provide a service to many across the system. It is likely that states will find it inappropriate to have each provider replicate all functions in a technology-based delivery model – especially when many are client-based and can therefore be best met by institutions that are in geographic proximity to learners. The learning center model in place in several states is an example of this approach to structuring programs. In other states, some of these functions (e.g.,

networks, servers, help desks, etc.) are performed by a state agency rather than by any one of the institutions.

Six: Developing capital funding alternatives. States must recognize that technology-based education is capital-intensive. For this reason, states must create mechanisms that allow institutions to amass the resources necessary for the acquisition of expensive technology assets, including programs. These mechanisms must also ensure the renewal and replacement of these assets on an appropriate cycle. One approach is to create revolving accounts against which institutions can borrow with repayment conditions such that terms are no longer than the expected life of the asset being purchased. In a significant departure from past history, the capital-intensive assets of technology-based education go beyond traditional capital outlay categories such as equipment to include resources that have always been thought of – and funded – as renewable, annual expenses, such as courseware, faculty, and technical staff.

Seven: Utilizing people effectively. States need to understand that the major costs of instructional delivery and provision of student services will continue to be people costs – not the costs of technology. Policymakers must always demand to know the people costs of technology decisions. They should also take steps to ensure that personnel policies don't get in the way of cost-effective use of technology. The use of technology in instruction—and the "unbundling" of the instruction function required if economic returns to scale are to be realized—almost demands that peoples' time be used in ways different from that which has historically been the norm. Policies and procedures that don't recognize this reality often get in the way of innovation. For example, the so-called "12-hour rules' that require faculty members to teach 12 credit hours per semester stand in the way of using senior faculty members as content development specialists who actually teach few, if any, sections directly.

Conclusion

A simple rule for states to follow to bring these issues much more readily into focus is to direct attention to the clients to be served, rather than the technology itself. By doing so, states can keep accountability consistent with their intentions or expectations. If states cannot be clear about accountability a priori, they probably should not be investing in technology-based programs and the capacity to deliver them. "Because everyone else is doing it" is not a good enough reason for states to start down this path.

Few continue to doubt that information technology will fundamentally transform the structure and delivery of higher education. In spite of this realization, however, few states are addressing the changes in state higher education systems and policies that will be the inevitable result of this transformation. Without change, state higher education policies will unnecessarily delay and obstruct the ability of higher education institutions to respond and adapt to the new environment resulting from the revolution in information technology. With the right kind of changes, however, state policy can foster and support the transformation of higher education systems so public higher education will continue to play a vital role in the economic and social life of states.