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ABSTRACT

Access to information technology is rapidly becoming the benchmark by which quality in higher education is judged. The use of information technology for both on-campus instruction and distance learning is nowhere near reaching its full potential in Colorado. This report provides a statewide vision for the incorporation of information technology into the fabric of the teaching, learning, research, and service agendas of Colorado institutions. Necessary components include: a statewide infrastructure connecting Colorado institutions and communities to world-wide computing networks; a campus network and student support services that facilitate learning whether on or off-campus; a curriculum that incorporates the best in instructional tools and software; a committed faculty who incorporate technology into their teaching, research, and service; and access to a computer for each student. The report provides specific recommendations on the following topics: (1) student access to computing and information resources; (2) faculty and curriculum development; (3) technology fees; (4) state financing of technology based instruction; (5) capital funding; (6) state incentive grants; (7) cost and productivity issues of information technologies; (8) K-12 connections with higher education; (9) workforce preparation and continuing professional education; (10) role and mission issues; (11) private college involvement; and (12) legislative perspectives. An appendix describes the project methodology. (SWC)

COLORADO COMMISSION ON

HIGHER EDUCATION

ACCESS TO HIGH-QUALITY, AFFORDABLE EDUCATION FOR ALL COLORADANS

ACCESS TO INFORMATION TECHNOLOGY: A STATEWIDE VISION FOR COLORADO

JUNE 1996

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ACCESS TO INFORMATION TECHNOLOGY: A STATEWIDE VISION FOR COLORADO

A Report and Recommendations from
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of the
State Higher Education Executive Officers

Presented at the CCHE Special Meeting on Educational Technology
June 3, 1996 at
the Aspen Institute, Aspen, Colorado

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1. The Colorado Commission on Higher Education (CCHE) should, in cooperation with the governing boards, establish standards for minimal levels of student computing access, library data base access, and Internet access: Such standards should be reviewed and updated periodically, and a combination of institutional funds and targeted state funds should be used to achieve these minimal standards in all institutions.

2. Student training in the use of technology, especially the resources of the Internet and electronic data bases, should be made a priority of institutions and librarians. In many cases, existing resources are underutilized because of a lack of familiarity from both students and faculty. Students themselves are also a good source of technical assistance and mentoring of other students.

3. CCHE should, in cooperation with the governing boards, establish pilot projects in selected institutions to put full-time, 24-hour access to individual computers (laptops or other "mobile" devices) in the hands of all students.

Faculty and Curriculum Development

1. Colorado should, along with other western states, create through the proposed virtual university, a mechanism for raising capital from institutions and from private corporations and foundations for high quality instructional software and educational programming.

2. CCHE should, through its technology grants, support more "active learning" approaches to uses of technology.

3. Governing boards should consider the "pooling" of instructional technology support funds to find economies of scale in the areas of faculty and curriculum development.

4. Institutions should be encouraged to change their hiring, promotion, and tenure policies to recruit and retain faculty who are willing and interested in using instructional technology.

5. Institutions should consider including a description of the "Information Technology" component in all courses descriptions so that students can choose faculty who are conversant with and utilizing technology in their instructional practices.

6. Student groups which conduct evaluations should consider including "use of technology" in their course evaluations.

Technology Fees

1. Institutional governing boards should, with CCHE support, encourage the use of technology fees which directly affect student access to computing and information technology resources.

2. Students should be asked to play a collaborative role with university administrators and faculty in determining expenditure priorities which directly address their concerns about access to technology.

State Financing of Technology Based Instruction

1. CCHE should continue to examine the rationale for providing state subsidies with the objective of making subsidy and rationing policies site and medium neutral.

2. CCHE should clarify and more widely communicate the policies which provide for alternative delivery modes, and assist institutions in developing defensible alternatives to seat-time requirements.

Capital Funding

1. Commissioners should set overall policy direction in the capital funding process including directing staff to develop criteria for "basic" technology needs.

State Incentive Grants

1. CCHE should improve its RFP process by providing more specific guidelines as to priorities and then assure that these priorities are strictly followed by the review committee.

2. The application process should be simplified in order to ensure that small institutions without large grant writing staffs can remain competitive (e.g., limiting the length of applications).

3. CCHE should consider broadening the scope of its review committee to include experts from outside of the state and the system in reviewing proposals.

4. CCHE should ask for brief progress reports and evaluations of prior years funding as a part of any renewal application.

Cost/Productivity Issues

1. CCHE and the legislature should adopt incentives in the capital funding process which encourage institutions to take advantage of electronic networks in lieu of new construction when educationally appropriate.

2. Governing boards should, with state support, adopt policies which encourage on-campus students to take a greater portion of their coursework in a distance learning mode -- for example through asynchronous computer conferencing courses over the Internet. Such an approach could significantly increase the "carrying" capacity of such entities as Auraria. This would also dispel the myth that distance learning is only applicable to isolated populations unserved by campuses. (This policy would require students to have individual computer access, and thus dovetail with a "computers for all students" policy.)

3. Institutional leaders should, with state support, find ways through technology to cover the same material in less time (e.g., the "studio" model of Rensselaer). Savings from such credit hour reductions would be retained by the institution for reinvestment in the technology infrastructure of the institution. (Given current state policies, there is no incentive for such shortening of curriculum.)

4. CCHE should, study the possibility of moving entire programs or institutions to a "privatized" model in order to stimulate competition and effective use of resources.

5. CCHE and the governing boards should conduct studies of the cost/benefits of various technology-based instructional programs.

K-12 Connections

1. Early-enrollment options in postsecondary education and Internet connectivity in schools should be made a high priority of the recently implemented technology legislation (Senate Bill 197).

2. CCHE should encourage collaboration between higher education institutions and K-12 districts and schools for joint staff

development programs on the integration of technology in the classroom.

Workforce Preparation/ Continuing Professional Education

1. The access of workers and professionals to telecommunicated learning at the worksite should be made a high priority of the emerging statewide network and the proposed Western Virtual University. The proposed "learning centers" of the virtual university should include employment sites.

2. Community colleges and four-year institutions with existing or emerging capacity in high-tech occupational fields (e.g., manufacturing and engineering technologies) should assume regional, and possibly, statewide roles in these areas.

3. Greater use of industry/business representatives should provide feedback on the quality and relevance of academic and occupational programs, with special attention to up-to-date technology applications. Such outside reviews should be a standard component of governing board/CCHE program reviews.

Role and Mission Issues

1. CCHE should explore a dual approach to role and mission issues -- deregulation and free-market in some areas and more strategic state investments in other areas (especially high cost fields that are likely to be neglected by a free-market or cash-funded approach).

Private College Involvement

1. Access to statewide infrastructure resources such as the current "CIVICS" network and any emerging networks should be available to interested private and proprietary institutions.

Legislative Perspectives

1. CCHE should play a leadership role in informing legislators and other policy makers of the contributions that information technology can play in advancing the teaching, learning, research and service agenda of higher education.

ACCESS TO INFORMATION TECHNOLOGY: A STATEWIDE VISION FOR COLORADO

Access to information technology is rapidly becoming the benchmark by which we can judge quality in higher education. With it, faculty and students are literally connected to the world; without it they may languish in a backwater of higher education and the digital economy. Quality is no longer measured solely in library volumes, faculty credentials and the campus buildings; but in e-mail and Internet access, in software applications and network connectivity. Student success is no longer measured solely in the gaining of credentials, but in the skills and talents required by the information age.

A statewide vision for the incorporation of information technology into the fabric of the teaching, learning, research, and service agendas of Colorado institutions must include several essential components:

1. a statewide infrastructure that connects Colorado institutions and communities to world-wide computing and telecommunications networks;
2. a campus network that provides ubiquitous access to wherever students and faculty work whether on campus or off-campus;
3. a curriculum that incorporates the best in instructional tools and software;
4. an enthusiastic and committed faculty capable of incorporating technology into their teaching, research, and service;
5. student support services that facilitate learning regardless of the location of the learner; and
6. widespread, if not universal, access for every student to a computer which they may own or use as their own.

Colorado has begun to take important steps to put in place these necessary elements. The priorities established by the Colorado legislature clearly demonstrate their commitment to the expanded use of technology in higher education. The commitments made from institutional funds

to information technology demonstrate, as well, their enthusiasm for implementing a technology-based educational delivery system. Change is apparent on campuses throughout Colorado. This is paying dividends in improved teaching and learning, greater outreach to communities to solve important problems such as access to healthcare, improved access through distance learning technologies, and world-class research.

But there is still much work to be done. The use of information technology whether for distance learning or for on-campus instruction is nowhere near reaching its full potential in Colorado. A relatively small percentage of the total off-campus enrollment in Colorado uses any form of electronic delivery; and while an enthusiastic set of "early adopters" among the faculty are using instructional technology tools like multi-media and the Internet, many are not. More disturbing is the growing disparity among the technologically sophisticated campuses (many along the front range) and institutions, many in rural areas, whose basic capacity and utilization of technology are quite limited. Student demand for access to information technology and for up-to-date curriculum is growing at a pace which challenges even the best institutions in the state to keep pace.

The challenges facing Colorado higher education are many. It must respond to the increasing demands for access to a postsecondary education, and it must assure that this access remains affordable. It must respond to the increasing expectations of employers and students themselves, and ensure that its curriculum and equipment is current. It must connect its structures and programs to those at the K-12 level through more early enrollment options and joint curriculum development, for example. It must play a leadership role in extending access to information and healthcare education to all parts of the state. It must be responsive to the needs and perspectives of employers for a highly trained workforce -- one that is flexible and able to find information and knowledge to do the job effectively and efficiently.

Like many other sectors, higher education is in the midst of a fundamental transformation from a producer-driven to a customer-driven enterprise. In this regard, higher education's most important customers -- employers and students themselves -- are asking that the educational process more accurately mirror the work process. This will mean more collaboration, more contextual learning, more active learning, and more use of technology by faculty and students in all institutions.

The phrase "learner-centered" instruction and the goal of improved "learning productivity" best captures what should be the overarching goals of the Colorado higher education system in the years ahead. These concepts imply not only new ways of teaching and learning, but new responsibilities of faculty,

administrators, and policymakers. It also implies new and greater responsibilities on the part of students. With the tools of technology, we believe it is possible for students to become more self-directed, motivated, and engaged in their own learning and thus their ultimate success. With technology, the dream of "anytime, anyplace" education can be made a reality. With technology, students can learn the skills that will make them employable throughout their working lives.

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Student Access to Computing and Information Resources

Colorado institutions are rapidly dividing themselves between the "haves" and "have nots" when it comes to computing and information technology resources. This condition has resulted from a variety of factors: past institutional priorities, availability of nonstate resources, individual institutional lobbying with the legislature, organizational structure, and staffing patterns, size, and location.

Colorado institutions are rapidly dividing themselves between the "haves" and "have nots" when it comes to computing and information technology resources.

Regardless of the cause, wide disparities do exist across Colorado institutions. Both the Colorado Commission on Higher Education (CCHE) survey results and our campus visits attest to these differences in the accessibility of students to personal computers, computer labs, and the information resources of library data bases and the Internet. This is especially problematic on smaller, more rural campuses and a source of great frustration and tension especially from students and concerned faculty. During our interviews, students and faculty strongly expressed the importance of this access in order for students to be competitive in the job market.

This concern ranged across all fields and degree levels. In other words, access to technology is not just for the "high tech" fields, but is essential to all students who expect to be productive members of an "information age" economy.

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Across all levels and disciplines, students were vocally supportive of obtaining greater access to computer technology on campus. On a rural campus with very limited computer access for students, one student remarked, "I took a class here on computers. I got an A. That didn't mean much, because when I started working, they had to retrain me to use their computers...[with more up-to-date software]."[1] In contrast, students at an urban institution were satisfied with the computers available to students on campus, but voiced concern about access from remote sites. (Many computer center directors report the continuing challenge of providing remote dial-up access to their computer networks.) At a large state university, students have so many technology options and resources, they are not sure how best to take advantage of them. These students believed that training for both students and faculty needs to be a higher priority on their campus.

Acquiring skills relevant to future jobs was the single most important reason students cited for greater access and utilization of technology. Generally, they felt their institutions were not preparing them with relevant technology skills. For example, an education student at a rural institution noted that his professors emphasize technology skills as being expected of teachers, yet provided little access to technology or use of these skills in their own instruction. Similarly, an accounting student at an urban institution, who already works in her field, stated, "In one class we actually worked on an accounting (software) program. But it wasn't any kind of a program you would ever use in the real world." Another student, reflecting upon her future job prospects, noted, "I'm confident with my math skills and my people skills, but not with my computer skills." Overall, students appear to have a keen understanding of how quickly the world around them is changing and that, as one student put it, "...technology is advancing much faster than we are."

All student input was not negative, however. We found, for example, a broadcast production technology program at a community college whose equipment and

[1] The computers available to students on this campus consisted of one classroom with approximately forty 286s, another lab with twelve 8086s used to teach "keyboarding", and an alternative learning center equipped with eight Apple IIe's.

instructional experience was "state-of-the-art." Not surprisingly, the program's internships were in great demand, even from students enrolled in four-year programs, and the success of its graduates was reportedly very high. At research universities we found faculty in fields as diverse as mechanical engineering and classics who were on the "cutting edge" of the use of instructional technology -- creating materials which engaged students actively in the learning experience.

Overall, however, we found a need for significantly greater institutional commitment to put information technology resources directly in the hands of students. We would suggest that it be made the highest priority through a combination of state incentives and governing board intervention especially to correct disparity across campuses.

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A strategy referred to as "computers for all students," which ensures every student 24-hour access to a laptop or desktop computer is gaining momentum around the country.[2] In other states (e.g., California, Georgia, Minnesota, North Dakota, and Wisconsin) the strategy has proven to be a powerful tool for changing the teaching and learning process. It also has the potential for ending the inequities which already exist where students with resources have their own computing devices, while others do not.[3]

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Institutions that have implemented this strategy note that the students themselves are an essential and integral part of a program's success. Because students bear a significant portion of the cost, they expect to participate in decisions about how the computers will be used and to oversee the use of dedicated technology fees. A "computers for all students" strategy can also solve the continuing space and equipment updating problems facing most institutions by significantly reducing the need for computer labs and for institutional obligations to upgrade equipment.

[2] Resmer, M., Mingle, J. R., & Oblinger, D. (1995, November). *Computers for all students: a strategy for universal access to information resources.* Denver, CO: State Higher Education Executive Officers.

[3] Results from the written survey portion of this study indicate that, statewide, approximately 30% of students come to campus with their own computers. Rural institutions reported an average of 18% of students with their own computers. Individual computer ownership ranges from 5% to 70% of students at Colorado institutions.

In our conversations with students, we described the "student mobile computing" concept, including the potential cost implications for students. Their response was overwhelmingly positive, although the idea seemed so far out of reach for the rural campuses that it was difficult for students to imagine the implications of having their own laptop computer. A student from an urban institution expressed this view: "I think everyone would squawk about the price initially, but then people would say, wow, a laptop, how cool. And then once they started using it they'd wonder how they ever did without it." Several students envisioned some of the potential benefits of the strategy. For example, one student suggested, "Psychologically, it would be a big confidence booster for students. To be able to walk into an interview with a laptop and know technology skills is a wonderful idea." On the other hand, potential fee increases worried most students. But as one student put it, "As long as I know what the money is going for, I don't have a problem with it. I think educating the students on it would be key to getting this to go across. Make them understand exactly what they are getting." Across all campuses, students made it clear that if they were able to see immediate tangible benefits, they would be willing to make a personal financial investment in this strategy.

Recommendations:

1. CCHE should, in cooperation with the governing boards, establish standards for minimal levels of student computing access, library data base access, and internet access: Such standards should be reviewed and updated periodically, and a combination of institutional funds and targeted state funds should be used to achieve these minimal standards in all institutions.[4]

2. Student training in the use of technology, especially the resources of the internet and electronic data bases, should be made a priority of institutions and librarians. In many cases, existing resources are underutilized because of a lack of familiarity from both students and faculty. Students themselves are also a good source of technical assistance and mentoring of other students.

3. CCHE should, in cooperation with the governing boards, establish pilot projects in selected institutions to put full-time,

[4] An example of such a process can be seen in Virginia, where the Council on Higher Education developed detailed cost estimates for bringing every public campus up to minimal standards in computing and telecommunications (including software, maintenance, training, and support costs; in networks, both local area and wide area (including Internet access for students, faculty and staff); and in administrative data systems. See "Proposal for Technology and Equipment: 1996-98," available from the State Council for Higher Education in Virginia (SCHEV).

24-hour access to individual computers (laptops or other "mobile" devices) in the hands of all students.

Faculty and Curriculum Development

Better student access to computing and information resources is a necessary, but not sufficient, first step for state policy. The needs for faculty development, as expressed by our respondents, was ranked very high. While the use of instructional technology is, in many ways, still in the infancy stage, there is a core of "early adopters" among the faculty who are enthusiastic and innovative in how they are using technology to improve teaching and learning. A recent faculty survey conducted by the University of Colorado shows only small levels of "in class use" of instructional technologies such as Internet and World Wide Web, authoring software, and discipline-specific software. However, the survey results indicate faculty have high "aspirations" for using such classroom technologies in the future. The greatest barriers to such use identified by the faculty were inadequate classrooms, lack of facilities, and lack of student access to computers. In addition, some institutions demand for assistance from instructional technology staff was greater than the current capacity of the institution to provide this support.

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During our campus visits, many faculty expressed the belief that use of technology in instruction was going to take time that they didn't have. This sentiment was especially strong at community colleges. Some faculty (i.e., those at research universities), expressed concerns that they would not be rewarded with promotion and tenure if they emphasized instruction instead of research.

On rural campuses faculty were most concerned about infrastructure development. For example, one faculty member remarked, "We are enthusiastic here about technology, but frustrated with this campus's lack of infrastructure." At this same campus, another faculty member noted, "Students are demanding more use of technology, and we need to stay ahead of them." At a rural community college, one faculty member in the field of horse management and training could barely contain his frustration toward the state of affairs at his campus: "I'm embarrassed when I look at where my industry is going and then look at our campus technology. Students come here from all over the country for our program, and we can't get access to on-line databases such as the American Quarter Horse Association. I'm computer illiterate myself, but I see the need for my students. My

industry has simply moved beyond me as an educator over the past three to five years."

"Students are demanding more use of technology, and we need to stay ahead of them."...a faculty member

On the other hand, at institutions with more advanced technology resources, faculty were most concerned about training and development.[5] "My concern is faculty development, faculty training, and content development because we just can't take what we have right now in the existing curriculum and use technology. It will require some modifications," said a behavioral science faculty member. At an urban institution, the faculty group we spoke with indicated that the institution had placed greater emphasis on administrative rather than academic computing. "We have so much infrastructure already. We have so many capabilities here, and so many faculty that aren't trained," according to one in the group.

On one four-year campus, we met with a core of supporters of technology in the classroom who were among an important new minority in the institution where the majority of the faculty were either ignorant of the potential of technology or adamantly opposed to its application. This group faced enormous challenges in implementing a technology-based curriculum -- out-of-date computers, not enough workstations, a shortage of licenses for software, and the near absence of a "academic computing" support structure. In the face of these obstacles, there were pockets of creativity and commitment -- from a biology faculty member using recently acquired equipment to improve student presentations, a music faculty member working to use video conferencing for instruction in areas where faculty had no expertise, and from an education faculty member who was using the Internet for graduate teacher education.

In talking with students, we discovered that they held deep reservations about their professors' ability to integrate technology into instruction. According to one student at a large state university, "My professors know their material very well, but they are not computer jocks. They need support and training on how to use computers and software."

In talking with students, we discovered that they held deep reservations about their professors' ability to integrate technology into instruction.

[5] Results from this study's written survey of campus computing directors support this finding. Developing training programs for faculty and staff was among the highest rated priorities for institutional budget planning, and providing support for faculty to integrate technology into instruction was one of the top three policy issues for almost every institution.

Another student remarked, "Faculty use of technology varies a lot. You can walk by faculty offices and see a one with a UNIX station and equipment and wires all over the place, and right next door see nothing but bookshelves." A student from a rural campus sympathized with the difficulties faculty on her campus face: "We have wonderful teachers here. Most of them are very good teachers, but don't even have computers on their desks, let alone in the classroom." "With or without technology," said an urban campus student, "teachers who are highly motivated make the biggest difference for students. When teachers are motivated and excited, their enthusiasm is highly contagious. And that counts for a lot."

One way to drive change on campus is to harness student enthusiasm. One California institution is now listing the "information technology" component of all course sections. Students can then "vote with their feet" for the faculty with the most up-to-date uses of technology. One Colorado campus president noted that students were enrolling in courses *because* of the technology component, which was a significant change from past practices.

Some campuses have begun addressing the faculty development problem by establishing "centers for instructional technology" to work with faculty to teach the basics of Internet access and multi-media presentations. We also found pockets of excellence around the state in both large and small institutions. Pueblo Community College, for example, is creating a Center for Teaching Excellence to assist faculty with content development and using technology in the classroom. The University of Colorado is supporting the "Changing the Learning Paradigm through Technology Initiative," which awarded 16 faculty projects a total of $400,000 to create innovative ways to use technology in the classroom. Metropolitan State College of Denver is launching a Center for Instructional Technology which will work with faculty interested in developing instructional materials. In addition to this, several deans at Metro State began a program this spring to encourage development of Internet-based courses. Ten faculty members from various disciplines were released from one course during the spring term. They were asked to work with a consultant along with information technology staff to develop a course for delivery on the Internet. Through this program, Metro hopes to accomplish three objectives:

One way to drive change on campus is to harness student enthusiasm.

1. allow faculty intense involvement with technology in redesigning their curriculum;

2. use technology to enrich existing courses; and

3. create a visible group of faculty on campus that will be seen as serious about integrating technology into the teaching and learning process.

We also found some less productive trends in faculty development. The current interest in faculty development appears to be focused on "presentation" hardware and software aimed at recreating the lecture mode, albeit with more interest and glitz than traditional lectures. While faculty presentations using technology are improvements over traditional lecturing modes, they are not in themselves evidence of a "student-centered" curriculum. We encourage more attention to "active learning" approaches which, again, focus on student engagement with computing technology and digital learning materials. The studio courses pioneered by Rensselaer Polytechnic would be good starting points for Colorado models.

We did not find much enthusiasm for collective approaches to faculty and curriculum development. With the exception of the community colleges (which plan to utilize the joint efforts at Lowry), we found no institutions planning joint faculty development efforts. Neither did we find any collective curriculum development efforts aimed at important problems, such as mathematics or writing skills. It is assumed by many administrators and faculty that electronic-based curriculum development will take care of itself once faculty are trained to use authoring software. We believe, however, that a more concentrated, systemwide effort in particular fields and in partnership with commercial developers would produce higher quality products at less cost.

We encourage more attention to "active learning" approaches which focus on student engagement with computing technology.

We also found few incentives and current interest in "importation" of curriculum from other institutions. Some respondents, however, indicated that their lack of action in this area was not for lack of interest but rather lack of awareness of commercial products that are available for importation. They were not sure exactly how to go about initiating such programs.

Recommendations:

1. Colorado should, along with other western states, create through the proposed virtual university, a mechanism for raising capital from institutions and from private corporations and foundations for high quality instructional software and educational programming.

2. CCHE should, through its technology grants, support more "active learning" approaches to uses of technology.

3. Governing boards should consider the "pooling" of instructional technology support funds to find economies of scale in the areas of faculty and curriculum development.

4. Institutions should be encouraged to change their hiring, promotion, and tenure policies to recruit and retain faculty who are willing and interested in using instructional technology.

5. Institutions should consider including a description of the "Information Technology" component in all courses descriptions so that students can choose faculty who are conversant with and utilizing technology in their instructional practices.

6. Student groups which conduct evaluations should consider including "use of technology" in their course evaluations.

Technology Fees

Many institutions around the country have instituted "technology fees" to cover part of the costs of infrastructure, software acquisition, and computers which directly benefit students. Several institutions we visited had instituted technology fees (e.g., students at Adams State pay $25 per year, while students at CSU pay fees set by individual colleges ranging from $25 to $125 per semester). While we expected to find some opposition among students to technology fees, the students with whom we spoke (including student leaders) were openly supportive of technology fees.

In a few cases, students had lobbied specifically for such fees but had been defeated by administrative and board opposition. A student leader from a rural campus explained, "We had an open forum on campus when the technology fee was coming about. We were all for it." The students were told that the "state" turned down their resolution to impose a technology fee. "When the state said 'no' we asked for somebody from the state to come down here and look over our campus and then explain to the students why we were overlooked in having a technology fee." A student from another institution that unsuccessfully lobbied for a technology fee remarked, "We've supported student fees in the Senate. I don't think it would be a problem if the students see a difference in what they're receiving. If they see more computers out there, more computers integrated in their classes, and more access either on campus or at home, then I don't think they would have a problem paying the extra fees."

In a few cases, students had lobbied specifically for such fees but had been defeated by administrative and board opposition.

We believe such fees are a reasonable way to share technology costs with those directly

benefiting from such investments. In some cases, it may be the only reasonable approach for increasing quality and access to technology resources. Some boards and administrators have not been enthusiastic about technology fees, either because of a philosophical opposition to raising costs or because they believed technology fees would constrain their ability to raise tuition for meeting personnel costs. While we are concerned about the overall costs of higher education, we believe it would be a mistake for institutions to compete solely on price, especially given the frustration expressed by students on some campuses regarding their poor access to technology. With the appropriate accountability mechanisms and student involvement, we believe students and their parents will support such fees.

Some boards and administrators have not been enthusiastic about technology fees, either because of a philosophical opposition to raising costs or because they believed technology fees would constrain their ability to raise tuition for meeting personnel costs.

Recommendations:

1. Institutional governing boards should, with CCHE support, encourage the use of technology fees which directly affect student access to computing and information technology resources.

2. Students should be asked to play a collaborative role with university administrators and faculty in determining expenditure priorities which directly address their concerns about access to technology.

State Financing of Technology-Based Instruction

One of the most common recommendations offered by institutional representatives to changes in CCHE policies related to the funding of distance learning enrollments and emerging "nonseat-time" approaches. While many respondents lauded CCHE for recent changes in policies which would support four-year institutions in providing distance learning courses to specific sites, others suggested that the policy change did not go far enough. Others noted the irony of the gubernatorial support for the western "virtual" university at a time when state policy constrained such activity. Several responses mentioned state policy which sent auditors to the campuses to check on "seat-time."

However, from our reading of CCHE policies, most courses delivered via technology are, in fact, eligible for state FTE funding. In March 1995, the FTE policy was amended to allow institutions to assign

credit hours for courses delivered through "alternative delivery methods," such as telecourses, self-paced computer instruction, interactive video, video tapes, and others. In these courses, credit hours can be assigned according to base clock hours or "institutionally defined" policy. In other words, if the institution does not use clock hours, they must establish policies and keep records to document how the number of credits to be awarded was determined.

The confusion over CCHE policies is understandable. With new course delivery modes rapidly changing, there are no longer concrete measures, like clock hours, upon which to base decisions. Continuing discussions are needed with institutions to gain consensus on what constitutes good practice in electronic-based curricula. The competency based approach supported by Governor Romer and central to the plans for the Western Governors University would be a good starting point.

Another point of confusion may be the language which accompanies the March 1996 revisions to the FTE reporting policy which led some in the higher education community to conclude that courses which are not "time-based" would not be eligible for funding. CCHE staff note, however, that the same courses that were eligible under the 1995 policy (which may include self-paced computer lab courses or Internet courses) still are eligible as long as the student is registered in the institution offering the course. The new policy allows technology-based courses that were formerly part of the cash-funded extended studies program to be FTE funded as long as they are delivered via interactive technology to approved sites.

There is also a belief among Colorado institutions that General Assembly funding policies (which are reflected in CCHE FTE funding policies) are aimed primarily at cost containment rather than providing incentives for expanding service delivery. If rationing of state support is necessary, there may be better ways to do this than attempting to set policies either on clock-time or mode of delivering. Other alternatives for "rationing" state support could include the following: placing specified graduate courses on a cash, nonstate subsidy basis (regardless of site or type of delivery) while extending state support to undergraduate courses regardless of site or type of delivery. CCHE and the General Assembly could also consider limiting in-state tuition subsidies to a specified number of credit hours and/or provide state subsidies only for successful completion of distance learning courses, not initial enrollment.

Recommendations:

1. CCHE should continue to examine the rationale for providing state subsidies with the objective of making subsidy and rationing policies site and medium neutral.

2. CCHE should clarify and more widely communicate the policies which provide

for alternative delivery modes and assist institutions in developing defensible alternatives to seat-time requirements.

Capital Funding

The CCHE role in developing priorities for capital construction is a process with a long tradition. A collaborative process built around agreed upon criteria (between CCHE staff and campus facilities directors) is used to provide guidance to legislative decisionmakers. This process has worked relatively well for traditional buildings and for equipment, including computing and technology infrastructure, when those requests could be judged against specific educational program needs (e.g., computer assisted design hardware and software for architecture students). However, requests for more general technology infrastructure -- for example, networking and general purpose computer labs, or upgrading of faculty computers -- have been less well-received by the legislature. In the words of one Department of Higher Education staff member, "...the higher education community needs a more justifiable process for communicating general technology needs." We would add that the commissioners themselves may need to play a more active role in setting overall policy direction in the capital funding process. It would be appropriate, for example, for commissioners to direct staff to develop criteria for "basic" technology needs, which would receive high priority in capital funding. We did note on campuses a tension between the funding of on-campus technology needs and the current emphasis at the state level for distance learning priorities. A more aggressive stance on the part of CCHE for on-campus infrastructure will help mitigate this conflict between on-campus and distance learning technology.

At the same time, the commissioners along with the institutional governing boards should look for incentives and funding streams from operational and continuing sources (such as technology fees on students), which allow for many of the costs of replacement and upgrading of technology.

A more aggressive stance on the part of CCHE for on-campus infrastructure will help mitigate this conflict between on-campus and distance learning technology.

Recommendation:

1. Commissioners should set overall policy direction in the capital funding process including directing staff to develop criteria for "basic" technology needs.

State Incentive Grants

One of the ways in which CCHE can directly affect the use of technology is through the administration of the designated technology grant funds. We found a significant amount of dissatisfaction with the existence of such competitive grant funds (especially among small institutions who believed they would be at a disadvantage in competing for grant funds) as well as some constructive suggestions for improving the process. While it was outside the scope of this project to examine the effectiveness of past grantmaking, we heard anecdotal reports of the use of these funds, which would suggest that such an evaluation should take place prior to renewal of funds. We found it somewhat incongruous that institutions without basic infrastructure for information technology had been funded by CCHE for the purchase of "high-end" equipment which would be used by only a few faculty and students. We would also note that, due to specific institutional lobbying, the latitude of the Commission to make grants has also been reduced.

We found it somewhat incongruous that institutions without basic infrastructure for information technology had been funded by CCHE for the purchase of "high-end" equipment which would be used by only a few faculty and students.

Recommendations:

1. CCHE should improve its RFP process by providing more specific guidelines as to priorities and then assure that these priorities are strictly followed by the review committee.

2. The application process should be simplified in order to ensure that small institutions without large grant writing staffs can remain competitive (e.g., limiting the length of applications).

3. CCHE should consider broadening the scope of its review committee to include experts from outside of the state and the system in reviewing proposals.

4. CCHE should ask for brief progress reports and evaluations of prior years funding as a part of any renewal application.

Cost/Productivity Issues

Given the level of enthusiasm for the application of technology to all aspects of the university, the Colorado higher education community believes strongly that technology investments are essential to the quality and viability of their institutions. It is no longer a question for most institutions of *whether* to

invest in technology, but *how and when* to invest.

Many institutional leaders with whom we spoke were quick to note that few savings, at least in the short-term, were foreseen from these investments. In other words, they viewed technology as a cost-problem, not a cost solution. This is potentially problematic, given the enormous expectations of the public and legislators for, if not cost savings then, cost avoidance.

Many institutional leaders with whom we spoke were quick to note that few savings, at least in the short-term, were foreseen from these investments.

What is needed in Colorado and elsewhere are careful cost studies which compare the costs and benefits of varying technology-based delivery systems. Clearly, distance learning programs, especially those delivered asynchronously and at home locations are less expensive in terms of capital investment than traditional campus programs. Whether their operational costs are less depends primarily on the degree to which technology, both hardware and software, can be substituted for human mediation. Even modest substitutions may result in savings over time since the costs of technology tend to decline while labor costs rise. In our interview with Regis University, which had conducted preliminary studies of the comparative costs of its "university without walls" program, they noted some cost savings over traditional delivery modes. Other savings have also been noted by observers -- especially in joint purchasing/licensing of data bases in libraries (versus separate hardcover purchases) -- and in administrative areas (although here the savings usually translate into better, faster, more convenient service than dollar savings).

Clearly, distance learning programs, especially those delivered asynchronously and at home locations are less expensive in terms of capital investment than traditional campus programs.

Higher education, like the healthcare field, is a labor intensive enterprise. Thus, cost savings will need to be found in substituting capital for labor (e.g., learning software or information networks which allow more self-directed learning), substitution of high cost labor for less expensive labor (undergraduate mentors in tutorials in place of graduate TA's or instructors) or more efficient use of faculty time (technology which allows faculty to cover and students to learn the material more quickly).

A final observation concerning cost and productivity: There are many ways to improve efficiency and productivity through the use of technology, but it is not the "silver bullet" that many expect it to be. In fact, the opportunities for efficiencies are far more substantial outside the context of technology -- for example, through deregulation of higher education from state control, through a more intense use of current facilities, through outsourcing and privatization, and through selective altering of faculty workloads.

While it is outside the scope of this study to suggest specific cost advantages in the application of technology to the academic enterprise, we would suggest the following policies for CCHE and legislative consideration.

Recommendations:

1. CCHE and the legislature should adopt incentives in the capital funding process which encourage institutions to take advantage of electronic networks in lieu of new construction when educationally appropriate.

2. Governing boards should, with state support, adopt policies which encourage on-campus students to take a greater portion of their coursework in a distance learning mode -- for example through asynchronous computer conferencing courses over the Internet. Such an approach could significantly increase the "carrying" capacity of such entities as Auraria. This would also dispel the myth that distance learning is only applicable to isolated populations unserved by campuses. (This policy would require students to have individual computer access, and thus dovetail with a "computers for all students" policy.)

3. Institutional leaders should, with state support, find ways through technology to cover the same material in less time (e.g., the "studio" model of Rensselaer). Savings from such credit hour reductions would be retained by the institution for reinvestment in the technology infrastructure of the institution. (Given current state policies, there is no incentive for such shortening of curriculum.)

4. CCHE should study the possibility of moving entire programs or institutions to a "privatized" model in order to stimulate competition and effective use of resources.

5. CCHE and the governing boards should conduct studies of the cost/benefits of various technology-based instructional programs.

K-12 Connections

Legislators and others in the general public expect a closer working relationship between K-12 and higher education. Our conversations with K-12 education leaders centered around the collection of information on three general topics:

1. major [district or state] priorities for investment in educational technology;

2. planned initiatives that would be most helpful to be done in collaboration with postsecondary education; and

3. perspectives on the most important state policy and funding priorities that should guide the state's investment in educational technology. Although the three district level education leaders interviewed represent diverse regions of the state and the particular features of their technology plans reflect different strategies, their direction of district efforts all embrace districtwide priority setting and a student-centered planning focus.

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Districtwide Priority-Setting

The interviews reveal a fairly consistent set of general priorities for the development and use of educational technology for the state and across the districts surveyed. They include:

1. equipping schools and classrooms with computers and other technology resources;

2. creating the infrastructure needed to establish administrative and instructional networks;

3. equalizing student and staff access to useful technology-based information;

4. encouraging greater use of these resources by students and staff; and

5. staff development and training for teachers

A Student-Centered Planning Focus

All our interviewees emphasized a student-centered focus. In the Delta School District, the superintendent has decisively steered the district away from what might be described as the "if you build it, they will come" philosophy into one which focuses squarely on student learning needs. In the Cherry Creek School District, "the primary emphasis in the area of instructional technology is to enhance student achievement." According to Monte Moses, assistant superintendent, "We

have tried to make certain that our technology effort is a tool and a means to an end and not the end in itself."

When asked what initiatives would be most helpful to be done in collaboration with postsecondary education, the K-12 leaders suggested that, while current linkages are not very strong, the potential for greater collaboration exists in several areas. Perhaps the most important technology-related K-12 need right now is for staff development. This is described as a labor-intensive, cost-intensive effort that, according to all respondents, is best accomplished jointly with colleges and universities.

The financial costs for a single district can be staggering: Jeffco's technology consultants recommended that for every dollar spent on technology, 30 cents of it should go towards staff development. And, like higher education, K-12 educators must work at changing some teachers' attitudes toward technology. The sentiment expressed by Monte Moses could apply easily to college faculty: "A key value for teachers is that we show them that this would not make the act of teaching harder. We are going to have to do that through staff development."

Higher education can also play a critical role in conducting school-based research studies related to technology innovations. K-12 leaders specifically mentioned a tremendous need to examine connections between technology and student achievement and the state's academic content standards. Perhaps surprising, considering legislative interests, is the low emphasis given to developing distance learning linkages for the purpose of providing high school students with access to college level courses. This is not because district level K-12 leaders consider them unimportant but rather it is due to districts meeting student needs for college level coursework by other means.

From the perspective of higher education representatives with whom we spoke, strengthening relationships with K-12 is a high priority. This priority also was confirmed by results from this study's written surveys. Higher education has played a modest but important role in providing Internet access to school districts which are in close proximity to main campuses -- for example, the productive relationship between CU-Boulder and the Boulder County Schools. Metro State also has a pilot program supported by US West to improve technology skills of math and science teachers in Denver area schools.

But there is much opportunity for new initiatives in this arena. For example, several of our institutional respondents noted the need to improve teacher training in the effective use of technology in the classroom. This will be a challenge in some institutions given the low level of use of instructional technology by their own college and university faculty.

Several of our institutional respondents noted the need to improve teacher training in the effective use of technology in the classroom.

We also believe, despite only modest interest at the present time, that there are opportunities for expanded early collegiate enrollment at the high school level. College level courses using video or internet delivery can be an exciting addition to the senior year curriculum of many high schools. For example, the Colorado Electronic Community College is using electronic means for these purposes. In addition, Colorado Mountain College is adding six high schools to its network for fall 1996, while working with K-12 personnel to develop plans for the system's use.

Recommendations:

1. Early-enrollment options in postsecondary education and Internet connectivity in schools should be made a high priority of the recently implemented technology legislation (Senate Bill 197).

2. CCHE should encourage collaboration between higher education institutions and K-12 districts and schools for joint staff development programs on the integration of technology in the classroom.

Workforce Preparation/ Continuing Professional Education

In many ways, the needs of employers for a more highly trained workforce and the desire of students and faculty to stay current with changes in the workplace is the most important issue facing higher education today. Time and again during our interviews we heard students and faculty express anxiety that, because of outdated technology, they were at a disadvantage. Faculty in fields as diverse as music, accounting, business applications, and agriculture spoke passionately of how technology was changing their industry and their fears that they were not keeping pace. In the area of distance learning, it is the employed professional who is most likely to benefit from expanded statewide infrastructure and expanded institutional capacity.[6]

Faculty spoke passionately of how technology was changing their industry and their fears that they were not keeping pace.

[6] In this study's written survey of continuing education directors/distance education directors, respondents projected their highest future market growth to come from continuing education professionals, customized training for employers, and high school students enrolling in collegiate classes.

At the community college level, we noted that many institutions had discontinued or were woefully out-of-date in fields that were technology-intensive. The costs of these programs were prohibitively expensive in some cases. However, at least one institution we visited, Pueblo Community College, has begun construction on the Gorsich Advanced Technology Center for instruction in high-tech manufacturing technologies using state and private support. With advanced telecommunications networks, the assets of this local institution may well become regional or statewide assets, which can be shared beyond the Pueblo area.

Recommendations:

1. The access of workers and professionals to telecommunicated learning at the worksite should be made a high priority of the emerging statewide network and the proposed Western Virtual University. The proposed "learning centers" of the virtual university should include employment sites.

2. Community colleges and four-year institutions with existing or emerging capacity in high-tech occupational fields (e.g., manufacturing and engineering technologies) should assume regional, and possibly, statewide roles in these areas.

3. Greater use of industry/business representatives should provide feedback

on the quality and relevance of academic and occupational programs, with special attention to up-to-date technology applications. Such outside reviews should be a standard component of governing board/CCHE program reviews.

Role and Mission Issues

Many observers of the impact of technology on public higher education, including many of our respondents, note the disregard of technology for political and geographic boundaries. Both in Colorado and in other states, we have noted significant changes because of technology in the role and mission of institutions. In some states, for example, community colleges are becoming a substantial base for the delivery of baccalaureate programs via distance learning technologies. This is not yet the case in Colorado although we found emerging new roles for some community colleges as "brokers" of distance learning providers at their location (e.g., receive sites for out-of-state graduate programs).

Several institutional leaders, however, urged CCHE commissioners to maintain current role and mission boundaries among sectors, especially at the graduate and professional level. Community colleges are also reluctant to let their colleagues infringe upon their local territory regardless of the assets they might bring.

Many observers note the disregard of technology for political and geographic boundaries.

We also found a predictable territoriality about competing enterprises such as the proposed Western Virtual University. Advocates of a deregulated free-market approach in public higher education have argued that by freeing public institutions to better compete and by opening state subsidies through student-carried financial aid programs, the people of Colorado will be better served. We would suggest, however, that market mechanisms and competition are likely to meet statewide needs only in areas where students and employers are willing to pay the majority of the costs -- for example, in graduate business and engineering. Such courses and programs might well be deregulated and privatized. In other fields -- for example, access to high quality general education curricula and high cost associate degree technology programs -- there is an important role for both CCHE and the governing boards in focusing role and mission and related funding on these priorities.

Market mechanisms and competition are likely to meet statewide needs only in areas where students and employers are willing to pay the majority of the costs.

The issue of role and mission is often fought on abstract grounds, but is directly affected by funding policies. Changes in subsidy policies, for example, funding distance learning course delivery regardless of location or medium used, implies a laissez-faire approach to role and mission issues.

Recommendation:

1. CCHE should explore a dual approach to role and mission issues -- deregulation and free-market in some areas and more strategic state investments in other areas (especially high cost fields that are likely to be neglected by a free-market or cash-funded approach).

Private College Involvement

Our study in this arena was limited to an examination of three nonprofit degree-granting institutions: Regis University, the University of Denver, and Colorado College. (The Air Force Academy was included in our written survey.) Only one of these institutions (Regis) has any substantial use of distance learning. We found its "University without Walls" program a significant resource to students in areas not currently serviced by public four-year institutions.

All three institutions expressed a desire to be included to a greater degree in the policy deliberations of CCHE. They also would like to be beneficiaries of statewide infrastructure developments, both through the technology initiative in the 1996 legislative session and to a lesser degree in the proposed Western Virtual University. The institutions also noted some interest in using the facilities being developed by the community college system at Lowry for faculty training and development.

At the same time, private college representatives continued with their stance of wanting the option of being involved in any state initiatives, but declining if they felt the regulatory burdens were too great. We would respectfully suggest that the privates might wish to take a more proactive stance, communicating the ways in which they are meeting important statewide goals if they wish to participate in emerging statewide initiatives.

Recommendation:

1. Access to statewide infrastructure resources such as the current "CIVICS" network and any emerging networks should be available to interested private and proprietary institutions.

Legislative Perspectives

In our interviews with legislators, we sought to elicit the perspectives of key Colorado state legislators on two key issues:

1. the role of educational technology in meeting postsecondary needs in the state of Colorado; and

2. the state policy and funding priorities that should guide the state's investment in educational technology. Telephone interviews were conducted with three legislators: Representative Peggy Kerns, Senator Al Meiklejohn, and Representative Tim Foster. Senator Tom Norton preferred to write out his responses and return the questionnaire by mail.

When we asked legislators about the state's most important postsecondary needs, all their responses tended to center around undergraduate education, and in particular, degree attainment. For Senator Norton, this means "being able to get a four year degree in four years." Senator Meiklejohn is concerned that getting a degree be coupled with high quality teaching and strong academic advising. Representative Kerns would add a high priority is "serving the needs of lower and middle income students who cannot afford increasing tuition." Embedded in these comments are concerns about higher education quality, access, and costs.

When first asked, legislators did not immediately see a direct role for educational technology in addressing these needs. Clearly, however, their remarks pertaining to underlying purposes for investing in technology indicate at least two important strategies for dealing with cost and access issues. The state's investment in educational technology may, in the long term, reduce capital construction costs for "bricks and mortar" while at the same time, allow higher education to extend its reach to better serve rural, elementary-secondary, non-traditional, and continuing education students. Additionally, Senator Meiklejohn felt an expanded use of technology could help higher education lower its administrative costs and achieve "substantially more efficient management."

Among the various priorities or uses legislators were asked to rate, "improving the use of educational technology for students on-campus," while considered important, received a relatively low collective rating. The highest collective legislative priority uses for educational technology include improving higher education connections with K-12, ensuring equitable statewide access to technology resources, and equipping the state's colleges and universities to take advantage of those resources. Representative Kerns' succinct "vision" for delivery of higher education may reasonably capture the

general goal legislators hope to achieve: "The total population would have access to courses and information from higher education institutions."

Although it is difficult to predict how political winds might shift, none of the legislators surveyed felt that the state's investment in technology for educational purposes would decrease over the next three to five years. Their collective opinion was support would either increase or stay about the same. It was unclear from the responses whether legislators felt the state, college and universities (with existing funds), or students (through their student fees) should bear primary responsibility for various ongoing and associated costs related to technology.

Legislators feel that business and industry have a role to play in developing, supporting, or financing the expanded use of educational technology; however, they are uncertain about what form that involvement should take. It was suggested that business and industry should be brought in more as collaborators. Partnerships and internships between the business sector and higher education, according to those interviewed, need to be encouraged.

A final note on legislative perspectives: There appears to be a gap between how state legislators and educators talk about technology's potential impact on education. Our interview findings suggest that, at this time, some state legislators may not envision educational technology as transforming classroom teaching and student learning to the same extent and degree as some "experts" do. This is more than likely the result of legislators not having sufficient information.

Recommendation:

1. CCHE should play a leadership role in informing legislators and other policy makers of the contributions that information technology can play in advancing the teaching, learning, research and service agenda of higher education.

There appears to be a gap between how state legislators and educators talk about technology's potential impact on education. Some state legislators may not envision educational technology as transforming classroom teaching and student learning to the same extent and degree as some "experts" do.

APPENDIX: PROJECT METHODOLOGY

In order to address the objectives outlined for this study and to answer some basic questions, we concluded that both quantitative and qualitative information were needed. Therefore, both kinds of data were collected through a combination of written surveys, personal and telephone interviews, and campus visits. All project data were collected during the months of March, April, and May 1996.

The written surveys were sent to all public campuses plus the Air Force Academy and the three major private nonprofit degree-granting institutions in the state. Two survey instruments were used to assess current capacity and utilization of technology for both on-campus and off-campus students. Complete results from this survey are available from CCHE staff.

Interviews were conducted with campus administrators, faculty, students, private college representatives, legislators, and representatives from the K-12 community. Business and telecommunications industry representatives were also consulted, the results of which will be reported separately.

The research team visited a total of six campuses: Adams State College, Metropolitan State College of Denver, Colorado State University, Colorado Mountain College, Lamar Community College, and Pueblo Community College. Additionally, we spoke with several representatives from the University of Colorado System. Interview questions and names of persons who participated in interviews are available from CCHE.

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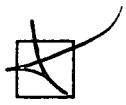

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