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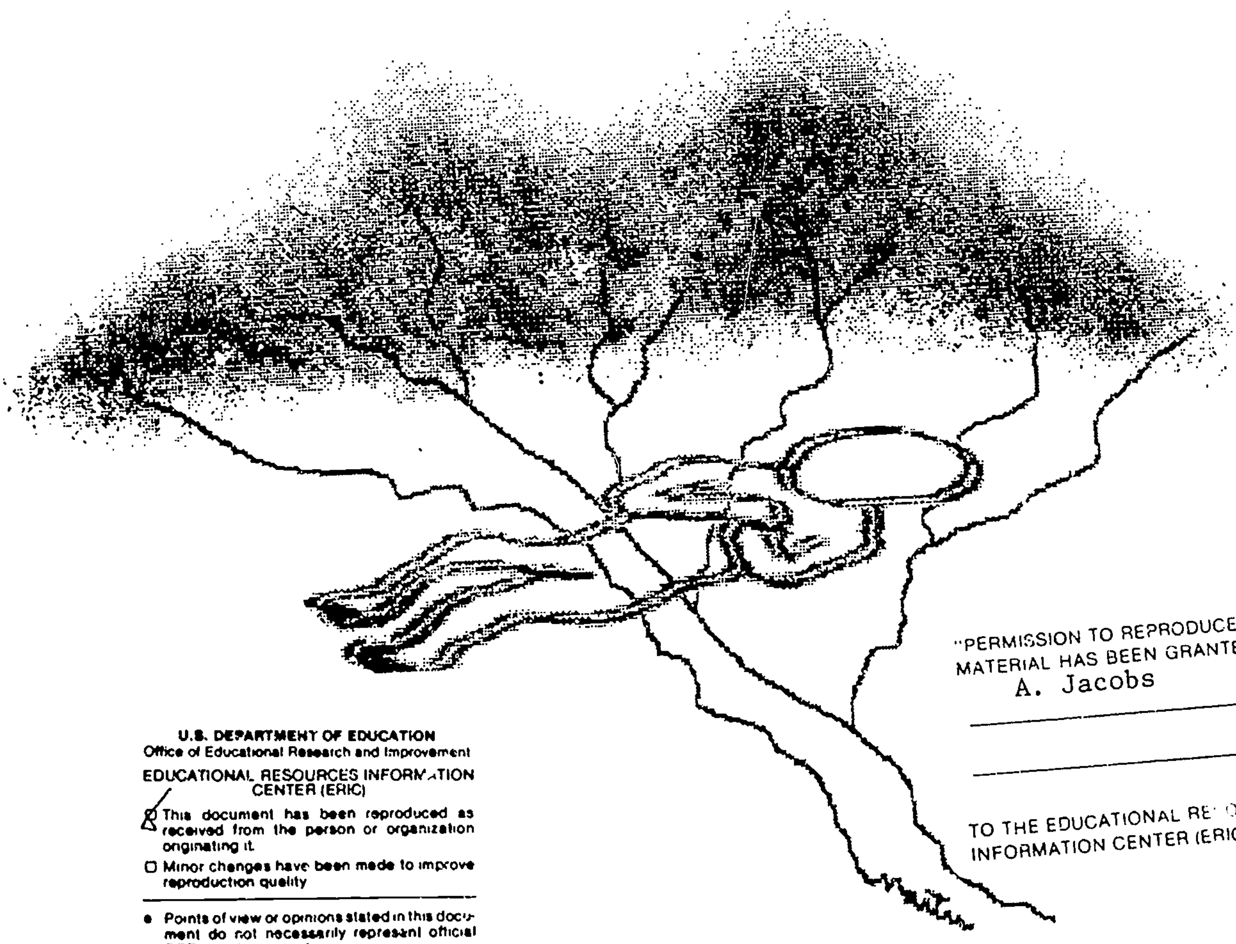
ABSTRACT

This report examines the effects of technological change on Arizona's Maricopa County Community College District (MCCCD) and assesses changes and progress made since the publication of MCCCD's Master Plan for Instructional Computing in 1986. The first section views constant change in computer technology as a running stream and examines the need for using resources to keep up with changes. The next section reviews planning assumptions and recommendations from the 1986 plan and measures progress at MCCCD as of 1993, indicating that student access to computer terminals has moved from 17 per terminal in 1986 to 7.7 per terminal in 1993 and that nearly all faculty and staff have networked desktop workstations. The next two sections describe the type of computing resources MCCCD would like to have in the future and issues of productivity, costs, learning/training, and understanding of change that present difficulties for reaching these goals. Finally, recommendations are offered for meeting future needs, including: (1) develop and implement a new learning paradigm for employee development which recognizes continual learning as a natural part of work; (2) support and encourage faculty who are preparing to relearn their art of teaching by utilizing new tools and techniques; (3) increase funding for instructional technology development for innovative projects; (4) describe and assess the effects of technology on student learning; (5) provide a base level of capital funding for technology; and (6) begin a thorough study of organizational structural reform of MCCCD. A chart of recommendations from the 1986 report and results is appended. (KP)

It's a River, Not a Lake

A Report on Instructional Technology for the Maricopa Community Colleges



January 1994

It's a River, Not a Lake

A Report on Instructional Technology for the Maricopa Community Colleges

by

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submitted to

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Vice Chancellor for Educational and Student Development

January 1994

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Preface

This report was commissioned in January 1992 by Alfredo G. de los Santos Jr., Vice-Chancellor for Educational and Student Development for the Maricopa Community Colleges, for the purpose of revisiting issues addressed by the 1986 *Master Plan for Instructional Computing,* to take note of what has changed since 1986, and to explore the current issues facing us as we attempt to find and implement effective uses of technology for college teaching and learning.

After the Introduction, the report is divided into four main sections:

1. Where We Are
2. Where We're Headed
3. Problems in Getting There
4. Recommendations

It is my hope that this report will serve to deepen our understanding of the context in which the infusion of technology into teaching and learning is taking place.

Executive Summary

This report on instructional technology, *It's a River, Not a Lake,* presents two central ideas. The first is, simply, that technology changes.

Not only does technology change within itself, but it changes us. Like a river, technology moves and changes. New technologies become available and older technologies improve or sometimes fade away. Like living on the river, we expect the relative instability of living on the current and we prepare ourselves for surprises. In the context of technology, we have grown to expect the relative instability of the technology marketplace because it is changing so rapidly. The technology marketplace will not allow us to remain fixed at one particular state-of-the-art.

This report examines the implications of this stream of changes on a number of issues, including: the cost of technology and related software, and the increased attention to learning for employees. We have traditionally thought of technology purchases as capital purchases. However, with a replacement cycle of six years, even with intermediate upgrades, we recognize that most of our technology lacks the permanence of many other capital purchases. Once we have committed to the technology stream, it costs every year to stay in that stream, by retiring and replacing obsolete technology.

Equally important to the health of the Maricopa Community Colleges, however, is the change in employee development, from a training paradigm to a learning paradigm. All employees need to learn more: faculty, professional staff, management, maintenance and operations, crafts. No employee comes to the job knowing everything they need to know for the next 20 years. In fact, most employees now spend part of every workday learning. The change of paradigm implies, among many other things, the district office and colleges will support employees who consider: What do I need to learn to do this better?, rather than the more limiting question now: What training seminars are being offered that I might need?

The second main idea in the report concerns the future of technology, specifically computing technology. The report concludes that we need to regard the network as the computer. The network is what unifies two apparently diverging developments. On the one hand technology is becoming smaller and attending to special purpose needs, as in electronic Rolodex, graphing calculators, CD-ROM books, or portable computers. Other developments attempt to unify many media into a single box to create a rich, multipurpose, multimedia environment. To regard the network as the computer may be the most useful way to approach the future.

It's a River, Not a Lake

Back in the early Eighties-really, before microcomputers were taken seriously-the conventional wisdom for data processing planning was to make decisions (hardware, software, management, etc.) that would position your company or college in the mainstream; moreover, to make strategic decisions that would keep you in the mainstream. With that strategy, one would not only be current with the current but would constantly adjust toward the center of the flow, neither to be caught in a back-eddy nor flung against the canyon wall on the outside of a sharp turn.

The stream analogy made sense then, as it does now, because a key characteristic of microprocessor technologies is that they are changing. Not only have dramatic changes taken place every few years, but we've every reason to believe that dramatic changes will continue to take place. In computing and related technologies, for example, the operating systems, the basic hardware chip sets, and the application programs will change both incrementally and dramatically.

Neither DOS nor the Macintosh Finder, nor VAX VMS, nor UNIX will be the last operating systems we'll use in our lifetimes. Each of those systems will have a lifetime, during which incremental changes take place, but each of those systems will be superseded by others.

The IBM clone, with an 80x86 Intel microprocessor, or the Macintosh with its Motorola 680x0 processor will not be the last we'll use. They may be the latest and greatest, but not the last.

Over the past 4-8 years, most of us have experienced the turbulence of the computing stream at the application software level. Software upgrades are announced annually, if not more frequently, and always at an additional cost. Competitive products capture the market for a time, only to be supplanted by superior software which takes advantage of hardware not available previously, to offer the user even more capabilities and control.

It's hard to stay in the center of the software stream. Even when you have selected a software product with a long and useful life, that has surely meant changes: incrementally, with each new version; or abruptly, as you realize you can't share files with your colleagues/run under the newer system software version/communicate with the mainframe's newer software versions/ etc. It's especially hard to stay in the mainstream when you've selected application software by companies who later went out of business, or who dropped the product from further development. When no one else is buying current versions of the software you use, that product is drifting out of the mainstream and so are you.

In either case, the result of not staying in the software mainstream (by falling far behind in version upgrades, or by continuing to use non-supported software) is ending up in a back-eddy. The back eddy is a peaceful place and not uninteresting at all, for a while. In fact the relative calm is very tempting: "Aha," we think. "Now I can get some real work done." While that is true, the stream keeps right on flowing. And after a while, it's hard to keep contact with our colleagues. They are using different software; we have less in common now. And after too long a time, we've lost touch altogether. And later, when something goes wrong, when the hardware or the software fails, there's no one to turn to for help. The rest, in moving with the mainstream, have forgotten those who stayed behind. The cost of not moving with the mainstream is isolation.

It's a river; not a lake, this experience of ours with technology. While the examples so far have reflected the stream of changes in computing, those who use other technologies will recognize the same dynamics. Consumers of recorded music have been part of a media roller coaster ride: LP record/8-track/cassette tape/CD-ROM/and perhaps digital tape. Have you tried to buy a new LP recently? Producers of music (many of them are artists and performers) have seen a two-decade change in digitally-synthesized and digitally-recorded sound, and in the control and manipulation of those sounds. Recorded music is being transformed into a genuinely different art form than live music.

It's a river; not a lake. Our behavior, then, and our decisions need to reflect that reality. Namely, we should expect continual revision of the software tools we use. They are not onetime purchases with a onetime learning component. Rather, the software represents a continual cost in both time for learning and expense of upgrades.

"The cost of not moving with the mainstream is isolation."

The same is true, though it occurs at a slower frequency, of operating systems and computer hardware. We needn't get too attached to a specific hardware model or to system software, because we know that in ten short years neither that hardware nor that system software will be in widespread use. If they can be found at all, it will be in back eddies where they are serving some single-function use. Technology purchases are not onetime purchases. They are simply the latest purchases in a stream of purchases.

Not only do the current technologies change, but new technologies emerge and recombine with the old ones: video, satellite transmission, multimedia, MIDI, and virtual reality.

This technology river is beyond our control. Like the Gila River at flood stage, it makes its own way. Like the Gila River at flood stage, it will not be ignored. It will leave lasting marks on what we do. Like the Gila River at flood stage, it has raised the cost of doing business; it is forcing us out of comfortable homes, out of formerly-secure content and methodologies.

Because it's a river, not a lake, we need to spend part of our energy and resources keeping current with the current, learning enough so that our decisions, vis-à-vis technology, position us in the mainstream. We need to continually update our own knowledge and skills with current hardware and software and their uses, with the current changes in hardware and software, and with the next changes in hardware and software. All this is necessary so that we make excellent use of our past decisions and so that we position ourselves to make quality decisions in the future. Most challenging of all, we are being forced out of old paradigms of teaching and learning; among all else we are being forced to consider and reconsider both content and methodologies. As technologies emerge and begin to influence what we do, we need to explore and evaluate their impact on teaching and learning.

In preparation for writing this report many people were asked the following question: "What will our instruction look like when we have fully arrived, taking advantage of a mature technology?" It seemed like a reasonable question, though few could articulate an answer. The truest answer was given by Dr. Larry Christiansen, President of MCC: that there will be no time of a mature technology. There will always and only be emerging technologies with which we will experiment and put to use in various ways. There will be no peaceful lake of stable resources, only an ever-changing river of new and changing technologies. There is no arrival, only approaching.

Where We Are

Did we do what we set out to do in 1986?

As described in the 1986 *Master Plan for Instructional Computing*, we had determined to improve the quality of instruction by integrating computers and instruction.

In 1986 the foundation for the integration of technology and instruction had already been established in three main respects: 75% of the residential faculty were computer literate, a major bond referendum was providing technology funding through 1993, and the colleges were rewired for voice-video-data transmission into each classroom and office.

The 1986 *Master Plan for Instructional Computing* estimated that the number of student computers would need to triple by 1991, reflecting a tripling in the number of faculty who would be expecting students to use technology in their classes.

In 1986 we intended that by 1991 students in every discipline would be using computer technology, in the form of tutorials, application tools, and simulations. And we expected that students would come to us from businesses and high schools already computer literate.

In 1986 we expected the future to include instructional applications that took advantage of the network. And we expected students to begin to use on-line, off-site information databases.

In 1986 we thought that the dominant increase in instructional applications would take place on microcomputers, not on the VAX.

In 1986 we thought that instructors would develop their own instructional software, using improved development tools that would involve less programming than earlier systems. And we thought that instructors would need better information for making technology purchasing decisions.

In 1986 we understood that faculty held the key to any successful integration of technology and instruction. Faculty would make the wise assessments of the values of technology for their instruction, would choose appropriate technologies, would judge the impact of those technologies on teaching and learning, and would take part in curriculum revision.

To help understand and quantify this focus on the instructor, four stages of technology (computer) infusion were identified:

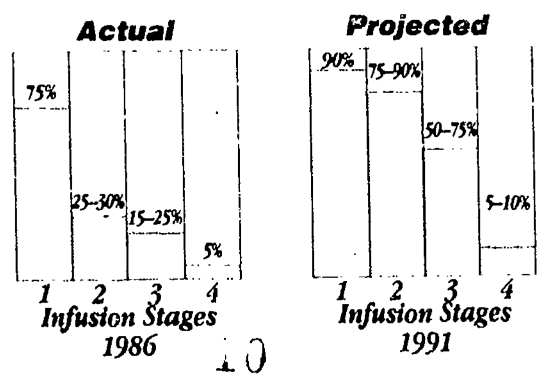
Stage 1: The instructor is computer literate

Stage 2: The instructor uses the computer for office/professional uses

Stage 3: The instructor integrates computer uses into the existing curriculum

Stage 4: The instructor reassesses curriculum goals and priorities

The two graphs below indicate the computer infusion in MCCCD in 1986 as compared to a projected infusion in 1991.



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How did we do?

In 1986 there were about 1200 student micros and terminals (and about 1300 for faculty and staff). In 1993 we have about 9,000 microcomputers and terminals, 4700 for students and 4300 for faculty and staff. The number of student micros has increased fourfold since 1986, just about matching the 1986 expectation.

In 1993 there is practically no discipline that has remained untouched by technology. Indeed, as predicted in 1986, more faculty in nearly every discipline expect students to use technology in their courses. Application software, simulation and tutorials remain common categories of student use, but three additional categories have emerged: student/student communication in course-related discussion groups via the Electronic Forum, student access to electronic information on CD-ROM and the library automation system, and multimedia. Multimedia is now considered an important area for development. In fact the use of video is now commonly included when we write about technology.

While most students come to the community college with computing skills, it is still not uncommon for students to have never used a computer before. This pattern is likely to continue into the near future, given that so many of our students are adults returning to school.

...three additional categories have emerged [since 1986]: student/ student communication ...student access to electronic information..., and multimedia.

In 1993 we have over 130 local area networks, connected to each other and to a network of VAX computers by an Ethernet backbone. In 1986, the Ethernet backbone was in place, but there was perhaps only one LAN connected to it. The intervening years have seen a growth in networks, but faculty and student/instructional use of these networks has developed only sporadically, and not as fast as predicted in 1986. The last three years have seen an increased use of file servers for shared resources and increased use of the Electronic Forum (EF). Recently there has been increasing interest in instructional access to the Internet.

Student use of off-site databases has been redirected: in 1993 students gain access via microcomputer to electronic databases on CD-ROM in each college library.

No new instructional use of the VAX was predicted in 1986. While this was true for the traditional categories of uses of instructional technology, the EF was developed on the VAX and is still in widespread use on those computers, though it is migrating to UNIX servers. INFORM, an instructional management system, has followed a similar development path: first on the VAX, later on servers. In fact, it is more clear now than it was in 1986, that the microcomputer is the computer of choice for instructional applications.

Many faculty have developed courseware for their students: tutorials, simulations, testing systems. In some cases faculty have redesigned their entire courses around courseware they've written. And many more faculty have enhanced their courses with technology-related assignments, using popular commercial software.

The chart of the predicted computer infusion for 1991 looks quite accurate from the 1993 vantage point.

Did we do what we set out to do? By many measures we have. We reached a target number of student computers: many more faculty have authored or customized or adopted software for use by their students. Students are more likely to use technology in more courses in 1993 than they were in 1986. But, did we successfully integrate technology with instruction? Or, more to the point, did we improve teaching and learning by the integration of technology with instruction? That, after all, was what we set out to do.

Students are more likely to use technology but a thorough integration of technology with instruction has only just begun. Many faculty, in some courses, have shown us some of the possibilities: video tapes which prepare students to set up their Chemistry labs and the use of some dry-lab simulations in Chemistry, Biology and Physics, for example. These technologies

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can likely be successfully used by even more faculty in more courses. Students, in some courses, use the Electronic Forum to conduct course-specific discussions. Students in many more courses can likely benefit academically from this special, time-delayed, community-building dialog.

But what else should we expect? The technologies are changing; and the adoption of new technologies will always happen gradually. Each new technology will have its beginning, its growth in use, and its transition to new technologies. The Electronic Forum is currently growing in use. The teaching of the COBOL compiler has declined, having given way to the teaching of DBase and other applications, a change which was well underway in 1986.

Any given snapshot of levels of uses of technology will reveal both its partial adoption and at the same time its possibilities for the future. Any given snapshot will picture the river, with some in the mainstream, some in secondary channels, some in back-eddies; some ahead, some behind.

Students are more likely to use technology... But a thorough integration of technology with instruction has only just begun.

Measuring the integration of technology with instruction is more complicated than counting occurrences of use. We need to know not only the kinds of current uses of technology, but we would also need to know how that college or department or faculty member is positioned to take advantage of the next changes; how they are positioned vis–à–vis the mainstream.

But did we improve the quality of teaching and learning over the past seven years? And did our adoption of technology contribute to that? These are the important questions but we have a paucity of tools with which to answer them. The measurement of the quality of teaching and learning, in particular, seems extraordinarily elusive.

In what we can measure, numbers of student computers, numbers of classrooms equipped with video and/or computer projection systems, and numbers of faculty adopting technology for use in instruction, we did accomplish much since 1986.

What we've got and what we're doing with it

To describe what technology we've got is much more difficult than it was in 1986, or in 1981 for that matter. In 1981 only 1/5 of the workstations were microcomputers. Computer users sat in front of a terminal; college users dialed into a mainframe located at the district office. Student users were mostly programming students, though some used MINITAB, and some ran tutorials using an in-house authoring language, TEACH. The mainframe could handle about 90 users at a time, though a person could wait 1-2 minutes (!) for a response after hitting the RETURN key.

By 1986 we were comfortably dispersed into distributed computing. A network of VAXes connected administrative users throughout the district. At that time about 1/5 of the administrative desktop units were micros, the rest terminals. Administrative computing applications were distributed on the network of VAXes.

Faculty and students were using, typically, microcomputers. For the most part these were stand-alone systems, not connected to the VAX network, nor networked to each other. In that sense academic computing in 1986 was "dispersed" computing. In 1986 there was, perhaps, only one local area network, in which the chief advantage was a shared laser printer.

In the period of time 1986-1993 several developments have taken place. Fueled by funds from the 1984 bond, the colleges have made enormous investments in technology.

Among the most important developments, early in this time-frame, were improvements in our technology infrastructure. We invested in an Ethernet backbone at each college, rewiring each building to give improved voice and data access to each office and classroom. Broadband systems were installed to provide video delivery across the colleges. And a microwave network for voice, data and video was built to improve the speed and quality of communications among the colleges.

Characteristics of instructional uses of technology in 1993

1. Student access to computing has improved dramatically.

   1981: 156 FTSE/terminal-microcomputer
   1986: 17 FTSE/terminal-microcomputer (Note: FTSE fell slightly from 1981)
   1992: 7.7 FTSE/terminal-microcomputer (Note: FTSE rose 40% from 1986)
   (FTSE: Full Time Student Equivalent, based on 15 credit hours/semester or 30 per year.)

Among the most important developments . . .were improvements in our technology infrastructure.

2. More difficult to quantify is the increase in the number and quality and variety of computer application programs that are appropriate for instruction. Students in 1993 still use word processing, spreadsheets, databases and drafting packages. They are still learning to program a variety of computer languages. But they are also using desktop publishing programs, presentation graphics, Electronic Forum, animation programs, and are beginning to use sophisticated Computer Algebra Systems for some mathematics classes.

3. Nearly all faculty and staff have a desktop workstation, usually a microcomputer, as an assumed part of their office furniture. In 1993 less than 1/5 of the workstations are terminals, a reversal of the 1981 ratio.

4. In 1993 nearly all employee workstations are networked, not only to the VAX network as terminals, but also to each other. There are over 100 local area networks in the district, bridged to ethernet, sharing printing resources. Use of file serving is growing, though this remains an under-utilized resource.

5. Nine sites have satellite downlinks.

6. Nine sites have the ability to send video across the microwave network.

Computers/Terminals in the Maricopa District, Summer 1992*

College	Fac/Staff Terminals	Fac/Staff Micros	Student Terminals	Student Micros	FTSE per Student Station
DO	180	644			
PC	196	545	7	542	11.7
GCC	189	505	84	1183	6.6
GWCC	90	274	21	446	3.5
MCC	354	784	33	759	12.0
SCC	89	397	21	411	10.4
RSCC	44	195	0	237	4.6
SMCC	69	195	0	237	5.3
CGCC	46	108	1	209	6.7
PVCC	62	233	0	470	4.4
*EMCCC	33	185	0	80	6.9
District Average					7.7

* figures for EMCCC are from 1993, reflecting the move into new facilities and computer purchases during the 1992-93 academic year. The other colleges made minor purchases of computers during the 1992-93, more or less matching the number of computers taken out of service.

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The Colleges and their technology agendas

...different investments are adding to the distinctiveness of each college.

Different colleges in the Maricopa District have made strategic investments in different areas of technology. And, not surprisingly, these different investments are adding to the distinctiveness of each college.

For example, MCC has the District's only set of NeXT computers. Since, in addition, MCC trains Motorola employees on SUN workstations, MCC is developing the most experience with UNIX among colleges in the District.

MCC, PC, and EMCCC are working to place the library at the center of academic life, by closely associating technology with the daily business of the library. The library, at these colleges, is reaffirmed as a center for access to information--and much of that information is available electronically. For example, MCC is pioneering network access to multiple CD-ROM databases, while EMCCC is basing its future on a CD-ROM jukebox, delivering electronic full-text information rather than making heavy investments in print material.

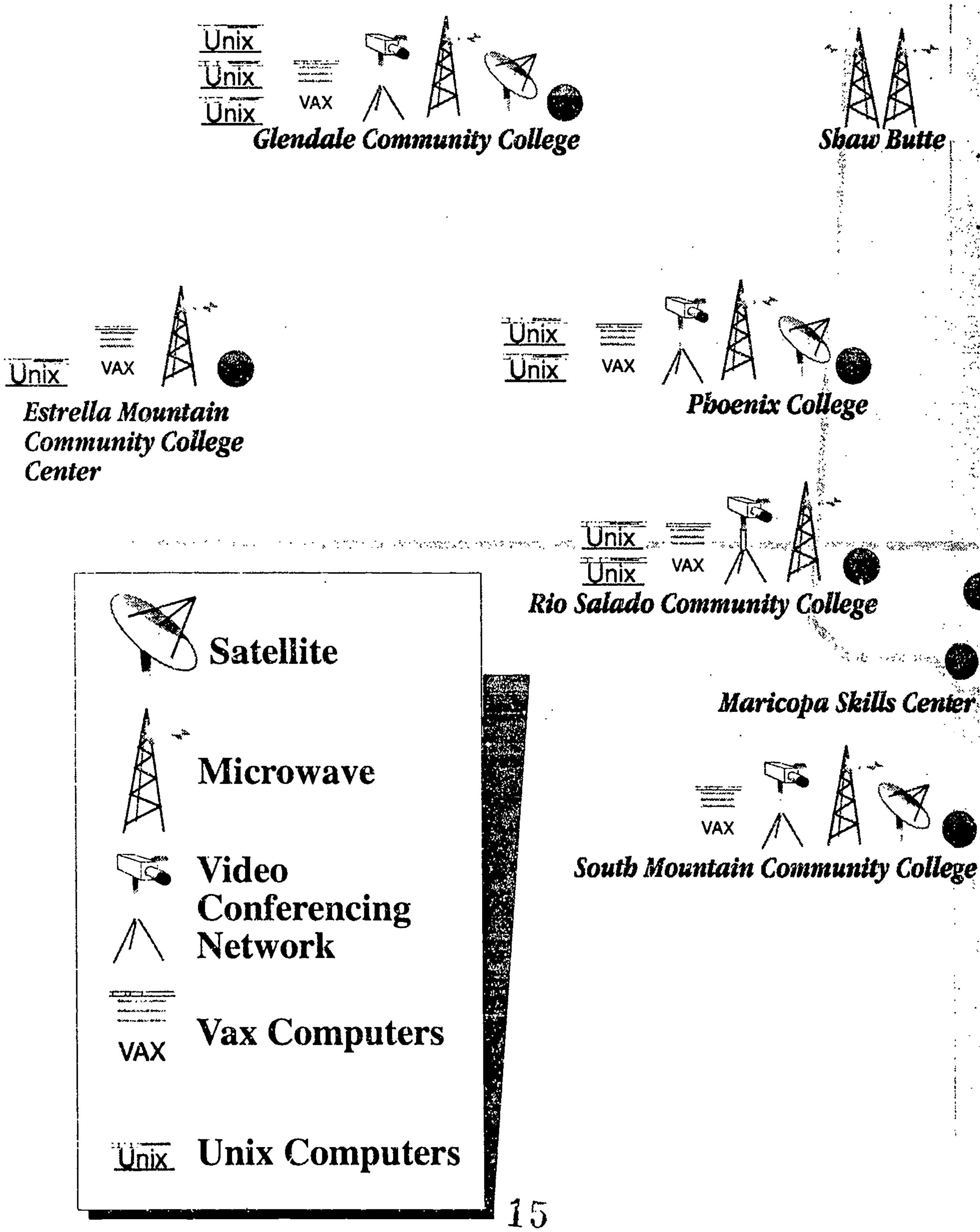
GWCC was an early leader in OE/OE courses and is now a leader in marketing customized technology training to businesses.

GCC, among many other endeavors, is putting substantial resources into courseware, testware and multimedia development, especially in the DOS/Windows environment. GCC is a technology transfer center for IBM. GCC built two instructional buildings which are technology showcase facilities, including a multimedia classroom of the future. GCC faculty and students are the most robust users of Electronic Forum (EF).

PVCC is an Apple Consortium School. With that incentive, PVCC has invested in a substantial amount of courseware development for the Macintosh.

RSCC remains the distance-learning specialist, with audio, video, phone and modem courses offered.

SCC, SMCC, and CGCC have not emerged into the '90s with an identifiable leadership niche in technology. There is a lot of creative enterprise at work at these colleges. For example, CGCC has made a focused investment in collaborative learning. As a result it is becoming a District model of this teaching/learning approach. In a parallel way, SMCC has become very good at 'human technology', in the words of Ken Roberts, Dean of Instruction, developing innovative approaches to teaching and learning that are people-based. *(I am perhaps too close to SCC to see its niche and just far enough from the others to make the caricatures above.)*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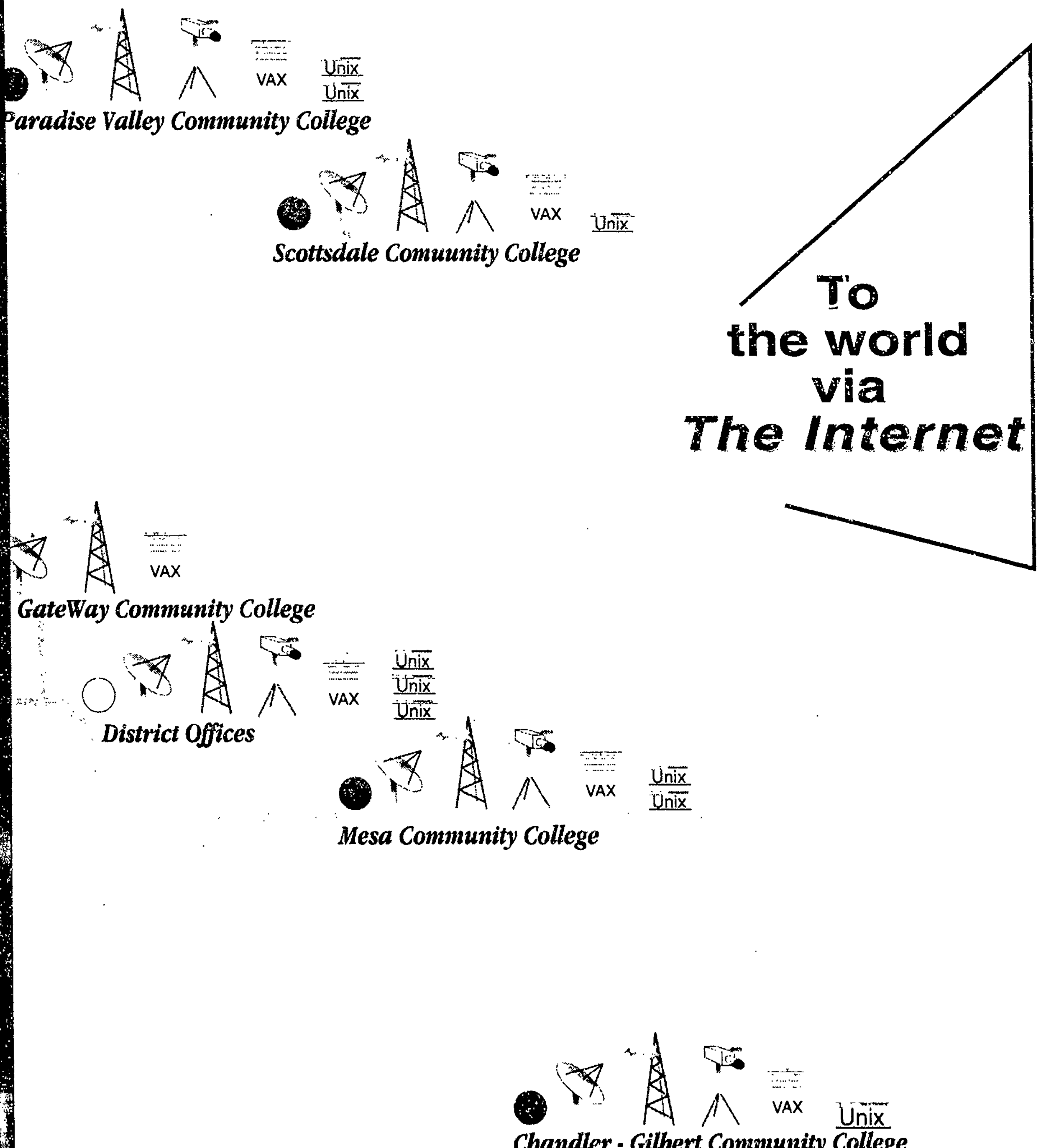
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Where We're Headed

Possible Futures

Computing hardware is moving in two, apparently divergent, directions: on the one hand is the rich computing environment, sometimes known as the workstation, exampled by the Sun and NeXT computers. On the other hand is the trend to minimalism and specialization, first by portable computers and later by graphing and programmable calculators and Personal Data Assistants (PDAs).

The lure of the rich environment is clear: the power to do everything from word processing to editing video and virtual reality, all in one machine. The rich environment provides a large, high-resolution color screen, a rich application and application-development environment, access to a network filled with resources for doing sophisticated work in a variety of disciplines, ability to connect multimedia peripherals, and the computing horsepower to bring it all together. Current, top-of-the-line personal computers provide the needed power: in the Intel world, the 486- and Pentium-based computers and in the Mac world, the 68040 computers.

The lure of special purpose devices is also clear: lower cost and increased portability make it possible for more people to use more technology more often. The PDA's and similar calculator-size devices are special-purpose, note-taking, personal-organizer computers, with small screens only a couple of inches square. These devices will provide uplink capabilities to larger systems via direct-connect and infrared connections to networks. Graphing, programmable calculators now provide personal, transportable, hand-held capability at a cost not more than the cost of comparable software on computers, without the cost of the computer.

Where do we prepare to invest? Does this divergence represent a fork in the stream, or just a widening of the main channel? In any case the divergence of this character does make it more difficult to identify the mainstream.

The link between these two diverging developments is the network. Both the rich environment and the minimalist environment assume access to a network, at least some of the time. For example, the logical development of the portable computer is the docking computer, where a portion of the base computer is portable, but at the base site one regains access to the network and a larger color monitor. The logical development of the graphing calculator is an upload/download link, not only to similar calculators, but also to base computers, so that programs and graphs can be shared and printed.

Greg Jackson, Director of Educational Studies and Special Projects at MIT, explains that academic computing has progressed through several stages. (Windows on Athena, Volume Two, MIT, 1991) For each stage below, italics are used to indicate how the Maricopa District fits into Jackson's schema.

- **Central**. Large computers provide batch processing to a limited number of users. *For MCCCD this period was pre–1980, on UNIVAC computers.*

- **Local**. Large and medium-sized computers provide remote time-shared access to a

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broader array of users. *For MCCCD this period was 1980-present, using the Intel and VAX computers. Administrative computing has remained at this stage, where users are dependent upon the VAX for major applications, while academic computing moved rapidly to the next stage.*

- **Personal**. Freestanding, personal computers are used for diverse office and instructional applications. Everyone, just about, is a user. *For MCCCD this period took off in 1984, after several years of experimental use, and continues to the present. This is the characteristic stage of academic computing now for MCCCD: not all student microcomputers are networked, though most faculty computers are.*

- **Distributed**. Powerful workstations are connected by high-speed networks to resources across the country. *For MCCCD this period has just begun. While network access to faculty and student microcomputers has been increasing since 1986, use of file servers and the Internet is just now building momentum.*

The network is an emerging technology, a new tool for teaching and learning.

Jackson describes a more ambitious fourth stage (Distributed) than we are experiencing in MCCCD. We have many personal computers (not quite the 'powerful workstation' he means) connected by moderate-speed networks, providing a limited set of network services. In Jackson's terms, we are, at our best, at a 'post-personal' and 'distributed', but not 'powerfully distributed' stage of academic computing.

Jackson sees that the imminent next stage of academic computing is **Integrated**. At this stage common applications are used across diverse computing platforms. The X-windows project by MIT is an early embodiment of this stage of computing.

The sixth stage, described by Jackson, is **Linked**–where a high-bandwidth interconnection will carry different kinds of information across the network to each workstation. The successful transmission, recently, of a video clip across the Internet is a portent of this stage of academic computing.

The network will be a definite part of our future, even if we're not sure exactly what will be connected to it. In fact, the computer we'll use for academic computing in the future is the network. The network is an emerging technology, a new tool for teaching and learning.

Our future, however, is not sufficiently described by the tools we'll be using. Our future is, really, what we'll be doing with those tools. Marshall McLuhan has said that the content of any medium is another medium. (***Understanding Media: The Extensions of Man***, McGraw Hill, 1964) For example, the content of film is a novel or play or opera and the content of print is speech. We've experienced something quite similar in academic computing. Early tutorial software looked like books and was described, negatively, as 'page-turning' software.

The first things we can think to do with a new medium are the old things we did. And the appeal of computing was to be able to do those old things faster or better: a faster way to comment on student papers, a better way to graph functions. While it was a necessary stage to progress through, we're only beginning to move out of that restricted mode of thinking. Having become competent with the new technology, we're getting ready to challenge the conventions and restrictions that our former tools have placed on our teaching and learning. We're just ready to rethink what it was that we really intended to accomplish anyway–and look with fresh eyes to see how we use the capabilities and advantages of the network to fulfill our mission.

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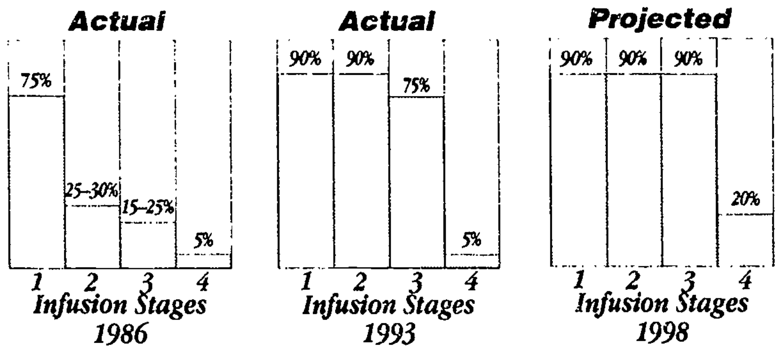
In the 1986 *Master Plan for Instructional Computing*, stages of infusion were described:

Stage 1:	The instructor is computer literate
Stage 2:	The instructor uses the computer for office/professional tasks
Stage 3:	The instructor integrates computers into the existing curriculum
Stage 4:	The instructor engages in formal reassessment of curriculum in response to the information age

...do more than imitate the old instructional forms.

Graphs on page 9 above indicate the infusion stage for 1986 and a prediction for 1991. The three graphs that follow indicate the infusion stages for 1986, 1993 and a prediction for 1998.

The figures for 1993 and 1998 reflect an expanded definition of computing, now called technology, which includes a variety of technologies from graphing calculators and desktop computers to multimedia workstations.



The next five to ten years will see a substantial increase in the reassessment of curriculum. The mathematics departments, for example, are already in this reassessment, as they have embarked on a three to six year project of curriculum reevaluation and restructuring starting the 1992-93 year.

The District Curriculum Committee has called for the review and revision of all curriculum areas, setting an October 1994 deadline. Before that October deadline and during the next five to ten years, more disciplines will challenge the current assumptions of their instructional format, including basic assumptions about time and place and duration and mode of instruction, as well as assumptions about appropriate content. And this reassessment will be, to at least some degree, prompted by the capabilities of technology to do more than imitate the old instructional forms.

The next five years may also see a change in the ways we measure the infusion of technology. We are, for example, just beginning to think about measuring the extent to which students are adapting technologies for their own learning. In this way we have begun to shift the focus from faculty usage to student usage.

Getting There is No Simple Task

Floating down a river seems like a pretty simple task. Fun, even! But, despite the metaphor of the river, making effective use of technology is not a simple task. In this chapter four issues are identified which point out the difficulties in reaching large-scale, effective uses of technology for teaching and learning. These issues are **Productivity:** determining what is effective; **The Costs:** keeping the investments in technology as a constant flow; **Learning/Training:** new time commitments for keeping up with changes; and **Understanding Change**: how changes are infused into and throughout an organization.

Perhaps "getting there" is more like "shooting the rapids." It demands our complete attention.

Productivity

An interesting question was posted recently on a bulletin board in the Math-Science Division at SCC: "Have computers made us more productive?" This is not the question of an active resistor to technology innovation. Rather, it is posed by a longtime user/developer in a Division noted for its long-term commitment to technology. In that context the question needs to be taken seriously.

Remove the word 'computer' from the question, so it reads "Has x made us more productive?" To be able to answer that question we need to be able to articulate not only what we mean by productivity but how, and in what units, it would be measured. Now the focus is on productivity, and not on the particular technology itself.

For an individual, increased productivity may be described as doing more in a shorter time, doing work of higher quality, or doing additional tasks that were simply unthinkable (or needed to be farmed out to specialists) in a pre-x era. Using x, individuals may be able to point to anecdotal evidence of improvement in one or more of those areas. For example, in the mid-80s I was pleased to be able to prepare better-looking math tests, incorporating graphic elements and typeset quality symbols, as opposed to handwritten tests earlier. The change reflected, I believe, an improvement in the *quality* of the test. But, I have also witnessed improvements in *quantity*, in particular the quantity and speed of communications within the college, across the district, and around the world. E-mail keeps more people in touch on both significant and insignificant issues. While some would argue that the quality of the communication has declined, the telephone and E-mail have combined to put me in closer contact with more people, more often.

Many faculty have increased the quantity of time they have available to their students. Tutorials and simulations (extensions of their instruction), targeted to the students in courses they teach, are available to students 17-24 hours per day. I suggest to my students that the tutorials are like an automatic teller. The students won't get full-service instruction; on the other hand the tutorials are available when I'm not.

For work groups, increased productivity is often described as doing the same tasks, or even more and of higher quality, with fewer people. The experience of the Math/Sc: nce Division at SCC may be typical in this regard. By 1980 we had 14 full-time and 19 part-time instructors with a Division Secretary. In 1993 we've grown to 25 full-time and 55 part-time instructors, and 4 early retirees, served by the same secretarial position. This has been made possible by two technology investments: 1) a network of office computers, where most faculty create their own tests/handouts to final form and 2) a new phone system which does not demand the intervention of the Division Secretary.

But the anecdotal evidence is not enough, is it? There surely were a few losses along the way. And what were the costs of implementing the productivity tool, ***x***?

In the Math/Science Division at SCC, we have probably saved hiring additional clerical personnel during the past decade, while maintaining a satisfactory level of service because of technology investments. What have been the costs? Consider $2500 per faculty workstation, replaced every 6 years, for 25 full-time faculty members. This amounts to an annual capital cost of about $10,000–barely half the average annual cost of an additional Division Secretary. Even if the desktop computers were only used for office/clerical tasks, they would be a good investment. In fact, many faculty use these computers for directly instructional matters: with software students will use for class assignments, or with professional contacts across the country.

...using computer and video technology demands persistent training.

Were the changes worth it? Were other changes also possible? Should we have done even more ***x*** than we did? To answer these questions we need to carefully define what we mean by productivity, in measurable terms.

But that is not enough, either. We need to also address whether the tasks we've been doing are worth doing at all; whether (and how much) they served the larger mission, and at what cost. For example, have my better-looking tests and handouts really served to improve student learning in some way? Perhaps they have given a more professional/commercial look and feel to instructional materials and, by extension, to the department/college. And perhaps that has had an effect on student attitudes toward the college academic culture. Perhaps the ease-of-reading has improved student learning. But by how much? And was it worth it? Was the personal touch lost in the change from the informality of the handwritten materials? And what was the impact of that loss?

So there are two kinds of productivity questions: a kind of internal productivity that needs to be articulated and measured. Assuming I want to write a math test, how can I improve its quality (in presentation), shorten its production time and lower its cost of production? And a second kind which includes some larger questions like, "Is giving this test at this time productive for student learning?"

Of course, it's not fair to ask these questions only of technology's impact. What is the productivity value, so to speak, of all the tools we use? These questions are both important and daunting. Clearly a systematic approach is needed to begin to answer these questions. Top-of-the-head answers just aren't satisfying.

The past decade has been a time when we (students, faculty, administration) learned much about the possibilities of computer and video technology for learning. It has been a decade of exploring these possibilities. And in the Maricopa Colleges we've done some serious exploring. What we're finding is that using computer and video technology demands persistent training (to be creative in this technology we need to continually improve our facility with it), access to instructional design expertise, access to programming expertise, and spacious gifts of time to reorganize our 'art of teaching'. We've been limited, often, by our own limited imaginations as much as by our limited access to the technology itself.

In other words, we're finding that the use of these technologies places different demands on our time and on the kinds of resources we need.

What is the use of technology like from a student perspective? Students are certainly witnesses to our scattered implementation across the curriculum. But have students themselves become computer users? Does the student who learned to use a function plotting program in physics use it easily in preparing a supply/demand chart in economics, or a demographics analysis for sociology? Or is word processing the only skill that moves across the curriculum! What cross benefits have students experienced? Or do computers and video technology simply reinforce the divided nature of instruction that departments embody?

Said another way, have students become more productive learners because of their uses of computer and video technology?

The issue of productivity is not so crucial when the choices are the appropriate mix of chalkboards/white boards/overhead projectors, because the costs are relatively modest for any of these technologies (and the differences in pedagogies are slight). Productivity, or effectiveness, does become an issue when the choice is the appropriate mix of chalkboard/LCD panel computer projection/multimedia lectern. The differences in costs for outfitting a classroom are so substantial that "instructional productivity" concerns can't be ignored.

Our dependence on technology implies a long-term commitment and a long-term cost.

In order to successfully discuss the values of technology for instruction we need a vocabulary and a grammar to articulate the bases for our instructional decisions. Then we need a system within which we can evaluate those instructional decisions. And this system needs to be able to distinguish between local, my-classroom-only projects, and college-wide implementations.

The Costs of Computer Technology

Once people have access to a computer and related technologies, they'll probably expect to use it regularly. Computer technology has become not only an expected part of each employee's office furniture, but has become, at least partially, integrated into most areas of instruction. It is not unusual to hear in the office setting that "I have everything on the computer!" Nor can most instructors imagine their students without access to the technologies that benefit their disciplines, whether that be tools for research, for problem-solving, or for communication. In many and varied ways, we've become dependent on the benefits of computer technology.

Our dependence on technology implies a long-term commitment and a long-term cost. The commitment is to stay in the mainstream, to refurbish and replace the technology as it becomes obsolete. The costs appear both in training/learning time, in the software costs, and in the capital costs of hardware..

The following analysis projects the costs of computer hardware into the future. This projection is based on several assumptions relating to rate of obsolescence, costs per workstation, etc., detailed as follows:

Assumption 1: Computers become obsolete after six year of purchase and will be replaced at an average cost of $2500. Actually, as we look around, we notice that most computers purchased 5 years ago have fallen into disuse. They haven't run the newer software for years, so they're no longer compatible with the other computers available. In most cases computers that are over 5 years old won't even run the current version of their respective operating systems. (This is especially vexing to students who sit at a variety of computers, in a variety of locations, preparing for a variety of courses. The lack of compatibility in disk size, software version, operating system version, even on computers of the same general class, presents unnecessarily large hurdles to student learning and productivity.) Nonetheless we have managed to find imaginative, special-purpose uses for old computers; so figure an average of six years of use for each computer system.

Some technologies do not change as fast as computer technology. Ten to twenty year old automobiles, for example, will physically wear out rather than outlive their usefulness.

Yet even in automobiles we experience the idea of obsolescence. Though an automobile from the 1920s has a certain charm, and though it (and those who keep it running) gain our respect, that car is simply not equipped for urban freeway driving. It still performs the way it was designed to perform, but in our transportation culture, it's obsolete. In contrast, computers often outlive their usefulness - they become obsolete before they physically wear out.

The typical cost of computer systems has been at the $2500 level throughout the '80s. For that $2500 we've purchased increasingly better hardware, moving to hard disks as they became affordable, to hi-resolution color as it became affordable, and to networking as that became normal and expected. Yet our typical system purchase price has not changed radically. For microcomputers put into service during the 1992-93 year, average cost for a CPU, monitor, keyboard was of $1850, district-wide. We spent about $350 per unit for printers. In fact we bought a laserprinter for each 6 micros during the year. And we spend about $150 per micro for networking, whether it's connected to a terminal server or its Local Area Network is connected by a bridge to the ethernet. So, for 1992-93, the $2500 purchases not only the stand-alone system with printing, but contributes to the overhead costs of being connected to a network.

...to insure that our technology infrastructure (especially the network) is capable of supporting the traffic.

Assumption 2: The usable life of a computer system can be extended by a mid-life upgrade of $300, on the average. The nature of the upgrade depends on the computer and industry developments. Typical upgrades have been increased memory, larger hard disk, replacement motherboard, added math co-processor, and added communications or network capabilities.

Most people want to know when you should upgrade an existing system and when it should be replaced. Probably no one knows the answer, but the answer to the following question may help: Does the upgrade put one back into the mainstream? If so, for how long? If by purchasing the upgrade one can then run current versions of software on current operating system versions, and is positioned for the next rounds of version changes, the upgrade is probably worth it. If however, the upgrade leads one further into a niche, or provides only short-term relief, then replacement is preferred.

Assumption 3: Student systems, faculty systems, and staff systems all need to be upgraded and replaced at the rate and cost described by assumptions 1 and 2.

Assumption 4: The costs of mainframe, mini, and server computers, wide-area-networking hardware, terminals, and multimedia peripherals are not included in the projection that follows.

These costs are omitted because the nature (and the costs) of our mainframe/mini computing may change radically in 3-5 years; and because the future growth of multimedia is frankly unpredictable at present. During the 1992-93 year about $600,000 was spent on computer technology that was not directly related to the purchase of individual microcomputers. Included are such items as minicomputers, LCD panel displays, hard disks, tape backups, and switch boxes.

Nonetheless, careful attention and substantial amounts of money will need to be spent during the next decade to insure that our technology infrastructure (especially the network) is capable of supporting the traffic. This money will be above and beyond the projections below.

Assumption 5: Computer systems purchased prior to 1986 (about 600 are currently on the books) will be abandoned without replacement. These are used negligibly now so that the transition to other computer systems will not have much impact on total computer usage numbers. This is an assumption for projection purposes only. Of course, those who now use equipment from that era would certainly feel a jolt if the equipment were yanked away, without being offered a transition path.

During the 1992-93 year, 135 microcomputers were taken out of service, mostly from 1985. Of the 135, most were sold at auction or used for parts by the Repair Department.

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Assumption 6: Assume that five years of computers (1986-1990) will be replaced during the four years 1993-1997. That is, assume that 1000 systems will be purchased each of the four years to replace the 4000 systems from 1986-1990.

Given the end of bond revenue funding for technology (and the subsequent failure of the 1992 Bond election), this assumption is optimistic. Hopefully, funding for technology will be resumed shortly, so that the indicated expenses are simply delayed, but not changed substantially. The longer, however, that we limp along with obsolete computer systems, the more computer systems will become obsolete, and the more substantial the early next investments in replacement systems will need to be.

Case 1: In addition to the six basic assumptions above, assume further that the total number of viable computer systems available in the district remains constant.

$2,700,000 per year... doesn't keep pace with an increasing student population, but it also fails to address any increase in the demand to use technology.

	Number of Additional New Units	Number of Replacement New Units	Running Total Number of Units	TOTAL COSTS Per Year	Running Total of Costs
1986	700		700		
1987	1300		2000		
1988	700		2700		
1989	700		3400		
1990	650		4050		
1991	1400		5450		
1992	1000		6450		
1993	650		7100	$1,625,000	$1,625,000
1994	0	1000	7100	$2,920,000	$4,545,000
1995	0	1000	7100	$2,800,000	$7,345,000
1996	0	1000	7100	$2,695,000	$10,040,000
1997	0	1000	7100	$2,800,000	$12,840,000
1998	0	1400	7100	$3,800,000	$16,640,000
1999	0	1000	7100	$2,800,000	$19,440,000
2000	0	650	7100	$1,925,000	$21,365,000
2001	0	1000	7100	$2,920,000	$24,285,000
2002	0	1000	7100	$2,800,000	$27,085,000
2003	0	1000	7100	$2,695,000	$29,780,000
2004	0	1000	7100	$2,800,000	$32,580,000
			Average per year	$2,715,000	

Assumptions:
1. $2500 for new microcomputer system
2. $300 to upgrade a system after 3 years
3. Every micro gets replaced after 6 years
4. We add NO MORE micros

Interpretation of Case 1: If all available money for desktop computer systems is spent replacing systems after six years of use, and upgrading them after three years, it will cost $2,700,000 per year, for the entire District. This annual cost extends into the future until one of the assumptions 1 or 2 changes.

This *no-growth* case means, in effect, that other colleges would actually lose systems as EMCCC grows over the next few years. It also means that the ratio FTSE/student-workstation will increase, as the number of enrolled students increases. In short, spending $2,700,000 per year, though it keeps the current fleet of computers at a reasonable level of currency, not only doesn't keep pace with an increasing student population, but it also fails to address any increase in the demand to use technology for the existing students and their courses.

Case 2: In addition to the basic six assumptions, assume that we increase the number of computer systems available by 900 per year, districtwide. This case assumes that we continue through the 1990s the same average increase per year that we have had for the past seven years.

Purchasing 900 additional systems per year is probably not a bizarre assumption.

	Number of Additional New Units	Number of Replacement New Units	Running Total Number of Units	TOTAL COSTS Per Year	Running Total of Costs
1986	700		700		
1987	1300		2000		
1988	700		2700		
1989	700		3400		
1990	650		4050		
1991	1400		5450		
1992	1000		6450		
1993	650		7100	$1,625,000	$1,625,000
1994	900	1000	8000	$5,170,000	$6,795,000
1995	900	1000	8900	$5,050,000	$11,845,000
1996	900	1000	9800	$4,945,000	$16,790,000
1997	900	1000	10700	$5,320,000	$22,110,000
1998	900	1400	11600	$6,320,000	$28,430,000
1999	900	1000	12500	$5,320,000	$33,750,000
2000	900	650	13400	$4,445,000	$38,195,000
2001	900	1000	14300	$7,690,000	$45,885,000
2002	900	1000	15200	$7,570,000	$53,455,000
2003	900	1000	16100	$7,465,000	$60,920,000
2004	900	1000	17000	$7,840,000	$68,760,000
			Average per year	$5,730,000	

Assumptions:

1. $2500 for new microcomputer system
2. $300 to upgrade a system after 3 years
3. Every micro gets replaced after 6 years
4. We add 900 micros per year

Interpretation of Case 2: By adding 900 systems per year, and continuing to replace obsolete systems, we would need to spend an average of $5,700,000 per year over the next 12 years, for the entire District. In this case the early years need about $5+ million and the later years need $7+ million, as there are more obsolete computers to replace each year.

Purchasing 900 additional systems per year is probably not a bizarre assumption. The student population will increase substantially, assuming we have more buildings for classes and more faculty to teach. Adding 900 workstations per year would surely improve the FTSE/student workstation ratio over 12 years, as it nearly triples the number of workstations in that period of time. However, the student population may easily double in that same period of time, so that the increase in workstations, even at the 900 per year level, may not actually keep up with increased demand for them by additional instructional applications.

During the 1989-90 academic year, colleges articulated both building and technology needs in preparing the 1992 Bond framework. For the time period 1992-1997, colleges anticipated that they would purchase 19,000 workstations, more than twice as many workstations in the same time period as would be purchased according to Case 2.

None of the assumptions above included costs for the infrastructure of technology and yet all assumed the viability of the infrastructure. These costs are nontrivial and must be included as a part of the total picture.

In preparation for the 1992 Bond Framework, Information Technology Services projected the following system-wide technology investments for the time period 1992-2000:

Data System	$ 6,380,000
Voice System	3,572,000
Network	1,405,000
Video System	1,400,000
Total	$12,757,000 or about $1.6 million per year.

...students will be using technology in their occupations and/or further studies, and they are counting on us to prepare them for that future.

Consider one more case for replacing our fleet of computers. If we were to replace computers every 3 years, instead of after 6 years, we would realize several benefits: 1) instead of spending $300 to upgrade the computer, we could sell it while it still had some street value, perhaps about $700; 2) we could reduce the size and budget of the Repair Department, and 3) our students would always be able to use up-to-date technology.

Replacing computers every three years instead of every six years would cost $4.5 million a year instead of $2.7 million a year, assuming the benefits of 1) above. The difference in costs increases dramatically if we assume that we would add 300 or 900 units per year. Even at the zero-growth costs, it is clear that the Repair Department is a bargain, since its repair budget (staff and operational budget) is just about $300,000, and that this department repairs the microwave network as well as the phone system, in addition to the computer-related repairs.

"Ignore your teeth . . . and they'll go away" is a favorite dental aphorism. It's true of technology, too. The cost of not renewing technology, of not staying in the mainstream, is that students and faculty will simply stop using it. The quality of the student's learning experience suffers. The end result is that the students will probably go away, too. Our commitment to technology has substantial ongoing costs simply for upgrades and replacement of obsolete hardware; namely $2,700,000 per year to maintain our present state, and up to $7,900,000 per year to maintain our growth of the past seven years. These figures are based on the average cost of $2500 to replace a computer system, the average life span of 6 years for a computer system, assuming a small mid-life upgrade of $300 after the third year. We would increase our costs substantially by moving to a three-year replacement cycle, rather than the current upgrade and repair case.

Colleges have predicted a need for twice as many workstations than the more optimistic case (2) has allowed for. Not only are the colleges aware of emerging new technologies, particularly multimedia technology, but they are also aware that faculty are requesting more uses of technology for their students, in more courses and more often.

In addition the cost of keeping the computing and communication infrastructure current will add about $1.6 million per year.

Not reported in this analysis are the substantial costs of furniture, electricity, or for software.

The total annual costs for maintaining currency in technology are sobering. But these are simply the costs of maintaining quality. All MCCCD students will be using technology in their occupations and/or further studies, and they are counting on us to prepare them for that future.

Training and the Need to Learn

When training has occurred, it's been excellent. Unfortunately, the training has only scratched the surface in terms of quantity and in its strategic focus.

Given the stream of changes in software, hardware, and the new technologies with which we do our jobs, continual learning will become a characteristic of our culture. We are not there yet, as the learning of both college procedures and software techniques are often perceived as an interruption rather than as a normal part of our daily work. We take 'time out' for training; we want it to be a one-shot experience. We like the immediate benefits of being able to use a new application program, but we are often irritated when that application is updated and we need to relearn. The attitude that learning is somehow only supplemental to what we do must change. In fact it will change. Learning, whether in the form of reading update information, or training workshops, or courses, or degree programs, or in any form, will become a regular part of the work we do.

We will more often ask the question of ourselves and of each other: *What do I need to learn* (to solve the problem)? We don't ask that question frequently enough. We do ask: How can I array all that I know to solve the problem? Both questions are healthy, but the question *What do I need to learn?* opens the door to the Information Age. It is the best question to deal with the climate of change we live in, because, more likely than not, we don't know enough to solve the current problems, even if we knew enough to solve the last ones.

In MCCCD we've done both an excellent job and a miserable job of training. When training has occurred, it's been excellent. Unfortunately, the training has only scratched the surface in terms of quantity and in its strategic focus.

Training Services at the District Office has offered one to three session workshops in a variety of microcomputer application programs, including Intro to the Mac, Intro to IBM, as well as workshops in A-1 and Bitnet. Training Services taught 679 different employees over a two year period of time, from July 1990 to June 1992. These offerings are supplemented at the colleges in a variety of ways. For example, SCC employs a technology trainer. PC and MCC are building out faculty resource centers in which training often takes place in the context of developing a project, with access to other support resources. GCC's center for courseware development serves as a similar learning resource. In other cases, employees are referred to courses that are offered through the existing college curriculum. Probably most training is 'on-the-job' training, by employees who learn the software applications as they use them.

Training is currently available on a popular, but limited set of topics. The reasons for this are clear. In the first place, the development of training workshops is fairly expensive. For example, it may easily take 280 hours to develop a seven-hour workshop. Because the technology changes, the workshop materials need updating from time to time. This factor alone limits the number of new workshops that can be prepared each year. But in the second place, there are simply too many software applications for any one person to know well enough to teach. As a reasonable result, training is available only on those applications which are extremely popular, and at an introductory level. In fact, there needs to be a guarantee of a sizable audience for the training over an extended period of time, before the training workshop would be developed at all.

Training, over the past few years, has tended to be a backfill type of training, rather than a strategic training. Of course, that's where the largest audiences are. And the need for this type of training is demonstrable. However, introductory learning of current software applications has partially obscured some of the other technology training needs we have which would keep us in the mainstream. For example, the MCCCD community needs desperately to know more about the network we're on, including 130 AppleTalk zones. And we need to learn how that knowledge can improve access to information that is available on servers within the MCCCD District. And then we need to leverage that knowledge into using the Internet. We should be using training opportunities to also prepare ourselves for the next waves of technology changes, as well as making better use of current applications.

Our training paradigm nudges us into providing training for the greatest number of people on the most popular tools. It fails to deliver strategic training; that is, in training us for the present, it fails to prepare us for the future. Our training paradigm ignores the multitude of ways in which employees could (and do!) learn.

We need to develop a new learning paradigm for employees. This new paradigm would recognize many different learning form--taking workshops, reading manuals, developing projects using unfamiliar tools, enrolling in courses and degree programs, researching and gathering information, engaging in a listserve discussion, interacting in a MUSE, serving on an Ocotillo Group, or preparing a lecture/workshop on new material or procedures.

This new learning paradigm would recognize that, of course, learning is a part of each employees' production during each week. With this new learning paradigm, college departments and services would routinely prepare learning materials, which might take the form of job aids, booklets, workshops, or electronic help forums.

The hiring workshops given by the Employment Department or the public information on servers provided by the Legal Department and MCLI point the way to implementing a new learning paradigm. The new paradigm of employee development doesn't alter a lot of what we do now, but it would expand the scope of available resources for learning. And, most of all, it would recognize and reward continued learning.

The district office and the colleges may become *brokers* of training more than *developers* of workshops. Expertise at one college may be more readily called upon by employees at another college to provide training. For example, one college may have taken the lead in a particular area, using the Internet for instruction or collaborative learning, for example. A broker would be aware of these training resources and would provide the connection to those who wanted to learn. The CIS departments, for example, may see a greater role in providing short-term, workshop style training to MCCCD employees, such as GWCC's FOCUS training course.

We need to develop a new learning paradigm for employees.

Who should be the broker? Staff development coordinators have served this role to some extent, at each college. Or perhaps we can use E-mail for this purpose: a group of people who want to learn a certain topic issue a "call for training" to all employees, via A-1, hoping for a response from a trainer.

How would the trainers be paid? As instructors of non-credit courses? ETL workshops? Credit courses? All of the above? What incentives would encourage an expert at one college to share her expertise at several other colleges, knowing that she would have less time for her college's projects? The faculty mentor project currently sponsored by MCLI, where a faculty member is paid to *be available*, may be one model to expand for sharing expertise across college boundaries.

And how would employee learners be rewarded? Salary advancement, as in Faculty professional growth? Expected as part of the job, as in ITS? Especially, how would independent learning be rewarded or even acknowledged?

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We've examined several different aspects of employee development recently. Last year an extensive study of staff development was undertaken. And Ocotillo has studied issues of training and support for technology for several years. By considering the larger question of creating a new paradigm of employee development, we may find the more narrowly-defined issues of staff development and technology training easier to address.

Understanding Change

Instructional decisions are most often, and most appropriately, made by individual instructors. Especially for that reason we have many false notions about how change takes place in a large, multiple-college institution. We're usually puzzled, for example, when successful implementations of technology in one department at one college are not immediately adopted by other departments at the same colleg–or by the same departments at other colleges. Indeed, the transfer of successful technology implementations remains one of our biggest challenges.

We need to learn about change and about the pace of change through a department or college or district. The following has appeared in the 1993 Ocotillo Report of the *Mechanisms of Technology Implementation and Evaluation* Group, in substantially the same form as it appears below. In fact improving Schema I: From Idea to Reality, on pp. 34-35, is the focus of a current Ocotillo Group: Mechanism of Change. It is included in this document because we need to develop and use a common language for describing how change takes place. Further, understanding how change works is a precursor to making good decisions about how to support technology innovations.

Evaluation of innovations can be pretty risky. Some would argue that too close an evaluation of innovations can have a chilling effect, to the extent that fewer (and tamer) innovations are attempted. And others will counter that we need to learn from each others' mistakes as well as from successes–and how would we know unless evaluations are performed?

The 1993 Ocotillo Group tended toward the latter argument: that we can build on each others' successes and learn from each others' failures, recognizing that evaluations will work best in an atmosphere of trust and support, where they might be disastrous in a hostile environment.

One is the culture of community and consensus... the other culture is that of independent professional.

The pages that follow present a description of technology infusion as it occurs within the district. And with this description the Ocotillo Group hoped to present a vocabulary and a schema for talking about technology infusion. (In fact, both the vocabulary and schema apply to many more kinds of infusion than just technology infusion.) And with the vocabulary and the schema, they hope to provide innovators and managers with a common way to think about particular innovations and what those innovations need to succeed.

Two Cultures. Instructional decisions regarding technology (actually, most instructional decisions, at all) take place at the intersection of two different cultures. One is the culture of community and consensus. A department may agree on a text for a course, or the instructional council agrees on a course outline, or the instructors of a given course collaborate on the technology applications that will be used as part of the student's learning experience.

The other culture is that of independent professional. Most notably evidenced by the large numbers of part-time faculty, but it is also seen in the myriad of small and large instructional judgments that are made by all faculty. The instructor may decide to change the emphasis in the standard course outline. The instructor may decide this semester to include a technology component in a course, as a way to solve an instructional problem that has occurred, only to choose a different solution the following semester.

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...we will always be asking the questions: "What technology should we use? And where? And When?"

Given that individual faculty judgment is a strong aspect of the culture, the schema for technology infusion must not ignore the individual. Given that a college is also a community, the schema must also reflect the striving for a sense of consistency and commonalty.

The coexistence of these two cultures implies that we might consider two different schema for describing technology infusion.

From an individual innovator's point of view, one first gets an idea, experiments with it to learn more about it, tries it out on a small-scale and, if successful, on a larger scale. During this time the idea may be revised or abandoned if it isn't working out. On the other hand new vistas may appear from initial, tentative uses. In fact, small scale implementations may reveal profound side effects which encourage or discourage further work.

From the organization's point of view--the department or college or district--an innovation catches on sporadically, and over time. Many individuals are first interested in learning about the idea, and later in trying it out. Much later the idea may be in routine use at some locations and, at the same time, other individuals are just getting the idea and wanting to experiment.

Since technology is continually changing, we will always be asking the questions: "What technology should we use? And where? And when?" And for that reason we really ought to come to grips with how we make those decisions. And we ought to set in place procedures and employ methodologies that encourage us to ask appropriate questions, and to avoid inappropriate ones, so that we can support different innovations well.

Schema I: From Idea to Reality. The following schema is proposed as a guide in understanding the development of ideas for the application of technology to instruction from the individual's point of view. This schema is intended to be a classification schema. It may be used to develop methodologies and procedures for evaluating technology decisions.

In this schema there are five zones. The first is the zone of *Getting the Idea*. Sometimes this can happen in a reflective state, but it most often occurs in contact with others, both at the college and outside, through conferences, Internet communications, professional journals, the popular press, etc. In MCCCD, Ocotillo has provided one forum for sparking ideas. In any case, an idea hits home, sparks further ideas, and leads the individual to want to learn more.

The second zone is *Learn More About the Idea through exploring, reading, research, etc*. In this zone one just wants to see what a given technology might be good for. Perhaps no instructional problem is identified at this point. The goal is just to sit behind the wheel and see where it takes you. In some cases the experiment may be to take a technology developed for one purpose and see if it can be put to other uses. In this zone, a person explores the limits of the technology and gets a feel for its potential uses. If the technology is being used elsewhere, the fastest way to learn may be to combine individual exploration with a close examination of its current use.

Zone three is the *Small-Scale Implementation*. After playing with the technology, a potential use may be identified. The small implementation is a live test of that potential use. This test may be as modest as a single assignment in a course, or as extensive as a theme around which a course is organized. However, the small-scale implementation rarely involves more than a single instructor in a single course. Small scale implementations tend to be idiosyncratic and contain high levels of personal involvement and time commitment. In this zone, the instructor often measures success by student outcomes as well as by the ease with which it fits into the rest of the course structure.

Zone four is the *Large-Scale Implementation*. Having experienced success in the previous zone, we're ready to involve other instructors, perhaps in several courses, perhaps at several colleges, in the innovation. This implementation contains an entirely different set of risks than

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Schema I: From Idea to Reality

What are the questions being addressed by the project?

ZONE 1
Getting the Idea

FROM:

Each other — Internet — etc.
Lodestar — Publications
Conferences — Ocotillo

Abandon -- Go to the next zone?

What are some possible instructional uses?
What do you hope to learn?
Who else is doing this?
Why is this idea important to explore?
Does it lead? or follow?
Does the idea have a future?
Given the choice of to experiment or to do research, or to observe others, which method is most justified in this case?
Is there a problem which you think this might solve?

What can I do in this medium?
What is this good for?
How does this work?
How might it serve learning?

ZONE 2
Learn More About the Idea

Refocus and Refine

Go to the next zone?

What do you already know about this?
What experience have you had with this?
What do you hope to accomplish?
Who else has done this?
What if it is successful? Then what?
Who else might also do this? Are they involved? How?
What problem do you hope to solve with this?

What will it take to make this idea work?
In what context can it work?
What else needs to be in place?
What is the impact on support staff?
Does it fit the target student audience?
What is the impact on student learning?

ZONE 3
Implement the Idea Small Scale

Refocus and Refine

Go to the next zone?

What do you already know about this?
What's the plan of implementation?
How long will it take?
How do you define success?
What are the costs/benefits?
How will it be maintained?
What organizational hurdles do you expect?
What problem do you expect to solve with this?

ZONE 4
Implement the Idea LARGE Scale

Refocus and Refine

Go to the next zone?

Who will be responsible operationally?
What's the process of renewal and re-evaluation?
What are the costs/benefits?
How will on-going training be handled?

It's worth doing. How can we get all the parts to work together?
Are there worthwhile results?
Any side effects?
What support really is necessary?

ZONE 5
The Idea is Now in Routine Use

Refocus and Refine

How can we improve it?

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Schema I: From Idea to Reality, cont'd

Instructions:

1. Identify the zone that best fits your innovation, by checking which set of questions best applies.
2. Questions for Zones below your identified zone are inappropriate, or at best, premature.
3. The questions associated with the decision symbol are posed prior to entering the next zone.
4. Questions may be asked and answered by individual innovators, as well as by chairs/deans, managers/funders.

Note: The questions below are intended to be a guide. Explore the questions. You may not be able to answer all the questions; nor are there right and wrong, or expected, answers.

What results do we expect from this?	Who could we look to for support?	Comments
• Personal/professional growth • A report on future possibilities • Some inspiration for others • To demonstrate a commitment to innovation • Some projects will develop to the next zone	Colleagues/Peers Department/Division Chairs Ocotillo	What can I do in this medium? What is this good for? How does this work? How might it serve learning?
• An evaluation of the project • To learn the costs and benefits of the idea • That others will learn from this experience • That not all projects will develop further • To learn its organizational impact • What is the impact on other faculty? • What is the impact on subsequent courses? • What is the impact on facilities? • What is the impact on connectivity • To learn what support/training is necessary • How has the idea changed? • Were there unexpected results? • What needs to be in place for this to be a success?	Colleagues/Peers Department/Division Chairs Technology Support District Ocotillo	What will it take to make this idea work? In what context can it work? What else needs to be in place? What is the impact on support staff? Does it fit the target student audience? What is the impact on student learning?
• Is it replicable? • Success • A replicable model • To devote $ • To fold it into on-going operations • To develop an operational plan	College President Appropriate Deans Instructional Council Department/Division Chairs Upper Level District Administration District: MCLI, ITS Technology Leadership Colleagues/Peers Ocotillo	It's worth doing. How can we get all the parts to work together? Are there worthwhile results? Any side effects? What support really is necessary?
• Results • Efforts to fine-tune it	College President Appropriate Deans Instructional Council Department/Division Chairs District: MCLI, ITS Technology Leadership Colleagues/Peers Ocotillo	How can we improve it?

the small implementation did. The other faculty may not be true believers, nor even familiar with the idea at all. Success in zone four depends on resolving issues about appropriate training of those involved, suitable standardizations, and support needs. Success depends on the proper organization of materials, keeping to a common timetable, and establishing procedures so that the idea can be self-sustaining. Success in zone four is more difficult to measure. Student outcomes and faculty perceptions are important, but so are an evaluation of the procedures, standards, and budget.

In Zone five the instructor and others are *routinely using* the idea. It is now self-sustaining and supported by the normal operational budget. Faculty and students are comfortable in the regular use of the idea. In fact, they expect to be using it.

...to understand the process by which an innovation moves through an organization.

Within each zone, faculty and other initiators revise and rethink the idea in the context of current experience. Even in the idea stage, a person is already customizing it to their own purposes. Some projects never develop beyond the small-scale implementation, but are continually revised and improved at that level.

Schema II: Adopting the Innovation. Substantial changes happened in Zone four of Schema I. The challenges for success in that zone had more to do with involving, training, and coordinating the work of others, than directly with the innovation itself. In many respects it moved out of individual decision and control to a more community effort. In fact, preceding the move to Zone Four, there was probably a group decision to attempt the large-scale implementation. For this reason, the focus on the individual is inadequate in Zone four; we need a schema which can give us insight into the movement of the idea through a community. CBAM (Concerns Based Adoption Model) is a schema which has been used for precisely this purpose: to understand the process by which an innovation moves through an organization, in the context of a large-scale implementation. CBAM is a comprehensive, grounded, tested and complex system, developed over many years. It provides both a theory and a framework for understanding the dynamics of successful implementation of any innovation in an organization.

Those who are familiar with CBAM can use its concepts and vocabulary to shed light on some of the issues that arise in Zones 1-3 of Schema I, but its main focus is: Now that we've decided that innovation X is valuable, what do we need to do to get X into routine use?

During the early stages of a project, an individual may define and redefine it many times as its salient features become clearer and as it meets the reality of student use. These salient features, however, are difficult to change once in Zone Four, Large-scale Implementation. In fact it is crucial to success in Zone Four that all participants have a clear understanding of the "expectations during the initial implementation phases." (***Taking Charge of Change***, Hord, et al, Association for Supervision and Curriculum Development, 1987) CBAM uses the concept of *Innovation Configuration* to clarify and communicate the variety of ways the innovation can be implemented successfully, and it clarifies the critical components of the innovation. During the implementation, the innovation configuration can be used as an evaluation guide, both to promote the success of the innovation and also to address the question of how well the innovation has been implemented in terms of its own description of success.

CBAM is based on several assumptions about change:

1. Change is a process, not an event.
2. Change is accomplished by individuals.
3. Change is a highly personal experience.
4. Change involves developmental growth.
5. Change is best understood in operational terms.
6. The focus of facilitation should be on individuals, innovations and the context.

CBAM works as a tool for guiding the infusion of an innovation, once the decision has been made to implement it.

Current Technology Innovations

The Maricopa Community Colleges are pursuing a wide variety of technology innovations, in three currents: networking, authoring, and funding.

Over the past few years departments and labs have invested in local area networks with servers which offer access to both common applications and information. There are over 130 local networks, mostly AppleTalk, which are connected to each other. The libraries are installing local area networks so that information resources at the college, or from external sites, can be accessed by multiple stations. These local area networks are growing in number and in the sophistication of task because of local decisions made in response to need and the maturing of the networking technology.

Looking outward, Information Technology Services has provided and promoted access to the Internet for the colleges. Excitement over the quality of professional contacts and communication has been developing among faculty and staff for a few years. Just within the past year a sprinkling of student-instructional uses of the Internet were beginning to develop.

Access to the Internet has contributed to the introduction of other applications, in particular the MariMuse project. Established at Phoenix College, this implementation of MUSE brings a powerful community building resource to a learning community.

Information Technology Services has also provided and promoted a districtwide microwave two-way video network, named VCN. With this technology, courses presented at one college can be simultaneously presented at other college sites. Students at each locale can be seen and heard by the instructor at the host college.

Besides networking, courseware authoring is a strong innovation current in MCCCD. As development tools have become more sophisticated, more faculty, as part of authoring teams, have been drawn into the creation of courseware. GCC has invested in Toolbook for Windows as a multimedia development tool in several disciplines. At MCC, a group of developers is producing magnificent courseware/simulations using NeXTStep.

The third current is funding. Faculty, departments, colleges and the entire District have begun to seek external funding in a much more concerted way. For example, several NSF grants for technology and curriculum change have been awarded during the past year. Colleges are seeking partnerships with business and industry–leveraging our ability to deliver training toward the receipt of both technology products and expertise.

...the larger problem has been to try to coordinate the scheduling and promotion of VCN courses among the colleges.

In the course of preparing this report, two technology innovations were examined in more depth. The first, VCN, is being actively promoted in the District as an instructional delivery medium. The second, Athena, is, at least for the moment, a path not taken.

VCN: The Video Conference Network (VCN) is a multi-site microwave video network. VCN is used for delivering instruction, meetings, and special events across the network to recipient colleges within MCCCD. Nine sites have installed a CODEC unit, with other support devices, to send and receive the video transmission. At the present time no sites external to MCCCD are connected.

VCN began operation during Spring 1990. Since then 24 classes have been offered on the network. For Fall '93 four courses were broadcast, with eleven scheduled for Spring 1994. It is expected that VCN will send 10-15 courses per semester, with about 2.7 sections for each course; i.e. an average of 1.7 recipient sites per course. The four courses in Fall 1993 had an average of 27 students per course. In addition to courses, VCN has also supported 60 meetings and five teleconferences during the past three years.

The investment in VCN has been interesting to place in the Schema I: Idea To Reality (pp. 34-35). It looks like the Zone 2: *Learn more about the Idea*, and the Zone 4: *Implement* *the idea Large-scale* happened simultaneously. That is a slight overstatement in that some key people were already quite knowledgeable with the system. Nonetheless, most of the participants in the implementation (faculty, deans, technicians) were novices to the technology.

So, VCN might be termed a large-scale experiment. And judgements about it need to keep in mind that, in many ways, we're just 'kicking its tires' to see what value it might have for us. There are possibilities of large off-site services, links to even wider distribution via satellite, as well as a variety of internal uses. Our current use is very introductory and exploratory.

During the first seven semesters of use a number of challenges emerged. There have been many technical problems to resolve, including the consistency of transmission; training faculty in the use of the system; supporting faculty in reworking materials to fit the medium; and finding the right level of technical support before and during the transmission itself.

While these problems have been pesky, nontrivial, and only partly resolved, the larger problem has been to try to coordinate the scheduling and promotion of courses among the colleges. So that information can be included in the published course schedules, commitments have to be made 6-9 months in advance of the actual course offering. While this corresponds to the colleges' earliest deadlines, the coordination has proven to be difficult to master. In fact, it has been possible only with the commitment given by the deans of instruction. As of this writing it looks as though progress is being made on all fronts, such that the contours of what it will take to make VCN work are becoming much better defined.

On the surface, the only way a college benefits from VCN is by receiving courses, not by sending them. Assuming that each college gets its own registration, whether a sending or a receiving site, the sending site has the following costs: employs a faculty member to teach the class, as usual, but places that class in an expensively-equipped room ($5,000-10,000), pays a technician to look in on the room to see if everything is working properly, and pays for training the faculty member and a rework of the curriculum materials. For the sending college, there are only increased costs and no additional revenues.

For the *Receiving College*, there are some benefits. A course is being offered which is probably not being offered in any other format, so students are being well-served, and some revenue is being generated. The receiving college also has costs: an expensively-equipped room, pays a technician to look in on the room to see if everything is working properly, and pays a clerk to assist during the class. These expenses are less than the sending college, some new revenue is generated, and students are able to take courses otherwise not available at their college.

Why would a college want to send a course on VCN? Besides the excitement of leading in a new venture and the pride associated with that leadership, it can only be seen as an investment in future possibilities. Having this knowledge and experience prepares the college to take advantage of opportunities for, who knows, delivery of courses internationally, or other opportunities which may develop the revenue to pay for the service.

Four recommendations:

1) Identify a limited clientele of faculty and their courses. Provide focused training and resources to this group to learn to utilize the medium to its best purpose, and to rework the organization and presentation of material, class handouts, etc. Train these people to be really good at the use of the medium.

2) Prepare a comprehensive operational plan, for a two-year period of time, with target dates for the major milestones for each semester's course schedule, planning for cross-college promotion to build enrollment, assigned areas of responsibility for key people.

3) Set a date for an evaluation, including cost/benefits.

4) Don't invest substantially more money in hardware until the current large-scale experiment has been evaluated.

Note: As of Spring 1994, VCN will be managed at RSCC. However, the aforementioned recommendations are still encouraged.

Athena's distributed client/server model reflects major trends in computing.

Athena: The Athena Project from MIT points the way to a possible future, namely the distributed client/server model. In Athena many high-end workstations are networked together with some server computers. While most applications run on the workstations themselves, each of the server computers has specialized services to deliver to the workstations: handling printing requests and authorization, file storage, and user authentication, to name a few.

With Athena a user can sit at any workstation and have access to his/her personal files and have access to any available software program. Thus, Athena combines features that are common in mainframe computing, without a mainframe computer, with features that personal computer users have enjoyed, like local processing and a graphic user interface.

Because Athena is a network, inter-user communication is available both as an instant message and as E-mail.

Athena runs on workstations and servers that themselves run on the UNIX operating system. Much software currently available in MS DOS, Windows or Mac OS is not available under UNIX, so the current software selection is limited. Of course, as third party software is developed for UNIX, the number of options will increase.

A great deal of the functionality of Athena is currently available to most MCCCD users. Most users have access to file and application servers. Nearly all employees take advantage of A-1 for interpersonal mail.

The value that Athena adds is that it is a comprehensive client/server system where all users have access to documents and applications on servers without relying on a single, large computing resource like a VAX computer. Since personal documents and all applications are stored on a relative few servers, and since it is a consistent system from any workstation, maintenance, upgrades and training can be handled by a smaller staff than other systems.

In Spring 1992 LeRoy Stevens, PC, led a project "to determine whether Athena technologies are appropriate and feasible to meet instructional objectives in the community college environment." (***Athena Year End Report***, LeRoy Stevens) Beset by installation problems, the end-of-the-semester time crunch, and ultimately by the loss of hope caused by budget shortfall, the investigation was less thorough than originally planned. In his report, Stevens writes that faculty were favorably impressed with the workstations, but that multi-user software was very expensive. Evaluators were concerned that Athena would cost too much in operational support. And, because of its heavy use of the network, Athena would certainly tax our current network resources. The cost of Athena workstations is sobering, at $10,000 and up.

In early June 1992, Alan Jacobs, SCC, and Naomi Story, DO, visited Iowa State University at Ames to investigate Project Vincent, an implementation of Athena. Project Vincent has been in operation for two academic years, serving research needs and upper division students in science and engineering. Following the distributed networking model, authority for Vincent is also distributed to department level Kahunas, local leaders who assume most of the responsibility for authorizing access to that area's workstation resources, and control over software updates, for example.

Iowa State, as well as MIT, is convinced that they can manage many more stations with fewer people because of Athena's sophisticated networking control system.

Overall assessment

1. Athena is too expensive; not Athena itself, but the workstations that run it. When Athena operates on hardware in the $3,000-4,000 range, it will look better to us.

2. Athena's distributed client/server model reflects current major trends in computing. For this reason we should keep in touch with Athena, as it matures over the next few years.

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Recommendations

Based on the previously-discussed status of instructional technology and as we anticipate and meet future needs, I offer the following recommendations.

1. **Develop and implement a new learning paradigm for employee development which recognizes continual learning as a natural part of work.**

   This recommendation has its source in the need for continual technology updating. However, it also recognizes that more is changing than just technology. We need to develop many more ways to enable learning, to recognize learning, and to reward learning. See pp 30-32 for further discussion of this issue.

2. **Support and encourage faculty who are preparing to relearn their art of teaching by utilizing new tools and techniques.**

   During the last decade, many faculty have experimented with technology in their courses. During the next decade, many faculty will make commitments to change curricula, delivery style and outcome expectations for courses they teach. Faculty will need institutional support for these retooling efforts. We'll need to direct resources into creative ways of restructuring instructor time, encouraging collaborative efforts, and providing implementation support.

3. **Continue to explore new technologies' impact on teaching and learning, especially in time of budget cut backs.**

   The technology mainstream is continually shifting. We need to continue to probe new technologies--to discover what doesn't work as well as what does.

4. **Increase funding for instructional technology development for innovative projects.**

   Fund those who wish to learn more about specific technologies and their applications to teaching and learning, as well as those who wish to develop technology-based materials for their courses.

5. **Increase funding for Ocotillo, so that it can undertake a wider variety of activities which will involve even more faculty and staff in its discussions.**

   The Ocotillo groups offer a superlative medium for generating and growing ideas related to improving learning through technology. Ocotillo remains **the** forum for investigating district-wide issues relating to technology and instruction. An enormous number of different employees have been involved in Ocotillo and efforts should be made to increase this number.

6. Begin to describe and assess the effects of technology on student learning.

What additional benefits have occurred? Any negative side-effects? We need to learn more about both, as we use technology more. Through FIPSE, a project called *Flashlight* is planning to address this issue.

7. Develop a change model for MCCCD to give us a common vocabulary for describing how innovations flow through our organizations.

Every aspect of MCCCD will continue to experience change. We'll communicate much better with each other regarding those changes if we share a common vocabulary about the process of change. An Ocotillo group is currently working to accomplish this.

8. Provide a base level of capital funding for technology.

Course fees and user fees for technology, as well as external funding sources, should simply supplement a base allocation for technology. Technology resources need to be renewed continually.

9. Begin a thorough study of organizational structural reform of MCCCD.

The way we are currently organized both encourages and discourages efforts to respond responsibly and creatively to change. We can't afford an organizational structure that gets in our way. So we need to change those structures and systems that impede rather than propel the flow.

Appendices

I. Recommendations from 1986 and the Results

Recommendations	Results
1. **Establish an Instructional Computing Information Fund, $20,000 per year.** This would fund faculty and staff research and the development of presentations on current technologies. The goal was to use the entire pool of MCCCD talent to disseminate information and to provide training.	This was not funded, nor was it implemented in a comprehensive way. Interestingly, a variation of this recommendation reappears in *It's a River, Not a Lake*, with a greater emphasis on training.
2. **Establish an Instructional Computing Development Fund.** Funded at $100,000 per year, this would fund the development of instructional software, courseware and templates.	This was funded continually since the 1987-88 year. Through this fund 35 projects have been funded in Psychology, Biology, Physics, Drafting, ESL, Math, Library, and English, as well as several interdisciplinary projects. This fund has provided seed money for the development of tests, tutorials, curriculum rethinking, and the exploration of different technology tools for instruction. The results of these projects have tended to remain local to the faculty member, department, or the college which received the funding.
2A **(Alternative to 2) Award funds to Instructional Councils.** This would involve the discipline-based instructional councils directly in planning the integration of technology in their own disciplines.	Not funded, in favor of Recommendation 2.

Recommendations cont'd	Results cont'd
3. **Use the computer itself as the information exchange.** Use the VAX network as the basis for a BBS system for disseminating information, questions and answers, and access to public domain software.	Mixed results: • A student-use system, called Electronic Forum (EF) was developed at GCC and is now in use at each college in MCCCD, as well as several other sites. • The increased use of file servers has prompted network access to information and software. The District Legal office has, for example, created a Public Access Server with legal information on a variety of topics. • Both faculty and students have access to listservers on the Internet. This use has increased dramatically the past two years. • The use of forum/discussion groups within the district for district employees has not developed. Discussions often take place on A1, our E-mail system, but seldom use EF or VAXNotes.
4. **District should maintain lists of software prices and discount options.**	No formal lists of prices are maintained. Computer coordinators often share information with each other and with the district purchasing office and provide, in turn, purchasing information on suggested vendors. It still seems like a desirable goal, but the reality of a rapidly changing market makes it difficult to maintain lists of current best prices.
5. **Form a public domain library of microcomputer software.**	Now irrelevant. In 1986 it looked like public domain software might be a viable alternative for education. However, it turned out that only the commercial distribution of software provided the quality that we expected.
6. **Develop and maintain a current directory of software in the district.**	Some colleges use the library's on-line catalog to maintain an index of at least some software.

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Recommendations cont'd	Results cont'd
7. **Continue print publications to disseminate information.**	Publications have come and gone. Several internal publications provide information about technology, including *The Forum: Sharing Information on Teaching and Learning*, *The Labyrinth: Sharing Information in Learning Technologies* and *Training News*.
8. **Host an annual MCCCD Computing Conference.**	Most years an event has been held: the Ocotillo Expo or the Ocotillo Showcase. These events have consisted of faculty/staff demonstrations of projects utilizing technology with instruction, as well as vendor displays.
9. **Bring C-IT to the colleges.**	C-IT (now called MCLI) did prepare a road show, demonstrating technology to most of the colleges. This did not become an annual event. Since that time, several colleges have established their own demonstration centers for new technology.
10. **Provide faculty with an array of development tools.** Promote and teach the following development tools to faculty: • Application shell software • Templates • Author languages • Standard programming languages	Most colleges have provided training for faculty in courseware development on the most popular development systems: HyperCard, Toolbook, and others. Probably 20% of MCCCD faculty have developed computer-presented instruction at one time or another.
11. **Establish a team of peer consultants at each college.**	This model for support did not develop. Instead a staff model for training and support has become more typical.
12. **Establish college instructional programming resource centers.**	Three colleges (PC, GCC, and MCC) provide programming support on a regular basis. Other colleges have provided such support on an intermittent basis.

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Recommendations cont'd	Results cont'd
	PC, GCC, and MCC have provided the most robust support for faculty courseware development.
13. College Computer Groups become catalysts for planning.	These advisory groups have been involved in planning, but the catalysts for that planning have been preparations for the Bond election and Ocotillo.
14. Formalize a royalty/copyright statement which serves to encourage faculty developed computing projects.	Such a statement has been included in the faculty RFP.
15. Bring to MCCCD speakers who challenge and enlarge our vision of instructional computing.	Many outside speakers have challenged and enlarged our vision of technology and learning, brought in through the Lodestar program, Ocotillo, the Honors Forum and others.
16. District should negotiate site licenses.	This seems to happen at the college and department level. It's probably unreasonable to expect it to happen at the district level. Not only do most vendors consider the 'college' to be the unit size, but it is also extraordinarily difficult for all the colleges to agree on a common software for any instructional purpose.
17. Spend more money for microcomputers, less for VAX.	That's what happened. As microcomputers, networks, and servers became mainstream, more money was spent on those technologies than on improving the VAX technology.
18. Formally establish The District Academic Computer Users Group (DACUG) as ITEC's advisory group.	DACUG withered and disappeared. In its place Ocotillo has become the inter-college, interdisciplinary instructional technology forum. ITEC continues to have one faculty representative.

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II. Chart: Percent of computers by year of purchase for each college.