ACADEMIC COMPUTING IN U.S. COLLEGES AND UNIVERSITIES: A SURVEY

Dr. Adolph I. Katz
Information Systems
Fairfield University
Fairfield, CT 06430

Michael Castonguay
Accountant
MBI Corporation
Norwalk, CT

ABSTRACT: A sample of colleges was surveyed to obtain a snapshot of how these colleges were using information technology in academic programs. The schools included in the survey were not a random sample. Our intent was to discover what colleges, large and small, were doing with computers, networks, and software. Our results are not meant to be interpreted beyond this objective.

The study reveals a broad range of applications and diverse levels of use of information technology. While five of the 33 schools in the survey require entering freshmen to purchase a computer, several schools have student-machine ratios of 40:1 or higher. Word processing is the dominant application. As the institutions move to computer networking, there is a trend towards increased use of E-mail, on-line library access, and computer-conferencing. Multimedia approaches to instruction are also occurring, stimulated in part by the availability of extensive compact disc libraries of audio, textual, photographic, video, and graphic materials. Systems and software training, for faculty and students, are major costs for academic computing services.

KEYWORDS: Information Technology, University Computing, Academic Computing

INTRODUCTION

Computers and telecommunications networks, together with extensive and varied databases, are being used to improve efficiency and effectiveness in business, industry, and government from the production floor to the board room. At the same time, enabled by information technology, major changes are taking place in the workplace including a more rapid pace of doing business, democratization of information, internationalization of activities, and increased emphasis on quality. In view of these environmental trends, what is the role of information technology in the academic programs in colleges and universities? To help answer this question, we surveyed a number of colleges to obtain descriptive data on their computing facilities and use of information technology.

Although the sample selection process was arbitrary, we did include a diverse group of schools with respect to size, type, control, geographical location and academic computing reputation among institutions of higher education in the U.S. Our objective was to obtain a snapshot of computer resources and support programs at institutions that were just establishing college-wide computing programs, as well as schools that were leaders in the application of information technology.

Thirty-three schools were included in the survey. Twenty-seven schools were contacted by telephone (Appendix A).

Information about six additional schools (Appendix B) was obtained from articles in trade and professional journals. A demographic profile of schools in the survey is presented in Appendix C.

FINDINGS

Student Computers

The data obtained from the survey are summarized in Appendix D. Detailed background, computer related data, and program information for the thirty-three colleges are contained in a "**Background Information Section**" of the original study. Copies of the material can be obtained by contacting Dr. Adolf I. Katz at Fairfield University. Five of the thirty-three schools require entering freshman to purchase a computer:

- Bentley College, 1984
- Clarkson University, 1984
- Drexel University, 1983
- Stevens Institute of Technology, 1982
- Virginia Polytechnic & State University, 1984

Virginia Tech is the only state controlled institution that requires students to purchase a computer.

Clarkson University issues PCs to incoming students [4]. The computer remains the property of Clarkson and the student pays a security deposit of $250. "At the time of the student's graduation, the issued computer may become the property of the student by forfeiting the security deposit." Repairs are done by the Educational Computing Service Center of the University. All students take an introductory computer course.

At Clarkson, students perform traditional activities with their own PCs in new ways such as accessing a "computerized course register" to search for courses of personal interest during registration. On-campus "software vending machines" hold a large number of programs that may be copied freely. Faculty members place course material on these "vending machines" for easy access by students.

Bowling Green State University has a pilot program in one residence hall where every student has a computer in his/her room [11]. Students are billed between $135 and $210 a semester, depending upon the computer system selected. The computers are networked using Appletalk. According to the director of computer services, this investment will shift the use of the computer labs from word processing to more specialized needs.

Training

Training is key to the successful implementation of computer technology. Faculty members must be familiar with the computer and its applications in order to take advantage of the potential of information technology in teaching. Fourteen of the twenty-seven schools surveyed by phone have a Faculty Support Center dedicated to providing faculty training, technical support, assistance in developing courseware, and demonstrations of the latest hardware and software.

Drexel University has a facility coordinator and support staff for its center. The University of Michigan has three offices of Instructional Technology to help faculty to introduce technology into the classroom. Faculty can work on their own or visit the demo center to learn the latest in multimedia technology.

Eight of 27 schools in the phone survey have a college-wide core-curriculum computer literacy requirement. Some schools had computer requirements established by specific academic departments or programs. Illinois State University, for example, requires students to take a computer literacy course to satisfy the English core requirement!

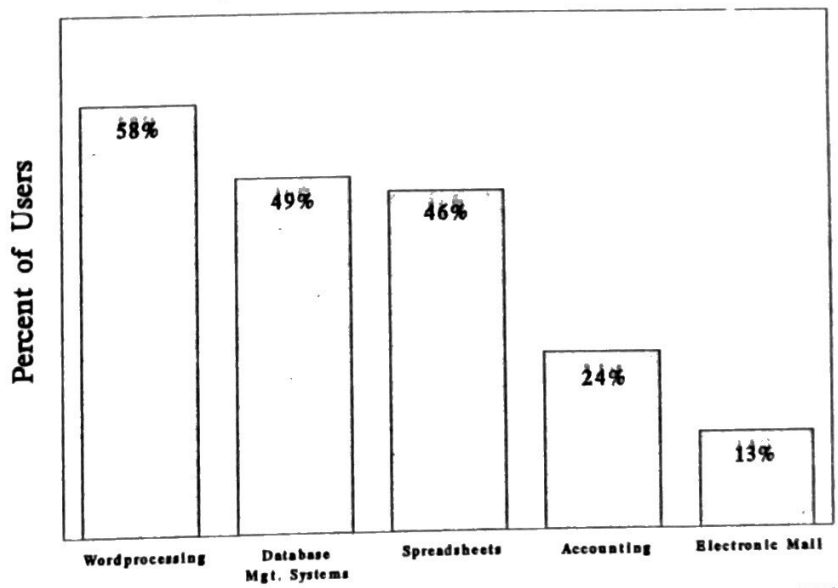
All 27 of the schools in the phone survey provide non-credit student workshops for application software training. The University of Michigan provided over 25,000 hours of workshops in 1990. Stevens Tech provides workshops for both students and faculty once a week.

Popular Software Applications

In a 1988 survey of 1000 computer users [13], Computerworld reported the following ranking for software applications:

In our phone survey, we asked the schools to identify the top three computer applications on their campus. The results are summarized on the following page:

Figure 1: SOFTWARE APPLICATIONS



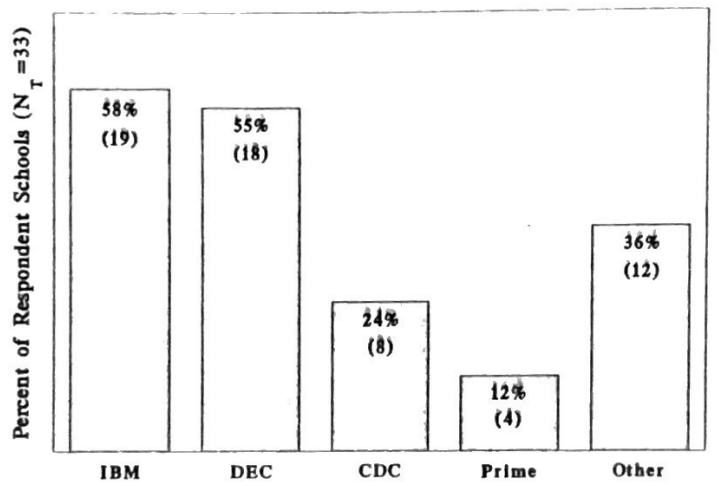
Source: Computerworld, August 1990

TOP THREE COMPUTER APPLICATIONS (n=27)

	1st	2nd	3rd
Word-processing	23	4	0
Spreadsheets	0	21	4
DBMS	0	0	4
Electronic Mail	4	0	2
Design Graphics	0	1	1
SPSS-statistics	0	1	3

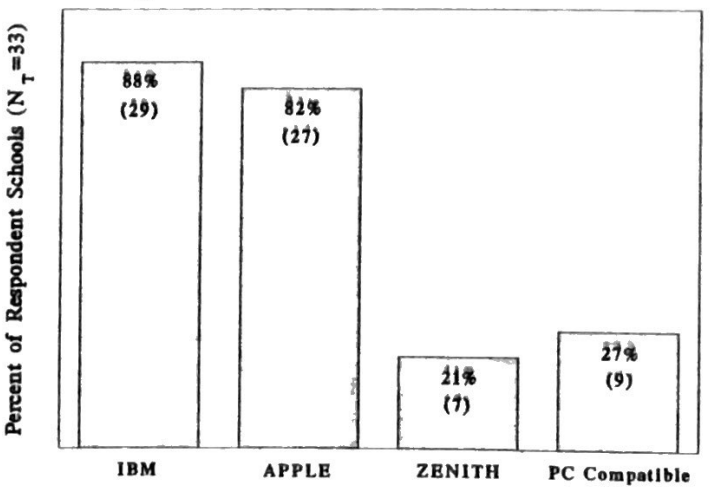
As in the Computerworld survey, word-processing is the dominant application. Spreadsheets are a strong second because of their use in the business school programs in the colleges. Unlike industry, however, where corporate and external databases are utilized extensively for planning, monitoring, and control, databases are generally not a significant component of either undergraduate or graduate programs.

Figure 2: MAINFRAME/MINICOMPUTER SYSTEMS



* *Counts do not total to 33 since some schools have more than one hardware system.*

Figure 3: PERSONAL COMPUTER SYSTEM



* *Counts do not total to 33 since some schools have more than one hardware system.*

Hardware

Schools use a variety of hardware systems to provide academic computing resources for faculty and students. Figures 2 & 3 identify the primary mainframe and microcomputer systems.

Architecture

Schools in the phone survey were asked whether the majority of their architecture was free-standing, networked, or set up as workstations. A networked system was defined as a system that was directly linked to the mainframe or connected to the mainframe via a file-server. A workstation was defined as a group of small computers connected only to a common file server. The computer architectures for the 27 phone survey schools are summarized in Figure 4:

Although the majority of schools have stand-alone systems, several are planning to network their computers.

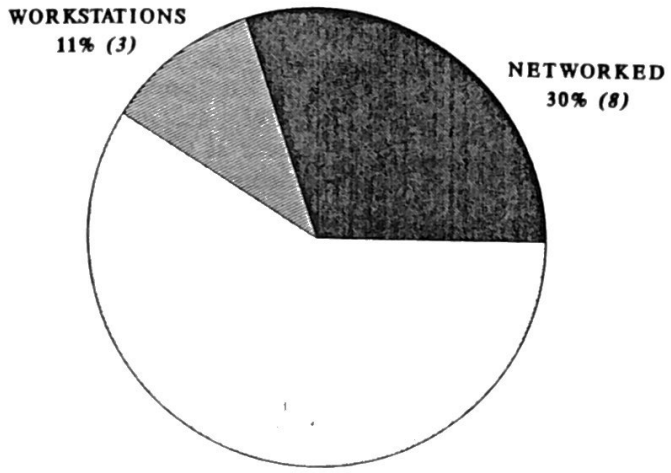
Brown University and Stevens Tech [10] are examples of networked campuses. Their designs allow for equipment changes, expansions, and upgrades as technology advances. Networks must be able to include equipment from different vendors. Technical support and service are also necessary components of a networked system.

Communications Networks

BITNET is a worldwide communications network that allows members to communicate with other member colleagues at more than 1600 colleges and universities that are connected to BITNET. With BITNET you can send or receive short messages, longer notes, and files to users at other universities. Gateways exist between BITNET and a number of other networks.

Internet is a global "network of networks" based on the TCP/IP protocol. It includes academic institutions as well as commercial, government, and other organizations. "...Anyone using any one of the member networks can communicate with people on any other member network. Thousands of colleges and universities are attached to Internet.." [15] In addition to communication services, Internet enables users to log onto to many remote computers connected to the network.

Figure 4: Computer Architectures



Colleges can join the BITNET or Internet community by paying a fixed, annual fee for connection and use. Twenty-one of the 27 schools in the phone survey have access to both Internet and BITNET. Four schools are connected only to BITNET.

Multimedia

A combination of lecture notes, 35 mm slides, and audio tape could constitute a multimedia presentation. Today, however, "multimedia" has assumed a more comprehensive and dynamic meaning and includes combinations of text, audio, graphics, photographs, and video integrated into a single, computer-controlled presentation. This technology is very flexible enabling faculty to customize their presentations, selecting information from large data sets, or varying the path by which information is presented. Seventeen of the phone survey schools have some form of this multimedia capability.

Videodiscs, which can store large quantities of data, (e.g. one side of a 2-inch disc can store 54,000 pictures along with stereo audio and digital data) are an effective source for multimedia material. Many videodiscs, with material from film, filmstrip, movie, newsreels, etc. are now available commercially [9].

The University of Delaware has developed a multimedia application system called PODIUM "that provides faculty with a powerful yet uncomplicated multimedia lecture tool." [6] Faculty have learned how to operate this multimedia system in a matter of minutes.

Word processor software is used to prepare an outline of the multimedia materials that has been selected for a course. If a student asks a question during a lecture prepared using PODIUM, the instructor can type a frame number into PODIUM and the desired material is projected onto a screen, even if it was not included in the presentation.

At the University of Missouri, desks in the advanced technology classroom are equipped with an electronic response panel [10]. The instructor, standing next to a large projection screen, can present multimedia course materials and get instant feedback from students through the response panel.

Stevens Tech is a leader in integrating computers into the college curriculum. Faculty use video projectors connected to a network to access files and illustrate lectures [10]. Harvard Law School uses a videodisc computer lesson called "Search and Seizure" [8]. Students, while watching a 'pursuit and arrest' video, can press a key to stop the action whenever they question the legality of police conduct.

Electronic Library Services

"Many of the familiar card-catalogue drawers are gone, replaced by computer-terminal search stations." [9] Using key words, students can perform bibliographic searches and print a listing of the results. In addition, the status of the library materials, i.e. whether the book is in the stacks or checked out, is indicated on the terminal screen. With some catalog systems, a map of the library is provided to show the location of the books identified by the bibliographic search.

Laser-disc technology, CD-ROMs and videodiscs, are also an important component of today's library. With CD-ROM drives connected to computers, students can access a variety of sources. A popular reference, The Video Encyclopedia of the 20th Century, is a 40 volume videodisc set containing film and still photographs of every major news story of this century [9].

Many libraries also include a computer lab. Students can use the computers to take notes as they do research and, if the computers are networked into the library catalogue system, search for resources as they write.

A major task in implementing an on-line library system is the need to convert the card catalog to a machine readable format. There are companies that provide this service for a fee. It is also possible to use a software program (e.g. Bibliophile) in conjunction with a compact disc containing bibliographic records of the Library of Congress [9]. Using an inventory listing of the college's collection, the compact disk listings are scanned for matches to the Library of Congress collection. The bibliographic record is then transferred from the CD-ROM onto the college's computer catalog file.

Eighteen of the schools surveyed had an on-line catalog which could be accessed outside the library. The University of Southern California [16] has an on-line catalog which can be accessed from within

the library as well as from dormitories, offices, and even homes of faculty members. At Carnegie Mellon's (CMU) three libraries, there are terminals for public use so that users can access the Library Information System from their office, lab, or home computers or workstation [16]. At CMU, the library catalog is one of a number of databases that students, faculty, and staff can choose from the Library Information System (LIS).

The University of Pittsburgh's data network and fiber optic backbone provides remote dial-up access through the campus network, PITTNET, to the library system from all buildings and campuses by means of 10 PITTCAT (on-line catalog) terminals. The University of Michigan also has an on-line catalog [16].

Electronic Mail, Computer Conferencing, Bulletin Boards

Electronic Mail (E-Mail) is information, usually text, that is electronically transmitted over the phone lines from a single sender to one or more recipients. E-mail is a computer file and can be manipulated, edited, saved, and retrieved like a word processor file. Twenty-four of the 27 schools surveyed provide E-mail service.

A common academic use of E-mail involves joint authorship of papers by faculty who reside in different geographic locations. Without E-mail, joint authorship involves long delays between exchanges. E-mail is likely to become preferred over the postal mail and even telephone because of its speed and convenience.

In selecting an E-mail system, it is important to choose one that makes it possible for people, even those with limited computer skills, to master quickly the basics. Support services must be available to assist users with technical problems.

Computer conferencing is a computer network application that has attracted much attention. In a computer conference, all communication is done through computer and therefore all participants do not have to be present at the same time. Eleven of the 27 schools surveyed provide computer conferencing; 15 provide bulletin boards. Computer conferencing is used:

- to serve as a substitute, or addition to group meetings, lectures, and office hours,
- to post announcements, assignments, and lecture material by faculty,
- to provide students, unable to attend a class session, a means to obtain essential instructional information,
- to provide an answer to a question once, and have it available to all students,
- to supplement mail systems and bulletin boards for the discussion of issues and exchange of ideas.

Many schools require students to have their own personal computers...

Financial and Organizational Trends

Due to the state of the economy, many college computer budgets have been reduced. However, 14 of the schools surveyed indicated an increase in spending on microcomputers in 1991. Only two schools indicated an increase in mainframe spending. Eleven of the schools surveyed had a student/computer ratio greater than 30:1. Seven schools had a ratio less than or equal to 10:1. The trend is to reduce these ratios.

Managers of academic computing services have been added to college administration. Committees on Academic Computing have been established at many schools to provide guidelines and recommendations for the continuing development of computing activities, research, and planning.

SUMMARY OF FINDINGS

Colleges and universities, large and small, are incorporating information technology into all aspects of their academic programs. Many faculty now have access to a variety of computing and communications resources for teaching, research, and the global interchange of information. Many schools require students to have their own personal computers to be used as educational media, to provide access to library resources, for campus communications, for course registration, and as productivity tools such as electronic spreadsheets and word processors.

A suitable information technology architecture or platform is necessary in order to integrate effectively the potential applications of information technology. Since there are many computer and communications options available to meet the specific needs of small as well as large institutions, it is incumbent upon the schools to identify their short and long-range academic needs and establish organizational and financial plans to meet these needs.

While major capital expenditures are required for hardware and software, there are also significant costs associated with the operation and support of academic computing and data communications facilities. Hardware and software maintenance, faculty development, software workshops for faculty and students, and system enhancements are continuing costs and must be incorporated into operating budgets.

It is no longer a question as to whether or not computer and communications resources will be available on campus but rather how soon they will be available. With the increased presence of personal computers in elementary and secondary schools, growing competition by colleges for a decreasing number of high school graduates, and demands by the workplace for information technology experience, a college or university will not be able to survive without a major commitment to computers and communications networks.

REFERENCES

1. Albright, Michael J., "It's Time to Rethink Instructional Technology Services in Higher Education", Tech Trends, January 1990, p 40-45.

2. Bruder, Isabelle, "Ed Schools: Literacy Requirements", Electronic Learning, April 1988, p 18-19.
3. Butter, Charles W., "Are Desktop Processors A Rational Choice", Journal of Systems Management, February 1991, p 28.
4. Clarkson University 1991 College Catalog.
5. Dirksen, Charles J., "Effective Computer Conferencing in University's Ed", Journal of Education for Business, May 1989, p 348-351.
6. Hofstetter, Fred T, "Podium: Presentation of Overlay Display For Interactive Uses of Media, Academic Computing, November 1989, p 10-13.
7. Lambert, Craig, "The Electronic Tutor", Harvard Magazine, November/December 1990, p 43-51
8. McCarthy, Robert, "The Advantages of Using a Network", Electronic Learning, September 1989, p 32-38.
9. McCarthy, Robert, "The New Library Center", Electronic Learning, May/June 1990, p 25-28.
10. Moeller, Joseph J., "Creating the Computer Integrated Campus: A Vision For the Future", Academic Computing, 1987.
11. Pastore, Richard, "PCs Take Command on Campus", Computer World, March 4, 1991.
12. Peterson's Register of Higher Education 1991, Peterson Guide Inc., 4th. ed.
13. Radding, Alan, "Big Innovation on Campus", Computerworld, October 31, 1990, p 43-46.
14. Romiszowski, Alexander, "Using E-Mail as a Seminar", Educational Technology, October 1989, p 17-14.
15. Solomon, Dr. Martin, "E-Mail: A Primer for Academics", T.H.E. Journal, August 1990, p 64-65.
16. Woodsworth, Anne, "Emerging Electronic Library Services", Academic Computing, February 1990, p26-28, 50.

Appendix A: SCHOOLS IN PHONE SURVEY

1. Alabama, Univ. of, at Huntsville
2. Alaska, Univ. of, at Anchorage
3. Bentley College
4. Bridgeport, Univ. of
5. Central Florida, Univ. of
6. Cornell University
7. Delaware, Univ. of
8. Drexel University
9. Florida, Univ. of, at Gainesville
10. Georgia State University
11. Glassboro State University
12. Illinois State University
13. Illinois, Univ. of, at Urbana-Champaign
14. Iona College
15. Michigan, Univ. of
16. New Haven, Univ. of
17. North Alabama, Univ. of
18. North Dakota, Univ. of,
19. Oregon State University
20. St. John's University
21. Stevens Institute of Technology
22. SUNY at Buffalo
23. SUNY at Fredonia
24. Texas Tech University
25. Virginia Polytechnic and State University.
26. Xavier University
27. Yale University

Appendix B: SCHOOLS NOT INCLUDED IN PHONE SURVEY

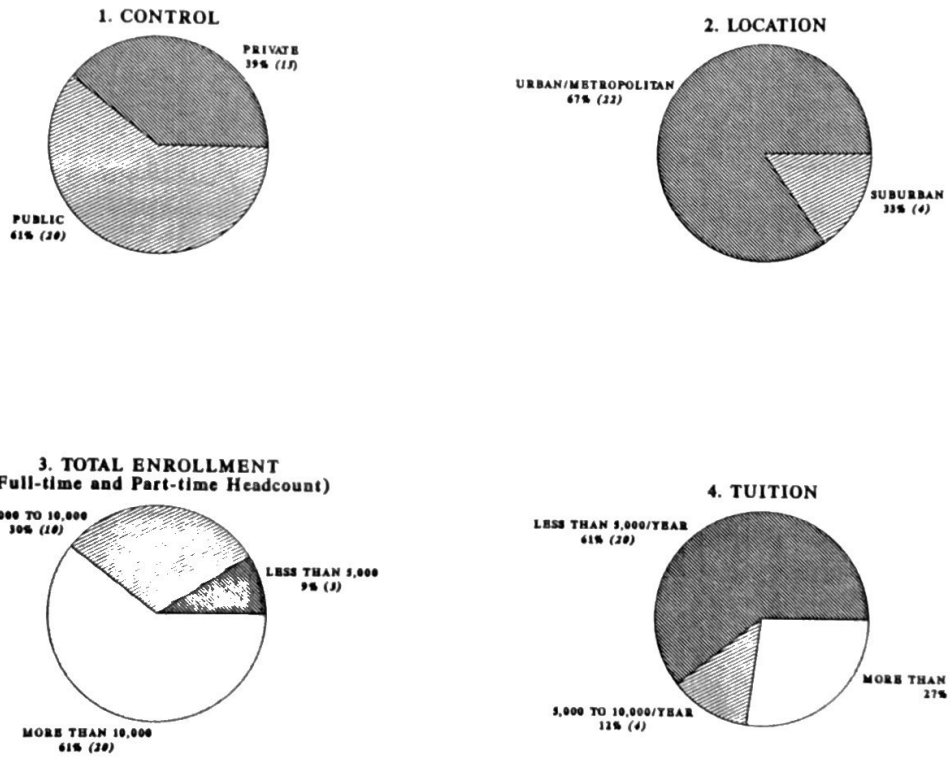
1. Bowling Green State University
2. Carnegie Mellon University
3. Clarkson University
4. Brown University
5. Missouri, Univ. of
6. Pittsburgh, Univ. of

AUTHORS' BIOGRAPHIES

Adolph Katz is Associate Professor of Information Systems at Fairfield University. He has worked in industry and government in the areas of planning and research. Dr. Katz has published articles in many professional journals and has presented papers at numerous conferences. He is past President of the Connecticut Chapter of the Society for Information Management (SIM) and currently a member of the Board of Directors of SIM International. His current interests include societal impact of information technology, telecommuting, the impact of information technology on organizations, assessment of the Information Systems function, and measurement of the business value of Information Technology.

Michael Castonguay is an accountant at MBI, Inc. He was awarded a Bachelor of Science degree with a double major in Finance and Management Information Systems from Fairfield University in 1991.

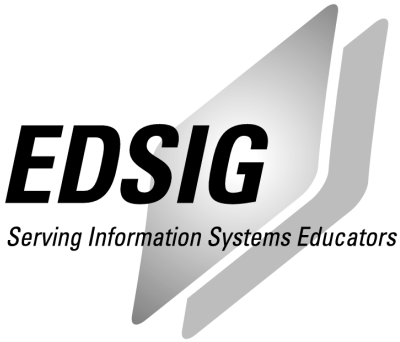
Appendix C: DEMOGRAPHIC PROFILE OF SCHOOLS IN SURVEY (N_T=33)



Appendix D: SUMMARY OF TELEPHONE SURVEY RESULTS

	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	Req. Students to purch/lease Comp.			X					X													X				X		
2	Faculty Support Center			X			X		X	X	X	X				X	X		X	X	X		X	X	X			
3	Computer Literacy Requirement			X	X					X			X	X	X			X				X		X				
4	Provide non-credit workshops	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
5	Most popular software applications																											
	-Wordprocessing	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	2	1	1	1	1	1
	-Spreadsheets	2		2	2	2	2	2	2	2	2	2	2	3	2	3	2	2	2	2	2	3	3	2	2	2	2	
	-DBMS										3	3			3						3							
	-Electronic mail		1		3			3						1								1	1					
	-Comp. Aided Design Graphics				3											2												
	-SPSS																3							3		3		2
6	Mainframe hardware																											
	-Digital/Vax	X	X		X		X	X	X			X		X								X	X		X	X	X	X
	-IBM		X			X	X	X	X	X				X	X	X		X	X	X			X			X		X
	-CDC Cyber													X					X	X								
	-Prime			X	X				X								X											
	-Other	X									X		X	X			X			X	X		X	X	X			
7	Micro hardware																											
	-IBM	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X
	-APPLE	X	X	X	X	X	X		X	X	X	X	X	X		X			X	X	X		X	X	X	X	X	X
	-Zenith										X		X						X									X
	-PC comp.			X	X				X			X					X			X		X				X		
8	Maj. of Arch (tree,network,workstat.)	N	F	F	F	W	N	F	F	F	F	F	F	F	N	N	F	W	F	N	N	N	W	F	F	N	F	F
9	Bitnet/Internet(B,X for both)	X	X		B	X	X	B	X	X	X	X	X	X	B	X	B		X	X	X	X	X	X	X	X	X	X
10	Multi-Media	X				X	X	X				X	X	X	X	X			X	X	X	X		X	X	X		X
11	On-line library catalog	X	X	X	X	X	X	X		X	X	X		X	X	X		X	X	X		X	X	X	X	X	X	X
	Can be accessed outside library	X	X			X	X	X		X		X		X	X	X		X	X	X			X	X		X	X	X
12	E-Mail	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X		X	X	X	X	X
13	Bulletin Bds /Comp. Confer(B,C,X)	X		X				X				X	B	X	B	X			B	B	X	X				X		X
14	Micro Budget increase in 1991			X	X		X	X		X				X		X	X	X	X		X	X				X		X
15	Mainframe budget increase in 1991			X																	X		X					
16	Approx. Stud/Comp. Ratio(xx:1)	28	52	1	31	50	NA	34	1	11	NA	NA	23	44	14	8	42	18	30	50	40	1	11	16	10	1	46	44

Information Systems & Computing
Academic Professionals



STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the Journal of Information Systems Education have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.

ISSN 1055-3096