

A survey of freshman students at Colorado State University measured their self-determined ability to use technology

Technology Literate Students?

Results from a Survey

By **Karen Kaminski, Pete Seel, and Kevin Cullen**

Contradictory beliefs exist about student information technology skills. One is that high school students know more than college faculty about computers and information technology. Another is that incoming freshmen do not have the information technology skills needed for college-level work and that faculty do not have the time to teach these skills in addition to course content.

These beliefs came up for discussion on the Colorado State University (CSU) campus, and the Office of Instructional Services formed a committee to investigate the relevant issues. The committee designed a survey to support or reject the hypothesis that a digital divide in IT-

based knowledge and experience did exist among the freshman students newly arrived on campus. This article presents the need for, methodology behind, and results of that survey.

Information Technology Literacy

Anecdotal evidence from faculty and support centers in higher education define a fundamental “digital divide” in computer-based skills that students bring to postsecondary education. Although Edmiston and McClelland¹ pointed out that predictions made in the early 1990s claimed that computer literacy courses would no longer exist by 2000, recent observations suggest a

remarkable range in students’ knowledge about information technology concepts and in their software skills.

A study conducted by Hackbarth² reported that elementary school students have only 10 to 60 minutes of access to information technology each week. Due to the lack of access time at school, K–12 students are gaining their technology literacy at home. The National Assessment of Educational Progress found that 41 percent of eighth graders in free and reduced lunch programs have home Internet access compared to 72 percent of their financially better off peers.

Sax, Ceja, and Teranishi³ suggested that the disparities in pre-college use of

information technology, if not attended to, might seriously compromise some students' ability to succeed to the fullest extent in college. Faced with such an inconsistent background environment among incoming students, instructors cannot assume prior knowledge of even the most basic of IT skills. Faculty are under increasing pressure to incorporate technology into their teaching and learning activities and to develop technology-literate students before graduation. Unfortunately, the inconsistency in student skills makes it difficult to design effective technology-enhanced instruction.

This dilemma is not a new phenomenon on campuses, but the search for possible solutions has taken on an increasing urgency in the past decade. The ability to effectively use computers in the workplace is now essential in almost every profession. The U.S. Department of Education's report to the nation on technology and education⁴ recognized that technology literacy "has become as fundamental to a person's ability to navigate through society as traditional skills like reading, writing, and arithmetic." Information literacy is defined as "computer skills and the ability to use computers and other technology to improve learning, productivity, and performance."⁵

The increasing use of technology in higher education reflects this ubiquity in the workplace. If a basic knowledge of information technology is so central to the education of all citizens, it forces the question of how educators should address the curricular issues involved.

In 1999 the Computer Science and Telecommunications Board (CSTB) of the National Research Council published the seminal report *Being Fluent with Information Technology*.⁶ The book was the culmination of a two-year national study by the CSTB's committee on information technology literacy. The report addressed the centrality of information technology in modern life in the United States and the related implications for higher education. It sought to answer the question of what should everyone know about information technology to use it more effectively now and in the future, making a significant distinction between



information literacy and information fluency. The report argued that, since digital technology is evolving at such a rapid rate, superficial attempts to promote simple literacy by stressing the acquisition of basic skills such as word processing would be too modest a goal. The acquisition of information fluency, on the other hand, implied a broadening of the learner's knowledge base to include fundamental IT concepts and capabilities that would enhance the learning of new digital skills.

This holistic approach is important in higher education, where a narrow focus on digital skills acquisition is often perceived as a simplistic solution dismissed with the epithet "too vocational." The CSTB report stressed that the development of IT concepts and capabilities must be linked with skills acquisition to transform literacy into fluency in a process it labeled FITness. The report suc-

cinctly outlined three significant components of FITness:

- Contemporary skills: the ability to use today's computer applications
- Foundational concepts: the basic principles and ideas of computers, networks, and information—the how and why
- Intellectual capabilities: the ability to apply information technology in complex and sustained situations

These components are further broken out into 10 requirements for fluency in each focus area.

While the traditional approach to improving computer literacy focuses on skills, the FIT model is valuable in its balanced approach. More recently, the Association of College and Research Libraries (ACRL) broadly defined information literacy as an intellectual framework for understanding, finding, evaluating, and using information—activities that may

be accomplished in part by fluency with information technology, in part by sound investigative methods, and, most importantly, through critical discernment and reasoning.⁷ Information literacy initiates, sustains, and extends lifelong learning through abilities, which may use technologies but are ultimately independent of them. The ACRL proposed the adoption of five discrete standards (with related performance indicators and outcomes) that define the ability of students to perform these key information access and processing tasks. These standards are useful for any educator working with information technology and related curriculum issues.

The ACRL report made a clear demarcation between “information literacy” as a “distinct and broader area of competence” than information technology, although there are “significant areas of overlap between the two.” The standards emphasize the focus of information literacy on “content, communication, analysis, information searching, and evaluation,” whereas information technology fluency focuses on a deep understanding of technology and increasingly skilled use of it.

The emphasis on lifelong learning in the ACRL standards is relevant for any educator teaching adult students in institutions of higher education or at a distance. The report noted that because information literacy augments a student’s competency with evaluating, managing, and using information, it is now considered by several regional and discipline-based accreditation associations as a key outcome for college students.

One can argue that the enhanced study of information technology should not be pursued as something to graft to the higher education core curriculum but something that should be an integral element of it. This was a topic of discussion on the CSU campus. Two primary questions evolved:

- Who is responsible for teaching the students the skills they need?
- What skills do we need to teach the students?

A committee formed to investigate the issues was chaired by the assistant

director in the Office of Instructional Services. Committee members included representatives from the faculty, the library, academic computing, and college IT support staff.⁸

How CSU Addressed the Questions

The committee examined the information technology literacy issue from numerous angles. In agreement with Hirt et al.,⁹ who completed an assessment of computer skills on the Virginia Tech campus, we determined that we needed to examine which groups on campus were using which types of technology and their skill in using that technology. Although in 1999 researchers could not find studies related to information literacy, we found a handful,¹⁰⁻¹⁴ which led us to believe that we needed to assess the status specifically at CSU.

We first determined what support systems were already in place. The only centralized student support for information technology is the help desk, staffed by Computer Training and Support Services. This desk provides answers to questions such as how to connect to the Internet, set up dial-up accounts, establish an e-identity, and change forgotten passwords, but does not provide any formal training for students.

Primary student support is based on student technology fees, which are set independently by the students in each college. Therefore, these fees vary among colleges along with the levels of support provided for their students. For example, the College of Business requires all incoming freshmen to attend a one-week boot camp before the start of the fall semester. During this time the students receive instruction in the basic technology skills they will need for initial course work. This includes setting up e-mail accounts and learning how to access the college’s networked software and drives.

The College of Agriculture offers one-credit elective courses that cover use of software such as Microsoft Word and Excel. Other colleges do not provide structured technology training.

We determined that, to make effective recommendations for student support in information technology literacy and faculty support for enhancing student information fluency, we needed to collect data on incoming students’ literacy levels.

Methodology

We determined that a survey would be the least invasive way to collect information. An electronic survey would be easiest and least expensive on the front end. If we wanted full representation, however, including those students who did not possess strong technology skills, an electronic survey would certainly eliminate a significant part of the target population. Therefore, we decided a paper-based survey would elicit the most significant results.

Surveying students enrolled in our freshman seminar course, required for all freshmen and transfer students, would give us access to all freshmen enrolled in the fall of 2001. A list of potential questions was narrowed to 71 questions with a response format designed to let us use a Scantron form to collect the information. After the survey received support from the vice provost and the council of deans, the vice provost sent a message to all freshman seminar faculty and instructors stating her support for and the importance of the survey.

We field tested the survey with one freshman seminar class. The students who completed the survey were asked for feedback on the clarity of the questions and for additional comments. We made a few grammatical modifications based on this field test. We also ran the data so that we could examine the output from the Scantron system and ensure we could analyze it. Once this phase was completed, we moved to implement the survey and disseminate the results.

Enrollment in each freshman seminar is limited to 19 students. There were 214 seminars with a total enrollment of 3,898 students. For distribution purposes we enlisted assistance from the University Instructional Technology Committee (UITC). Once scanned, the results were imported into SPSS, a common statistical software package, for

analysis. We tabulated all results for overall freshman class response frequency as well as frequency of response by college. We then completed additional analysis based on sets of questions, skills, and demographics.

Findings

Our design worked well. We received 155 out of 214 possible completed sets of surveys for a return rate of 72 percent. Of the 3,898 students, 2,102 correctly completed surveys for a response rate of 54 percent. Although most faculty supported the research project, some refused to allow time in their classes to participate in the survey. The freshman seminars had become a target for numerous surveys and data collection. In addition, this survey was conducted late in the fall semester, when some faculty were pressed for time to finish delivering content and preparing for final exams. Those considerations made survey completion a lower priority. We did find, though, that higher levels of compliance were achieved when a member of the research or UITS committees was present to administer and collect the surveys.

Demographics

Of the respondents, 1,933 were freshman, 118 sophomores, 28 juniors, and 7 transfer students. The majority were 18 years old (1,313); 660 were 19 years old, and 22 were under 18 years old. There were 793 male respondents and 1,268 female respondents. This represents a greater percent of females than the campus undergraduate population, which is 52 percent female.

Although we decided not to include detailed questions about the students' high school experience, we did feel that information regarding the size of their graduating class (see Table 1) and whether it was a Colorado school would provide us with important demographic data. Of the respondents, 1,587 (75.5 percent) indicated that they graduated from a high school in Colorado. This percentage is similar to campus statistics, which indicate that 76.8 percent of CSU freshman are resident students, and 79.7 percent of CSU's total undergraduate population are resident students.

We included two questions regarding the presence of information technology in high school. Only 500 students indicated they had taken a programming course in high school, while 291 indicated they had taken a Web development class in high school.

Hardware Information

Some of the more interesting data included information on computer ownership. Only 7 percent, or 150, of the students indicated they did not own either a laptop or a desktop computer. Of these, 1,286, or 61 percent, indicated their computers were less than one year old. Table 2 provides detailed information on computer and additional hardware ownership.

E-mail

Communication over the Internet is one of the most common uses of information technology, so we asked the students specific questions regarding their use of electronic mail. The majority, 98 percent, indicated they did have an e-mail account, and 81 percent indicated they knew how to attach a file when sending e-mail. While 49 percent used an e-mail account provided by their department or the campus, 41 percent used a commercial e-mail account. Only 3 percent indicated that they did not know they could receive a free e-mail account from CSU. Most (80 percent) of the students indicated they check their e-mail on a daily basis.

World Wide Web

The Web has become another common form of communication, along with its use for information and fact finding. When asked about their experience using the Web, the majority of the students, 87 percent, indicated they had been using it for two or more years, with another 9 percent having used it for the past year. When connecting to the Web, 68 percent used the campus network, 12 percent used DSL or a cable modem, and 10 percent used a regular modem and phone line. Interestingly, 8 percent indicated they did not know how they connected to the Web. Table 3 indicates students' reported use of the Web.

Table 1

High School Graduating Class Size

N	Number of Students
129	Less than 50 students
179	51–100 students
276	101–299 students
458	201–300 students
1,049	More than 300 students

Table 2

Freshman Hardware Ownership

Hardware	N	Percentage
Desktop	1,136	54%
Laptop	569	27%
Both	230	11%
Printer	1,722	82%
Scanner	445	21%
CD-ROM	1,823	87%
RD-recordable	1,083	52%
DVD	989	47%
Network		
Interface	1,091	52%
PDA	250	12%

Table 3

Use of the World Wide Web

Use	N	Percentage
Games	1,009	48%
Newsgroups	776	37%
E-mail	2,006	95%
Videos	888	42%
Music	1,847	88%
Library/		
research	2,019	96%
Info on CSU	1,915	91%

Software

We asked the students to indicate their proficiency in the use of different software packages. We not only included the frequency of responses but also analyzed the responses based on three types of software used, including Microsoft Office-type software, Web and multimedia development-type software, and

programming software. The maximum sum in the Office and Development categories was 15. Males scored an average of 10 and 5, respectively, while females scored an average of 9 and 3, respectively. The maximum score for programming was 9. Males scored an average of 3, while females scored an average of 2. The difference in skills between males and females was not significant. See Table 4 for information broken out by college.

Skills

Under the skills category we included questions intended to ascertain if the students had basic skills in setting up a computer and using some of the tools needed outside a software package (information fluency). This included the ability to download and install software, to which 82 percent responded yes; the ability to download and install plug-ins, where 46 percent responded yes; and the ability to download and read PDF files, to which 41 percent responded yes.

We also included questions about some basic skills in information gathering. Specifically, 52 percent of the respondents had received training in high school on information gathering. If asked to write a research paper, 58 percent indicated they would first use Yahoo or Google for a search, while 23 percent would use a database or index of abstracts and citations. Only 13 percent indicated they would go to the library first. Surprisingly, when asked what information they could find in a library

catalog, 19 percent indicated books and journals, 2 percent indicated citations to journal articles, and 71 percent indicated both, while 7 percent indicated they didn't know.

Support

We decided that, to provide effective solutions to helping students achieve information technology fluency, we needed to determine the students' preferred method of learning about technology. We also assumed that the students' responses to this question would inform us how much they already used technology-based solutions when faced with technology use challenges. When asked how they prefer to learn, most of the students indicated that they would rather receive one-to-one training; online training was not highly rated. Table 5 illustrates these results.

Discussion

There is no one right answer for resolving the issues surrounding information technology fluency. Doing so requires a shift in thinking across many areas of higher education. Increased awareness of the state of the divide will guide us on where to concentrate our initial efforts. Perhaps most importantly, when a society is fluent in information technology, its members have a better understanding of such issues as data mining, privacy, free speech, intellectual property, and even "photographic truth."

Events took place at CSU that impacted our survey data. During the semester we

Table 5

Preferred Instructional Style

Style	N	Percentage
One-to-one help	1,089	52%
Classroom	584	28%
CD/Computer-based	186	9%
Online training	63	3%
Videotape	33	2%

conducted the survey, the institution implemented an e-identity policy—a common username and password for access to all electronic information. This required all students, faculty, and staff to visit a Web site, establish a username and password, and indicate a preferred e-mail account. Students who did not already have an e-mail account set up a campus account at this time.

The following semester, students were required to have an e-identity to register for classes, which had a strong influence on getting it done. This might explain why such a large percentage of students responding to the survey indicated they did have and use e-mail. It might also have influenced the results indicating that the most frequent use of the Web was for e-mail, library research, and obtaining information about CSU. The fact that music and games followed in frequency of use conforms to findings in prior research. Also not surprising was that the highest level of software use was for the MS Office software and that students had the least experience with programming.

We were surprised by the number of students who reported that they owned a new computer. Frequently, lack of skills is attributed to lack of access.¹⁵⁻¹⁷ In agreement with prior studies,¹⁸ we recognized the need to identify additional ways to teach students—designing programs not just to teach the basic skills but also to increase technology integration and teach the importance of information fluency.

While the majority of students have the tools at hand to increase their infor-

Table 4

Software Skills by College

College	Office Score	Development Score	Programming Score
Agriculture	9.8	4.8	2.9
Applied Human Sciences	9.3	4.2	2.4
Business	10.4	4.8	2.7
Engineering	9.5	4.8	2.8
Liberal Arts	9.1	4.3	2.1
Natural Resources	9.3	3.6	2.1
Natural Sciences	9.6	4.1	2.5
Vet Med and Bio Sciences	9.8	4.0	2.2
Undecided	9.3	4.2	2.3

mation technology FITness, they still prefer classroom and one-to-one instruction for learning new skills. This preference agrees with experiences at other institutions. An article on freshman computer lifestyles at five institutions¹⁹ indicated that the majority of freshman students do not attend computer training sessions or use help services. We will take this information into account as we discuss what types of skills the students need to learn and how to integrate those goals into the core curriculum.

In addition, the fact that almost everyone has an e-mail account and that the majority of freshman students noted they check it daily indicates we would not need to consider the mechanics of setting up e-mail, but might need to enhance students' knowledge of how to collaborate. Continued monitoring of the issues will provide information on current needs and strategies, and technology advances.

We would argue, from the information gained, that everyone in the university should be teaching students information technology literacy. The ACRL report stressed that teaching information literacy works best when woven into the curriculum's content structure and sequence. While we concur that information technology literacy should be taught across the curriculum, its incorporation into the core curriculum will take time and patience as faculty become more technology savvy themselves.

Faculty should be provided with the tools needed to make this activity a stimulating and challenging part of their courses. When discussing obstacles to technology integration, Walbert²⁰ indicated that lack of use mainly results from lack of access, time, and experience on what to do. As Gilbert noted in discussing Moore's law, "...the rapidly spreading use of personal computers and related telecommunications networks explain the accelerating pace at which new technology-based options for teaching and learning emerge."²¹

These new options provide the tools to enhance information technology fluency through the classroom. The ACRL report on information literacy stated that it is best provided in student-cen-

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tered learning environments where inquiry-based instruction is combined with problem-solving activities and an emphasis on the development of critical thinking abilities.

Implementation of additional student support and training may ease faculty concern about the time involved in supporting nonliterate students and encourage faculty to incorporate additional technology into their teaching and learning activities. Increased awareness of the actual levels of technology literacy could help faculty in the design of these activities. Gilbert²² asserted that we need "deep learning" among faculty, support professionals, and administrators; the process of changing education is itself an educational process. Faculty need a framework, taxonomy, and introduction to relevant models. They need guided practice and support.

Thanks to the research done by Rickman and Grudzinski²³ on information technology use in the classroom, we have input from more than 2,300 students. They reported that the average time students thought IT should be utilized is 40 percent. This coincides with instructional design beliefs that a mix of delivery modes provides the most effective learning experiences. Achieving this level of technology use requires a change in administrative attitude toward recognition of faculty time invested in information technology.

Each college has looked at its results and begun discussions on how to address specific needs. Unfortunately, recent changes at the provost level have hindered overall campus considerations. The advisory board for the newly created Interdisciplinary Studies Program in Information Science and Technology has taken the information and the idea

of "FITness" seriously, however, creating a new Interdisciplinary Studies Program in Information Science and Technology for students seeking greater familiarity with IT content and skills. This 21-credit program is designed to complement any major except computer science and electrical and computer engineering. In addition, the advisory board recommends repeating this survey with freshmen over the next three years, along with a follow-up survey of the 1999 class the spring before graduation.

We might find more institutions implementing a program similar to South Dakota State University.²⁴ This program, a board of regents requirement, requires students to complete a proficiency examination and an information technology literacy exam approximately midway through their program of study. In addition, the students participate in a department-based information technology literacy assessment based on their particular program. Students must pass the exam for graduation. If they do not pass with a score of at least 70 percent, they must remediate and retake the exam.

With that said, additional research is needed to help faculty and administrators determine the best methods for integrating information technology literacy in the teaching and learning process and increasing students' information technology fluency. Educators need to address not only the issue of skills, but also the need for lifelong learning in a technology prolific society.

When we repeat this study, we will gather additional information regarding the amount of exposure students had to information technology in both their school and home environments. We may also focus more on obtaining information regarding the skills students feel they are lacking versus the skills they report having. *e*

Endnotes

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Karen Kaminski (karen.kaminski@colostate.edu) is Assistant Director of the Office of Instructional Services, Pete Seel (pete.seel@colostate.edu) is Associate Professor of Journalism and Technical Communications, and Kevin Cullen (kevin.cullen@colostate.edu) is Assistant Professor and Digital Projects Librarian for the University Libraries at Colorado State University in Fort Collins, Colorado.