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ECAR Study of Students and Information Technology, 2005: Convenience, Connection, Control, and Learning

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ECAR
EDUCAUSE Center for Applied Research

EDUCAUSE is a nonprofit association whose mission is to advance higher education by promoting the intelligent use of information technology.

The mission of the EDUCAUSE Center for Applied Research is to foster better decision making by conducting and disseminating research and analysis about the role and implications of information technology in higher education. ECAR will systematically address many of the challenges brought more sharply into focus by information technologies.

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Foreword: Growing Up Digital

By some counts the commercial Internet is 25 years old. From humble beginnings in 1969 as an experimental project of the Defense Advanced Research Projects Agency (DARPA), the Internet has become a mass medium and quite possibly the distribution channel of choice for voice, television, data, and other media.

Many refer to today's undergraduate college and university students as *digital natives,* or as the *Net Generation.* These names are apt, as these students grew up with one or more computers in their household and with one or more Internet connections. They have enjoyed access to the world's digital resources via the World Wide Web since elementary school. Indeed, we now believe that many U.S. teenagers, not simply college and university prospects, use the Internet (87 percent), use it daily (51 percent), play games online (81 percent), get news online (76 percent), and use the Internet to communicate with one another. More than half of U.S. teenagers with Internet access at home have access to broadband at home. Teenagers use instant messaging extensively (nearly one-fourth prefer IM to phone or e-mail) and not just to send text messages. Teens use IM to link to Web sites (50 percent), send photos or documents (45 percent), and exchange music or video files (31 percent) (Lenhart, Madden, and Hitlin, 2005).

We can reasonably speculate that college-bound teens enjoy even better access to computers, the Internet, broadband, cell phones, and other accoutrements of wired life. We take it to be self-evident that college-bound digital natives are in fact *digital cognoscenti, sophisticates,* and perhaps even *digital connoisseurs* who will arrive at our nation's institutions of higher learning with digital gadgets of every imaginable shape and function, with insatiable appetites for all things digital, and with limited patience for the charming but antiquated artifacts of the analog academic world. Such artifacts might include not only our clock towers and ivy-covered gates, but also our lecture halls, textbooks, whiteboards—even our professors!

A great unspoken fear in the halls of higher education is that these digital sophisticates will arrive at our institutions to find aging technologies, legacy systems, congested (or bandwidth-shaped) networks, and decidedly unsophisticated purveyors of institutional IT services—or even worse, a technologically unsophisticated faculty who will curb their enthusiasm for cyberspace. It is, to borrow someone else's great conceptualization, "another opportunity for hope and fear to collide," only in this instance it could be student hopes colliding with institutional fears (Levine and Cureton, 1998).

From Dream to Reality

The 2004 ECAR study of students and technology was a giant first step in fulfilling ECAR's earliest and most ambitious vision. Robert

Albrecht, Mary Beth Baker, Diana Oblinger, and I had the audacity to imagine that ECAR, our modest start-up, might someday institute an ongoing survey of the IT practices, preferences, preparedness, and performance of collegiate students. It took ECAR Fellows Robert Kvavik and Judy Caruso, working with many others, to bring this dream to fruition. The ECAR study is a simple one. In an era of spam e-mail, dwindling attention spans, and excessive market research, ECAR investigators knew that we would at best have a limited opportunity to engage—electronically or otherwise—with freshman and senior students. We would have to navigate institutional review board (IRB) scrutiny and approval processes not once, but repeatedly. We would have to depend on the generosity and shared vision of our colleagues throughout higher education to broker the necessary cooperation of CIOs, registrars, provosts, and many others. In 2004, 13 courageous universities took a plunge and important ground was broken.

In 2005, a solid foundation has been laid upon this ground. In all, 63 colleges and universities participated in the 2005 ECAR study, and invitations to participate went to more than 140,000 freshman and senior-year students. More than 18,000 college and university students accepted our invitation to participate, providing a rich source of data and insight into the behaviors and expectations of a critical cohort—our future leaders. Lest our excitement outrun the limits of our methods, we hasten to add that our findings are conclusive only as regards students at the 63 participating colleges and universities. These colleges and universities do not per se reflect the diversity of U.S. colleges and universities and in particular underrepresent two-year institutions.

Corroborative Findings

Notwithstanding these limitations, ECAR's 2005 findings closely resemble those of 2004 and from other studies. If and as participation in the ECAR study grows, we hope to make broader inferences. In ECAR tradition, we tortured the data and the data tortured us. In the end, what emerges is an increasingly robust understanding of how students engage with information and communications technologies.

The 2005 ECAR study findings to a very great extent corroborate the findings uncovered in 2004. Key among those findings:

- Students own a variety of information and communication technologies and use them regularly to communicate, find and exchange information on the Internet, do class work, and recreate.
- Students want a "moderate" amount of technology in their courses.
- Freshmen and seniors report different skill levels and preferences for technology in support of course activities.
- Male and female students report differing hours of IT use, skill levels, and IT application preferences, but these differences can be ascribed almost entirely to either males' extra time spent in gaming or their higher enrollment in business and engineering disciplines.
- The choice of academic major is closely associated with students' perceived skills in certain IT applications and their reported preference for technology in courses.
- Students are overwhelmingly positive about course management systems but want greater consistency in their use and availability.

Exciting Conjectures

The associations and findings above derive from a strict statistical reading of the data. In a more conjectural mode of inquiry, we might suggest some tendencies or indications. Two such tendencies or indications will be tracked in ECAR studies going forward. Call them hypotheses.

First, the 2005 ECAR data suggests our institutions of higher learning might become places where digital natives come to mature. Such a suggestion should not be considered preposterous, since young adults come to us for many other aspects of their social and intellectual development. Viewed in a context that includes findings of the Pew study of teenagers and the Internet, it is tempting to surmise that freshman students arrive at our institutions with a set of electronic core skills. Such skills include communications (telephone, e-mail, text messaging, and IM), Web surfing (not to be confused with research skills), word processing, and video gaming. Despite these skills, the freshmen in our survey express a *lower* interest in technology in their course activity and report lower skill levels in course-related technologies. One is tempted to conclude that these young people can make technology work but cannot place these technologies in the service of (academic) work.

A second thread, perhaps even more faint, is the hypothetical birth of the *media generation.* Not surprisingly, among the students of the 11 institutions who participated with ECAR in both 2004 and 2005, few things changed. What did change was the number of respondents claiming knowledge of presentation software, along with knowledge of software for creating or editing video/audio and Web sites. While not findings, these suggestions are interesting enough to track and report on.

Too Many to Thank

I know that I owe Robert Kvavik and Judy Caruso a lot for their work. I think the higher education community as well is indebted to them. This work is not only difficult in the usual analytical and logistical ways, but it also poses a big administrative challenge. Quite rightly, the study of students demands and receives the full measure of protections under a variety of state and federal regulations. In particular, research on students often falls under the purview of college and university IRBs. IRB approval is never a foregone conclusion and is rarely easily obtained. For this study, approval was received from every institution that participated. At each institution, one individual handled the necessary and often complex coordination associated with obtaining the necessary approvals to move forward. These people are named—with our considerable thanks—in Appendix B. I'd also like to thank ECAR Fellow Mark Nelson, who analyzed a great deal of the responding students' voluminous answers to open-ended survey questions, and Diana Oblinger for her careful review of the manuscript.

In addition, various campus operating leaders shepherded the process of developing randomized samplings of their freshman and senior populations and deploying the survey to resulting sample members. We owe this large cadre of active supporters a lot.

I'd like to thank those individuals who coordinated and participated in our on-site focus groups. In particular, James Jonas, information services/electronic resources librarian at the University of Wisconsin–Madison, and analyst Ronald L. Huesman Jr. of the University of Minnesota were exceptionally helpful. The opportunity for us to speak directly to instructional technologists and to students enlarged our understanding of the student experience of IT tremendously. And it was fun.

Finally, as always, the EDUCAUSE team is up to the task. Toby Sitko, Nancy Hays, and Gregory Dobbin coordinate the work of a talented group of editors, design professionals, and printers to ensure that good research is well presented. Their attention to detail and to deadlines is critical to our success, and I thank them here for their contributions.

Like Fish Describing Water

My colleague and friend Kristina Woolsey recently commissioned her three college-aged children to write about their experiences with IT. Based on her daughter Erika's reply, Woolsey remarked, "One thought is that asking a kid about technology is like asking a fish about water. It is clearly critical, but so ordinary it is not a very compelling topic to write about." Of the students in the 2005 ECAR study, all are engaged with technology, most are competent, many are literate (if not multilingual), some are fluent, and for a few, like Erika, technology is quite simply the universe of instruments and environments that make it possible to express themselves. The nuances that distinguish the "competent, but not confident" from the fluent or the immersed are essential for educators, policymakers, and instructional technologists. Our data remind me that while our *digital freshmen* are indeed digital, they are, even more, freshmen. The Net Generation is real, but as it is with all generations, it is not a monolith.

Richard N. Katz
Boulder, Colorado

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Executive Summary

The July 2005 Pew report *Teens and Technology* makes a compelling case for its subtitle: "Youth are leading the transition to a fully wired and mobile nation" (Lenhart et al., 2005). According to this report, fully 87 percent of U.S. teens aged 12 to 17 use the Internet; half of them use the Internet daily. Half of U.S. families with teens have broadband. Eight in 10 "wired" teens play games online, and most (78 percent) have gone online from school (Lenhart et al.). As a result of technology's breathtaking advance in teenagers' lives, many assume that today's undergraduate students possess unprecedented IT skill levels and think about and use technology radically differently from earlier student cohorts. In the context of higher education, this assumption has several implications:

- Students will demand greater use of technology in teaching and learning.
- It is increasingly necessary for faculty to use technology in order to appeal to the attention and learning styles of this generation of students.
- Students already possess good IT skills.
- Students gain these skills largely outside their courses.
- Students need little further training or education in the use of IT.

Key Findings

- Information technology in the higher education experience adds convenience, connection, and control for students.
- Students believe that IT in courses enhances their learning.
- Ownership levels of laptop computers and cell phones among surveyed students rose from 2004.
- While nearly half (49.0 percent) of students surveyed in 2004 obtained broadband access through the university, 39.8 percent of those surveyed did so in 2005.
- The curriculum continues to be a prime motivator of student IT skill acquisition.
- The percentage of students using media-intensive applications rose in 2005, although reported skill levels in these applications remained unchanged.
- Surveyed students continue to prefer a "moderate" amount of IT in their course experience.
- Students appear to like course management systems.

An objective of this study is to find evidence that supports or qualifies the merit of these implications.

The 2005 ECAR study of undergraduate students and IT is a study chiefly of "traditional" freshman and senior students at predominantly four-year institutions. While we studied IT ownership and uses generally, we focused on the application of IT skill and time primarily to the business of being a student. We recognize, therefore, that this paints a portrait with a limited palette.

Vis-à-vis the assumptions above, first made in the 2004 study, many of the study findings continued to surprise us. We expected to find that today's undergraduate students demanded greater use of technology in the context of their courses. They did not: We found instead a moderate preference for technology. We expected that it would be increasingly necessary for faculty to use technology in order to appeal to the attention and learning styles of this generation of students. Ironically, we found that many of the students most skilled in the use of technology had mixed feelings about technology in their courses. We expected students to possess good IT skills in support of learning prior to matriculating at a college or university. We found that many necessary skills had to be learned at the collegiate level and that the impetus for acquiring these necessary skills was often the requirements of the curriculum. The students in the 2005 ECAR survey had not gained many of the necessary skills to use IT in support of academic work. We found a significant need for further training in the use of IT in support of learning and problem-solving skills. Lastly, we found that students viewed course management systems quite positively but used them primarily to communicate information and execute administrative activities, and much less to support learning.

The 2005 ECAR study is a snapshot in time, providing a factual description of the state of student technology skills at 63 higher education institutions. It focuses on four issues:

- What kinds of information technologies do students use?
- What skills do students have with these technologies?
- How does student use of information and communications technologies contribute to their undergraduate experience?
- What contribution does using IT make to students' learning?

Methodology and Study Participants

The study consists of eight data collection and analytical initiatives:

- We undertook a literature review and reviewed other surveys, both U.S. based and international.
- The results of the *ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control* provided necessary insight into student perceptions about their IT experiences (Kvavik, Caruso, & Morgan, 2004).
- The 2003 ECAR study *Faculty Use of Course Management Systems* provided useful data on how faculty members actually use course management systems. It includes comparative data for analysis of student and faculty perceptions (Morgan, 2003).
- A Web-based survey of undergraduate freshmen and seniors supplied student quantitative data based upon their experiences with IT in higher education. A sample of 143,730 students at 63 higher education institutions in 24 states received the e-mail invitation to participate in the study. Fully 18,039 students responded.[1]
- We supplemented quantitative data with interviews of 82 undergraduate students at seven institutions to provide diverse perceptions of IT's impact in higher education.[2] We recognize, of course, that as consumers of higher education, few students can offer expert opinions about either instructional methods or IT. Opinions and perceptions nevertheless have meaning.
- Interviews with 20 instructional technology support staff at University of Wisconsin System institutions gave further insights

on student IT issues. This activity, too, was designed more to inform and calibrate the investigators' understanding of issues than to fulfill a direct research objective.

- More than 8,000 students commented on IT in open-ended survey questions. They expressed opinions on their use of and skill with IT, the state of their institutions' IT support services, and their perceptions of technology use in their courses. They also offered advice on how to improve IT at their institutions. These comments are analyzed and give additional perspectives on the undergraduate IT experience.
- A comparison between 2004 and 2005 results to identify similarities and dissimilarities is also an important part of this study.[3] Eleven institutions participated in both 2004 and 2005 surveys.

The ECAR Framework

Based on the results of the 2004 ECAR study of students, ECAR investigators have classified student activities with information and communications technologies into four groupings: (1) convenience, (2) connection, (3) control, and (4) learning. The ubiquity and use of IT in the lives of our study's youngest students produces a set of attributes that further define them. This taxonomy does not purport to be exhaustive. There are many attributes of student technology usage, and we discuss here only the few that this study is able to address—the contribution of IT to convenience, connection, control, and learning (see Figure 1-1). Needless to say, there is overlap among these four categories of activity. We use ECAR data, both quantitative and qualitative, to describe the current student experience with and expectations of IT in each of the four quadrants.

Higher education has spent considerable resources on technologies aimed at satisfying these preferences and expectations and on facilitating students' maturation from exuberant social and recreational technology users to purposeful and effective users who are well-socialized network citizens. Campus networks, messaging systems, portals, and online student services, for example, promote

Quadrant 1: Convenience	*Quadrant 2: Connection*
Technology and online resources readily available	Mobile electronic connections
Fast response time—immediacy	Multiple devices and media that are personal, customizable, and portable
Technology, services, and resources available anytime and anywhere	Always networked for communications
Converged devices	Members of their communities reachable anywhere and anytime
Networks and technical support available at all times	Social—work in teams

Quadrant 3: Control	*Quadrant 4: Learning*
Multitasking	Rich media and visual imagery, including the ability to integrate virtual and physical
Customization	Inductive discovery—experiential and participatory
Focused on grades and performance	Real-time engagement
Manage the undergraduate experience	
Control the when and where of social interaction	

Figure 1-1. Current Student Expectations and Preferences

widespread student access to one another as well as connections to institutional services and resources, while course management systems, library systems, and personal information systems (like e-portfolio) offer students the opportunity to plan and manage their academic experience. We believe instructors are steadily responding to students' expectations and preferences in the learning sphere.

Undergraduates Live with Abundant Technology and Networks

The vast majority of student respondents own at least one computer and a cell phone (see Table 1-1). They use these technologies daily for studying, social interaction, and entertainment. Students are increasingly mobile, using a combination of cell phone, laptop, and PDA, and about 25 percent have wireless adapters. Virtually all have Internet access and most have broadband access.

Students Prefer Technology in Their Courses, to a Moderate Degree

Students perfer moderate IT use in their courses, and they expect faculty to use technology well (see Figure 1-2). They give good grades to their instructors' skill in using IT in courses. The primary benefit of technology in courses is convenience, followed by connectedness.

Students Are Comfortable with a Core Set of Technologies and Less Comfortable with More Specialized Technology Applications

Both male and female students are comfortable using core information technologies such as e-mail, messaging, and word processing, and they rate themselves as skilled in their use. The majority of students perceive that they need no additional training to use these technologies. Students differentiate their skills with different technologies—word processing is highest and specialized applications are lowest (see Table 1-2). Gender differences are small and declining, as are differences between engineering and business students and students in nonscience disciplines. The exceptions are specialized applications such as spreadsheet and presentation (for example, PowerPoint) software and computer maintenance, where engineering and science majors rate their skills much higher.

Students View Technology in the Classroom as Supplemental to Their Course Experience, Not as Transformational

Students see IT in courses not as transformational but rather as supplemental. Students prefer face-to-face interaction with their instructors and with other students. One student told us, "Overall, I feel that using information technology could increase opportunities for classroom engagement and teacher-student accessibility. At the same time, though, it could become overwhelming and even distract from truly understanding a certain discipline or subject. Basically, as long as we stay in control of technology and use it with balance and thought, it will definitely be reliable and useful."

Core IT Skill Levels Are Comparable Across Class Standing

Core IT skill levels in e-mail, messaging, and word processing appear to be level throughout a college career. Specialized technology skills needed to satisfy specific course requirements, such as the use of spreadsheets, PowerPoint, and online library searches, on the other hand, are more evident in college seniors.

Table 1-1. Ownership of Selected Technologies

Technology Owned	Males (N = 6,123)	Females (N = 11,835)	Seniors (N = 10,042)	Freshmen (N = 7,997)	Overall (N = 18,039)
Personal desktop	68.7%	58.0%	70.1%	50.9%	61.6%
Laptop	55.0%	55.9%	49.3%	63.5%	55.6%
PDA	17.0%	10.4%	15.5%	9.0%	12.6%
Smart phone	2.2%	0.8%	1.4%	1.2%	1.3%
Cell phone	86.5%	92.1%	90.5%	89.7%	90.1%
Music device	46.3%	34.2%	34.3%	43.5%	38.4%
Wireless adapter	32.3%	20.9%	26.4%	22.8%	24.8%

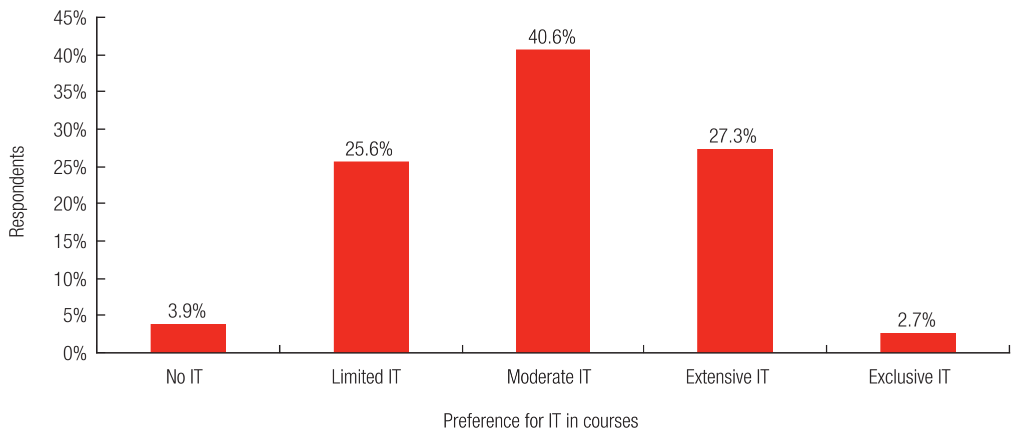


Figure 1-2. Student Preference for Use of IT in Courses (N = 17,856)

Table 1-2. Student Self-Reported Skill Level

Activity	N	Mean	Std. Deviation
Word processing (Word)	17,951	3.52	0.548
Computer operating systems (Windows, OS X)	17,371	3.04	0.773
Presentation software (PowerPoint)	17,191	2.98	0.745
Spreadsheets (Excel)	17,264	2.88	0.760
Online library resources	17,144	2.85	0.687
Course management systems	14,416	2.67	0.822
Computer maintenance	16,853	2.47	0.927
Securing your electronic device (firewalls, antivirus software)	17,102	2.47	0.922
Graphics (Photoshop, Flash)	14,686	2.40	0.850
Creating Web pages (Dreamweaver, FrontPage)	11,210	2.14	0.913
Creating and editing video/audio (Director, iMovie)	10,656	2.01	0.867

Scale: 1 = very unskilled, 2 = unskilled, 3 = skilled, 4 = very skilled

Technologies In Use

All students use IT for recreation, and this is especially true for younger students. The largest behavioral gap seems to be between those students below age 20 and those 20 and older who settle into their majors, have jobs, are increasingly concerned about getting good grades, and generally have less discretionary time than younger students.

Virtually all survey respondents use computers for writing documents and e-mail, followed by surfing the Internet for coursework (98.4 percent) and for studying and classroom activities (96.2 percent). As Table 1-3 illustrates, the least used (though hardly insignificant) capabilities are creating Web pages (24.9 percent) and editing video/audio (24.1 percent).

Curriculum and Technology Use Are Intertwined

The importance of the curriculum of the academic discipline is evident in the use of more specialized applications such as spreadsheets, presentation software, graphics, video/audio, and creation of Web pages. As mentioned, engineering and business students reported the highest levels of use of spreadsheets and presentation software. Spreadsheets are used by engineering students (79.3 percent) and business students (78.5 percent) much more than by fine arts

Table 1-3. Technologies Used by Students

Activity	N	Senior	Freshman	Total
Creating, reading, sending e-mail	17,865	99.7%	99.7%	99.7%
Writing documents for your coursework	17,902	99.1%	98.7%	98.9%
Surfing the Internet for information to support your coursework	17,936	98.7%	98.1%	98.4%
Class activities and studying using an electronic device	17,961	96.4%	96.0%	96.2%
Surfing the Internet for pleasure	17,925	94.7%	95.0%	94.8%
Using a library resource to complete a course assignment	17,960	88.8%	86.9%	88.0%
Creating, reading, sending instant messages	17,782	74.2%	89.7%	81.1%
Downloading or listening to music or videos/DVDs	17,891	68.2%	83.8%	75.1%
Online shopping	17,905	77.2%	65.3%	71.9%
Creating presentations (PowerPoint)	17,909	73.2%	54.6%	65.0%
Completing a learning activity or accessing information for a course using a CMS	17,910	64.6%	61.9%	63.4%
Creating spreadsheets or charts (Excel)	17,943	71.2%	51.7%	62.5%
Playing computer games	17,865	57.3%	64.9%	60.7%
Writing documents for pleasure	17,825	59.3%	61.9%	60.4%
Creating graphics (Photoshop, Flash)	17,837	49.3%	47.2%	48.7%
Creating Web pages (Dreamweaver, FrontPage)	17,821	26.1%	23.4%	24.9%
Creating and editing video/audio (Director, iMovie)	17,854	23.4%	25.0%	24.1%

students (47.6 percent). The same pattern exists for presentation software.

Students Spend a Lot of Time Online

Students indicate that they use a computer, on average, 11–15 hours per week, most frequently for course activities, writing documents for courses, instant messenger activities, e-mail, and surfing the Internet for pleasure. Least frequent activities include creating graphics, creating Web pages, and creating and editing video/audio[4] (see Table 1-4).

IT Permeates All Aspects of Student Life, but Its Use as a Tool Has Become Paramount

A pattern emerges from the data: Students use technology first in support of their coursework, second for connectedness, and third for entertainment. This varies, however, by gender. On the whole, men spend more time each week on their computer for entertainment than do women. For example, men report that they spend, on average, three to five hours per week surfing the Internet for pleasure, while women

Table 1-4. Hours Spent per Week on Technology-Related Activities

Activity	N	Average Number of Hours Used
Excluding cell phones, hours each week using an electronic device	17,964	11–15 hours
Course activities and studying using electronic device	17,281	3–5 hours
Writing documents for your coursework	17,701	3–5 hours
Creating, reading, sending instant messages	14,421	3–5 hours
Creating, reading, sending e-mail	17,811	1–2 hours
Surfing the Internet for pleasure	16,996	1–2 hours
Surfing the Internet for information to support your coursework	17,652	1–2 hours
Downloading or listening to music or videos/DVDs	13,437	1–2 hours
Playing computer games	10,836	1–2 hours
Completing an activity using a CMS	11,356	1–2 hours
Using a library resource to complete a course assignment	15,798	Less than 1
Online shopping	12,876	Less than 1
Creating spreadsheets or charts (Excel)	11,214	Less than 1
Creating presentations (PowerPoint)	11,636	Less than 1
Writing documents for pleasure	10,773	Less than 1
Creating graphics (Photoshop, Flash)	8,680	Less than 1
Creating Web pages (Dreamweaver, FrontPage)	4,438	Less than 1
Creating and editing video/audio (Director, iMovie)	4,303	Less than 1

report an average of less than three hours per week.

The attributes of today's students are more readily observable in nonacademic contexts than in the academic setting, despite the presence of enabling technologies readily accessible in both spheres. Technology use in classes is controlled and very much dependent upon instructor pedagogical preferences and teaching and IT skills. Course management systems, for example, which support new patterns of interaction, are faculty-centric. The instructor determines the features that will be used.

Outside courses, there is compelling evidence that students can and do use the Internet and a variety of devices to create and enliven social networks. To a great extent, these capacities are "left at the classroom door," as the formal learning process remains—despite much progress—largely teacher centered. Newer conventions such as social networking, blogging, and instant messaging, while in limited official use, are neither understood nor embraced widely by the faculty. New patterns of social interaction, which converged and mobile devices enable, occur mostly outside the academic setting. Indeed, students in this study express a much lower preference for online discussion groups in courses. This observation requires more study and could relate to the present characteristics of students, faculty, IT, or any mixture of the three.

Technology Facilitates Student Communications and Academic Feedback

When asked about the impact of IT in courses, students respond that IT has a positive impact, especially in communications. The highest scores are given to improved communications—communication with instructors (mean of 3.89), feedback from instructors on coursework (3.77), and communication with classmates (3.70), where the scale is 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Related to this is the ability to improve the presentation of one's work (3.56) and to take greater personal control of course activities—planning, apportionment of time (3.51).

The student perspective: Technology is improving their learning. The constraint may be the real or perceived ability of faculty to use technology effectively.

Although students might not see learning as the primary benefit of IT use in courses, 64.1 percent of student respondents nevertheless perceive that IT used in courses improves learning. The remaining students are largely neutral (28.8 percent), and only 7.0 percent disagree or strongly disagree.

The instructor's skill in using IT in courses makes a significant difference in the students' perception of IT's impact in courses. When comparing the differences in the means between students who rate the instructor's IT skills highest versus those who rate them lowest, we see results indicating that the instructor's IT skills have the greatest positive impact on student engagement in the course, student interest in the subject matter, and student understanding of complex concepts. For example, 40.0 percent of students who strongly agree that their instructor uses IT well in courses also strongly agree that they are more engaged in courses that use IT. In contrast, of the students who strongly disagree that instructors use IT well, only 10.1 percent strongly agree that IT increases their engagement in courses. There is a similar pattern for increased interest in the subject matter and understanding complex concepts. Where the instructor's skill is less relevant to the activity (such as communication), the mean differences are significantly lower. The instructor's overall pedagogy undoubtedly plays a role here but the questionnaire did not address this complex factor.

Technology in Courses Is Helping

Students report that the most valuable benefit of using technology in courses is convenience (50.3 percent), followed by connectedness (19.7 percent). Management of course activities (13.5 percent) and learning (12.7 percent) are next. Only 2.8 percent of the students perceive no benefit whatsoever from using technology in courses.

While learning is the fourth highest benefit mentioned when students are required to pick just one benefit, students agree that IT in courses improves learning. Fifty-three and one half percent of respondents agree and 10.6 percent strongly agree (total of 64.1 percent) that IT in courses improves learning. For these students who indicate that IT in courses improves learning, the most important factor indicated from the regression analysis, regardless of the student's age, gender, or major, is the instructor's skill. Many students commented on the importance of the instructor's skill on the learning outcome, regardless of technology, in the qualitative interviews and in the open-ended question comments. Students also think that IT, used well, can make a good instructor better.

Most Students Have Used Course Management Systems, and Most of Those Using Them Have Had Positive Experiences

The institutions in the study use course management systems differently. Some are just beginning to adopt them and have limited use; others have used them for many years. Student respondents, however, report an overall use rate of 72 percent. Of the institutions in the study, the lowest use rate for an institution is 12.2 percent and the highest rate is 95.8 percent. In the 2005 study, seniors (76.1 percent) are more likely than freshmen (65.8 percent) to have taken a course that used a CMS. Also, students at doctoral institutions (75.1 percent) are more likely to have taken a course that used a CMS, and students at AA institutions (23.8 percent) are least likely to have done so.[5]

Of students who have used a CMS, more than 75 percent report a positive or very positive experience using the system. Only 5.0 percent are negative or very negative, and 19.8 percent are neutral.

When assessing what factors contribute to a positive experience with a CMS, we found three of medium significance. Students who agree or strongly agree that courses using IT allow them to take greater control of their course activities (planning, apportioning time) report the most positive experience with a CMS. The next greatest factor is instructor skill, followed by the instructor's use of IT to provide prompt feedback to students.

Those students who prefer little or no technology in courses do not reflect a negative attitude toward course management systems. Almost 50 percent of students who prefer no IT in courses report a positive experience with a CMS. Also, students who have a very positive experience using a CMS overwhelmingly report a preference for IT in courses.

While students overall express a positive experience with course management systems, in the qualitative comments students also express frustration about poor and inconsistent use of the systems, along with concerns about reliability.

Students Use a Variety of CMS Features

Students report the highest use of the CMS syllabus feature (95.2 percent), followed by online reading (94.0 percent). Other features used extensively are keeping track of grades (90.5 percent), access to sample exams and quizzes (83.7 percent), and turning in assignments online (80.1 percent). The features used least are getting assignments back from instructors with comments and grades

(67.2 percent) and sharing materials among students (67.5 percent).

Student feedback on CMS use is fairly consistent: Students seem to like many of the features, but they wish instructors used them more extensively and consistently.

Students Who Have a Good CMS Experience Also Have Positive Feelings About IT and Learning

Students who report a positive experience with a CMS are more likely than students with a neutral or negative experience with a CMS to agree that IT use in courses has a significant positive impact on student engagement in the course and interest in the subject matter, improves presentation of their coursework, and increases their understanding of complex concepts.

Nearly two-thirds of students who have a very positive experience with a CMS also agree or strongly agree that the use of IT in courses improves their learning. Conversely, a student whose experience with a CMS is negative is more likely to indicate that the use of IT in courses does not improve learning.

While positive about technology, these college students are balanced.

A key finding of the 2004 ECAR study was that students prefer a moderate amount of technology in their courses. This year's findings are very similar, showing slightly less preference for technology in courses than last year. Students' general enthusiasm for technology balanced with an expressed preference for only moderate engagement of technology in course activities suggests that students in fact value the traditional facets of face-to-face instruction (and books, discussion, and so forth) and do not devalue the supplemental contributions that IT makes. Qualitative comments suggest that students have a nuanced understanding of the differences between direct interpersonal engagement and technology-mediated engagement in the context of learning activities.

Implications of the Study

The analysis of quantitative and qualitative data can help us develop strategies to improve the undergraduate IT experience. Such strategies must be responsive to student expectations in the four quadrants (Figure 1-1). To a large degree, higher education has come a long way with convenience and connectedness, and to a lesser degree with control. Learning is a work in progress.

Listening to the students and paying attention to this study's findings, we believe institutions must pay particular attention to six areas:

- integration of IT into the curriculum,
- definition of IT skills,
- training for students and faculty,
- common environments and common approaches,
- IT service and support, and
- monitoring and benchmarking.

Importance of the Curriculum

A major finding of the 2005 ECAR study on student use of technology is that students with the highest IT skill levels acquired many of these skills as a result of course (or program) requirements. Many curricula in science, engineering, medicine, and accountancy are becoming increasingly IT intensive as professional societies and government redefine required competencies for some professions.

In medicine, for example, the National Academy of Science's Institute of Medicine recently defined competencies in five areas: providing patient-centered care, working in interdisciplinary teams, employing evidence-based practice, applying quality improvement, and utilizing informatics. Several of these competencies are likely to be technology intensive and technology dependent. Such mandates and professional standards will likely lead to requirements for colleges and universities to develop clear and explicit policies on IT's role in courses and in the curriculum.

Defining Skills Needed for Learning

We believe that once we have a more global understanding of which information technologies we want to use in courses and in the curriculum, at what level of sophistication, and for what purposes, it will become possible to establish a set of required skills. To use the example of medicine, what competencies are required in the area of informatics, simulation, and visualization? What level of digital literacy is required to find, retrieve, assess, and manage digital information? And how skilled with IT and mobile devices must students be, especially as they enter the workforce?

Comprehensive Training

Once we have an agreed-upon level of needed skills, we can design training programs for faculty and students. Students expect their faculty to be skilled with PowerPoint and course management systems. We believe students are looking for more innovative use of information technologies to provide real-time data in experiential learning exercises, more visual materials, and simulation.

We cannot assume that students are prepared to take advantage of these technologies in the absence of planned, systematic, and just-in-time training that is based on a recognized level of required skills. Students need to learn how to learn with the new technologies. Training must be deliberate and continuous. Institutions should require all of their colleges to articulate concrete IT learner competencies and literacy for students in their programs. Once these competencies are aggregated, a work plan can be developed to achieve the proposed competency levels—through courses, curriculum changes, help centers, and so forth. It would be useful to articulate desired faculty competency as well, although we recognize this may be more difficult to do and harder to implement. Articulating student competencies will probably guide the articulation of faculty members' required competencies, as the one will likely have to complement the other in a sensible work plan.

Common Environments and Common Approaches

Like us, students want technology that is reliable and easy to use. They understand the value of consistency, standards, and common practice, and they seek greater commonality both in the information technologies used (standard platforms) and in how technologies are used (standard methods). This was especially an issue with course management systems, which students claim are used inconsistently by faculty. Students clearly want most of their classes to use course management systems, and they want faculty to use the CMS in a familiar, if not standardized, manner. They want courses and course materials to have a common appearance. We suspect this concern extends into departmental and collegiate Web sites, which often vary considerably.

IT Services and Support

In their survey responses and in interviews, students directly stated that they need IT services that are fast, easy to use, and reliable. Without basic reliability, students feel they can't count on the technology when they need it most—for submitting papers to their instructors, taking online exams, and communicating with instructors and classmates. They express frustration when networks or servers are down, technical support is unavailable, or the technology gets in the way of completing their required coursework. Without a core set of dependable IT systems and services, students and instructors alike will not fully adopt technologies to enhance the learning environment.

Monitoring and Measuring

On a more conjectural note, we strongly believe in the need to measure and assess student and faculty IT competencies, their attitudes toward the use of IT in courses, and how they actually use IT. Such assessment can contribute to our understanding of curriculum effectiveness, technology use, where and when to invest, and training programs' performance. And of course colleges and universities over time will also want to assess the financial impacts of e-learning and specifically the impacts on faculty, institutional, and learner productivity.

Next Steps

ECAR plans to repeat this study in 2006, providing a third snapshot in time and making possible an assessment of trends and rates of change in IT use, satisfaction with IT, and IT's impact, especially on learning. We will also collect institutional data on the use of IT in the curriculum, whether IT skills have been identified and defined, the quality and breadth of training programs, consistency of implementation, and monitoring. It will be interesting to see whether institutions that have adopted policies and practices in these areas show improvements in students' use of and skills with information technologies in courses and their ability to learn more as a result.

Endnotes

1. Students in this sample attend 30 doctoral institutions, 18 MA institutions, 12 BA institutions, 2 AA institutions, and 1 specialized institution. Two-thirds of the respondents are female. Thirty-nine percent of respondents are 18 or 19 years old, 48 percent are 20 to 24 years old, and 13 percent are over 25. Only 1.1 percent of the students are over 50. Ninety-two percent of respondents are full-time students. In the absence of our weighting of institutional responses, this means that we can generalize to the sampled students but not to the 63 institutions. These findings are instructive and not necessarily conclusive of student experiences at different types of institutions. One can say with 99 percent confidence that the error attributable to sampling and other random effects is +/– 2 percent.
2. Interviews were conducted at Brandeis University, Bridgewater State College, Colgate University, Franklin W. Olin College of Engineering, South Dakota State University, University of Wisconsin–Madison, and University of Wisconsin–Milwaukee.
3. The information collected from the student respondents is confidential and no personally identifiable data is available from the quantitative survey. The required institutional review board approval was received from every participating institution.
4. Note that students who did not use the application are excluded from the table.
5. It is important to note that only two AA institutions are reflected in this data and that generalizations about AA college students cannot be made with any confidence.

2
Methodology and Respondent Characteristics

You should continue to make these surveys and encourage students to take them because, quite honestly, it made me think about how technology has benefited us all.

—An undergraduate student

Methodology

This research study represents an important milestone in one of ECAR's most ambitious undertakings. In 2001, ECAR fellows discussed the paucity of data and analysis of undergraduate students and their uses, preferences, expectations, and experiences with information technology. With the help of knowledgeable leaders, the audacious idea of creating a new survey of students focusing on technology was hatched and given flight.[1] In 2004, the first ECAR study was launched at 13 institutions, and a baseline was established.

The 2005 study builds on and extends this success and consists of eight data collection and analytical initiatives:

- We undertook a literature review and reviewed other surveys, both U.S.-based and international.
- The results of *ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control* provided necessary insight into student perceptions about their IT experiences (Kvavik et al., 2004).
- The 2003 ECAR study *Faculty Use of Course Management Systems* provided useful data on how faculty members actually use course management systems. It includes comparative data for analysis of student and faculty perceptions (Morgan, 2003).
- A Web-based survey of undergraduate freshmen and seniors supplied student quantitative data based upon their experiences with IT in higher education. A sample of 143,730 students at 63 higher education institutions in 24 states received the e-mail invitation to participate in the study. Fully 18,039 students responded.[2]
- We supplemented quantitative data with interviews of 82 undergraduate students at seven institutions to provide diverse perceptions of IT's impact in higher education.[3] We recognize, of course, that as consumers of higher education, few students can offer expert opinions about either instructional methods or IT. Opinions and perceptions nevertheless have meaning.
- Interviews with 20 instructional technology support staff at University of Wisconsin System institutions gave further insights on student IT issues. This activity, too, was designed more to inform and calibrate the investigators' understanding of issues than to fulfill a direct research objective.
- More than 8,000 students commented on IT in open-ended survey questions. They expressed opinions on their use of and

skill with IT, the state of their institutions' IT support services, and their perceptions of technology use in their courses. They also offered advice on how to improve IT at their institutions. These comments are analyzed and give additional perspectives on the undergraduate IT experience.

- A comparison of 2004 and 2005 results to identify similarities and dissimilarities is also an important part of this study.[4] It is important to note that this study does not attempt to follow the same students over time.

The ECAR research team extended the 2004 literature review, looking especially to the EDUCAUSE Learning Initiative for new findings on student use of technology and learning. Of particular interest is the recently published volume edited by Diana G. Oblinger and James L. Oblinger, *Educating the New Generation* (Oblinger & Oblinger, 2005). We also reviewed case studies for both the United States and international institutions on student use of technology. The bibliography appears in Appendix A.

ECAR designed a quantitative Web-based survey to assess student skills and learning with information building on the ECAR 2004 survey.[5] A few questions were deleted because we found that they did not work well in 2004. We improved other questions with better wording or clearer definitions. We also added some questions in 2005 to address issues we learned were important in 2004, especially with respect to student learning with IT. We were careful not to change too many questions in order to track changes in student behavior and opinions from 2004 to 2005. When appropriate, we included questions from other surveys, which makes possible a limited but useful comparison with student behavior at other higher education institutions and affords us an opportunity to cautiously track trends in student technology use.

This year's study presented a challenge to the principal investigators because we increased from 13 institutions in 2004 to 63 institutions in 2005.[6]

Institutions were asked to construct a sample of their students to achieve a 95 percent level of confidence with a +/– 5 percent margin of error. However, a number of them chose to include their entire freshman and senior classes. In the absence of our weighting of institutional responses, this means that we can generalize to the sampled students but not to the 63 institutions. For the sampled students, we achieved a 99 percent level of confidence with a +/– 2 percent margin of error, which means that one can say with 99 percent confidence that the error attributable to sampling and other random effects is +/– 2 percent.[7]

We use means and standard deviations in this study. Means are arithmetic averages and measures of central tendency. Standard deviations are measures of dispersion or variability. What this means is that the larger the standard deviation, the more disagreement exists among the respondents. We also did some comparison of means and regression analyses to determine levels of correlation among the variables. We refer to these analyses but for reasons of simplicity do not present the figures.[8]

Research Team

Robert B. Kvavik and Judith Borreson Caruso are the principal investigators. Mark R. Nelson's contribution to the study is a content analysis of almost 400 pages of commentary provided by students in two open-ended survey questions. Judith A. Pirani provides interview data from student focus groups.

Judith Borreson Caruso

Judith Borreson Caruso is director of policy and planning at the University of Wisconsin–Madison and has been an ECAR research fellow since July 2002. She previously served for many years as the University of Wisconsin–Madison's director of applications technology. Caruso is active in several IT professional organizations, including CUMREC and EDUCAUSE. She has served on the EDUCAUSE Current Issues and *EDUCAUSE Quarterly* editorial committees. Recently she accepted the position of chair-elect of the University of Wisconsin System IT Management Council. While with ECAR, she participated in the enterprise resource planning (ERP), IT security, and student studies.

Robert B. Kvavik

Robert B. Kvavik earned his Ph.D. from Stanford University (1971). He is currently associate vice president at the University of Minnesota. He directed the University of Minnesota's implementation of the PeopleSoft student and human resources modules. He has published extensively in his academic discipline and increasingly on the impact and organization of information technologies on institutional services. Kvavik is a nationally known speaker on e-business and IT-enabled services in higher education. He was appointed an ECAR senior fellow in January 2002. Kvavik has been a principal author of ECAR's ERP, IT security, IT leadership, business process performance, and student use of technology studies.

Mark R. Nelson

Mark R. Nelson earned his Ph.D. in information science from the University at Albany, SUNY (1998). He is the Digital Content Specialist at the National Association of College Stores. Formerly, Nelson was assistant professor in management information systems and information technology at the Lally School of Management and Technology at Rensselaer Polytechnic Institute. Nelson has served as an ECAR fellow since summer 2003. In this capacity, he has contributed to major research studies including IT leadership, and he authored several research bulletins. He is a specialist in qualitative research methods and led the review and analysis of open-ended qualitative student responses to the survey undertaken for this study.

Judith A. Pirani

Judith A. Pirani earned her M.B.A. from Hofstra University (1984) and her B.A. from Simmons College. She is an ECAR research fellow and president of Sheep Pond Associates. Her expertise is in the area of educational technology. Her research includes the use of e-learning to improve employee efficiency and sales demand, marketability of course management systems for corporate training applications, and Web site development strategies in higher education and government. She was a principal author on three ECAR studies. Previously, she was vice president at Lyra Research and Giga Information Group, where she managed worldwide research practices in digital imaging technologies.

Participating Institutions

This study does not describe the behaviors, perceptions, skills, or attitudes of students in higher education overall. The 63 institutions that participated in this study reflect a mix of the different higher education institution types in the United States, in terms of Carnegie class as well as location, source of funding, and levels of technology emphasis. None of the above factors are used in our analysis.

Institutions participating in the 2005 ECAR study do not represent a statistical representation of U.S. higher educational diversity as a whole. Specifically, participating institutions are overwhelmingly four-year institutions whose undergraduate students are generally traditional in age (87 percent are 24 years old or younger). We therefore consider our findings to be instructive or indicative rather than conclusive of student experiences at different types of institutions.

Notwithstanding these cautions, our findings in 2005 are strengthened both by the striking similarities that we find when we compare data from the 2004 and 2005 survey results (see Chapter 6) and by the remarkable similarity of findings in three European studies. In 2004, the University of Oslo conducted a survey of student use of IT using a modified ECAR student survey instrument (Jacobsen, 2004).[9]

Participating institutions, by Carnegie class, appear in Appendix E.

The number of respondents by their institution's Carnegie classification includes 13.0 percent enrolled at BA institutions, 36.9 percent at MA institutions, 48.7 percent at doctoral institutions, and 0.1 percent at other institutions. Our data show that 8.4 percent of our respondents are from institutions with enrollments of 2,000 and under, 5.9 percent from institutions with 2,001–4,000, 12.2 percent from institutions with 4,001–8,000, 30.8 percent from institutions with 8,001–15,000, 35.2 percent from institutions with 15,001–25,000, and 7.5 percent from institutions with over 25,000. Note that 78.2 percent of our respondents are enrolled in 42 public institutions and 21.8 percent in 21 private institutions.

Sample and Response Size and Characteristics

Invitations to participate in the survey were sent by e-mail to 65,491 freshmen and 78,239 seniors at 63 institutions (see Appendix E). Of those we invited to participate, 7,997 freshmen and 10,042 seniors responded. Seniors make up 55.7 percent of the respondents and freshmen make up 44.3 percent. Each university used a different sampling model.[10]

The overall student response rate in the 2005 study is 12.6 percent, compared with the 23.7 percent response rate in 2004. Seniors' responses are higher at 12.8 percent than freshmen's at 12.2 percent. There is significant variation by institution. The reduced response rate, we think, is likely caused by the proliferation of spam e-mail over the past 12 months. Students have received numerous e-mails throughout the year asking them to take a survey and win a prize. And, since many spam e-mails can contain computer viruses and other forms of malware, it is not unlikely that students were cautious about responding to the e-mail invitation.

Female students made up 65.9 percent of the respondents, despite our strategy of oversampling male students in the population.

We would emphasize again that our student respondents are heavily weighted with so-called traditional students: 39.4 percent of the students in our study are 18 or 19 years old, and 47.6 percent are ages 20 to 24 (see Figure 2-1).

Fully 92.3 percent of the respondents are full-time students, and 7.7 percent are part-time. Fifty-three percent of responding students live off campus and 47 percent live on campus, reflecting in part the differing lifestyle patterns of collegiate freshmen and seniors.

The grade point averages for our respondents appear to follow a fairly normal distribution (see Table 2-1). More than 71 percent of the students have a B or better grade point average.[11]

We asked the students to identify their major (see Figure 2-2). Note that *N* is larger than the sample size due to students' reporting double majors. Because so many students are freshmen, it is not surprising to find that 18.1 percent are undecided or do not know. Social sciences (15.0 percent), business (14.3 percent), and life sciences (12.2 percent) are the largest major areas of declared interest.[12]

Qualitative Data

ECAR collected qualitative data by means of student focus groups at Brandeis University, Bridgewater State College, Colgate Univer-

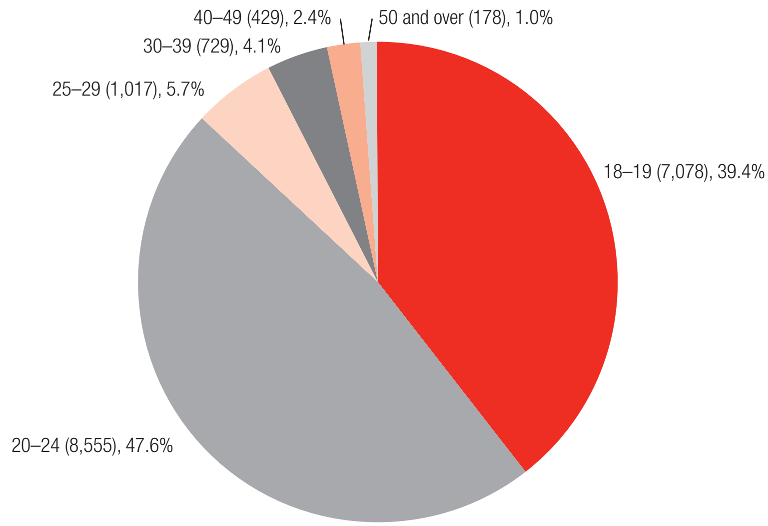


Figure 2-1. Age of Student Respondents (N = 17,986)

Table 2-1. Respondent Grade Point Average (GPA) (N = 17,966)

GPA	Frequency	Percentage	Cumulative Percentage
3.75–4.00	3,124	17.4%	17.4%
3.50–3.74	3,155	17.6%	35.0%
3.25–3.49	3,161	17.6%	52.6%
3.00–3.24	3,348	18.6%	71.2%
2.50–2.99	3,240	18.0%	89.2%
2.25–2.49	694	3.9%	93.1%
2.00–2.24	502	2.8%	95.9%
Under 2.00	225	1.3%	97.2%
Don't know	517	2.9%	100.1%
Total	**17,966**	**100.1%**	

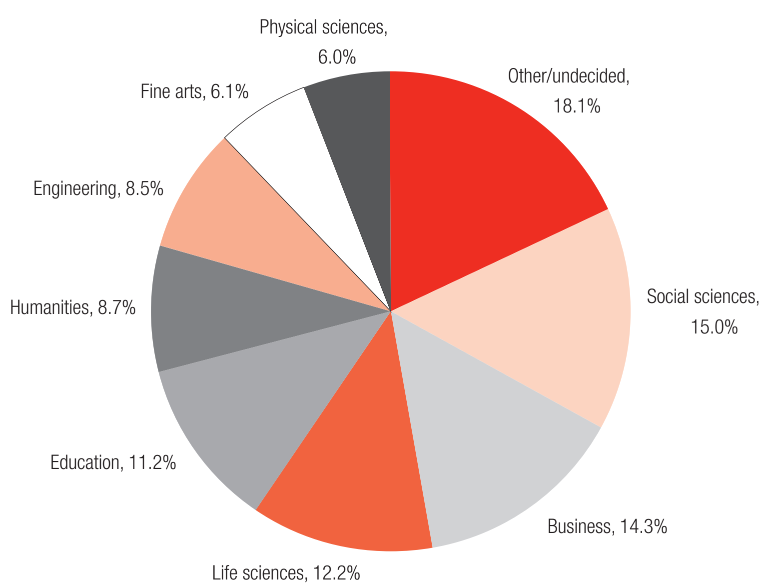


Figure 2-2. Students' Majors (N = 22,390)

sity, Franklin W. Olin College of Engineering, South Dakota State University, the University of Wisconsin–Madison, and the University of Wisconsin–Milwaukee. We strove to interview as diverse a group of students as possible. A total of 82 students participated in the focus groups, and each focus group meeting lasted for an hour. The focus group questions appear in Appendix D.[13]

ECAR also interviewed 20 instructional technology support staff and faculty, mostly at University of Wisconsin System institutions. We selected administrators and faculty who supported undergraduate students in their use of technology for academic purposes. We chose, for example, employees of computer help desks and those providing instructional technology support to faculty. Discussions with these professionals were designed to broaden (and leaven) our understanding of student perceptions as reflected in both survey work and interviews. Appendix D includes the interview questions.

In addition, more than 8,000 students responding to the quantitative survey took the opportunity to provide additional insights by responding to two open-ended questions. Mark Nelson analyzed their comments using the content analysis tool NVivo, thereby providing us with additional insight into the substance of the qualitative data.[14]

The students articulated several themes, which we have incorporated into the main text of this study. Noteworthy are assessments and recommendations on

- the learning experience using IT;
- online features of their courses and course management systems;
- faculty and student use of IT;
- access to IT and quality of the IT infrastructure available to students; and
- the reliability, convenience, and quality of support services.

Students' comments form the basis for a set of recommendations to administrators for improving IT use, presented in the concluding chapter. We characterize such comments as the wisdom of students, and policymakers should take them as one important input to the complex set of choices and options they face.

Endnotes

1. ECAR is indebted to Robert Albrecht (ECAR), Carole Barone (EDUCAUSE), Darwin Handel (University of Minnesota), Richard Katz (EDUCAUSE), Diana Oblinger (then with ECAR), and many others who consulted on this research and survey design.
2. Students in this sample attend 30 doctoral institutions, 18 MA institutions, 12 BA institutions, two AA institutions, and 1 specialized institution. Two-thirds of the respondents are female. Thirty-nine percent of respondents are 18 or 19 years old, 48 percent are 20 to 24 years old, and 13 percent are over 25. Only 1.1 percent of the students are over 50. Ninety-two percent of respondents are full-time students. In the absence of our weighting of institutional responses, this means that we can generalize to the sampled students but not to the 63 institutions.
3. Interviews were conducted at Brandeis University, Bridgewater State College, Colgate University, Franklin W. Olin College of Engineering, South Dakota State University, University of Wisconsin–Madison, and University of Wisconsin–Milwaukee.
4. The information collected from the student respondents is confidential, and no personally identifiable data is available from the quantitative survey.
5. To encourage a larger response from the students, ECAR offered a $50 gift certificate to be awarded to 100 students, using a lottery. We had learned from other institutions' experiences that the absence of an incentive would greatly reduce the response rate. Such awards are prohibited in some states; as a result, some institutions had to withdraw from participation.
6. Each institution required approvals from institutional executives and their institutional review board (IRB) in order to participate in the study. The approval processes, while navigated by an institutional contact, varied considerably in difficulty from institution to institution. Often, the information required for approval was different from one institution to the next. While the investigators made every attempt to provide all information required at the start of the study solicitation, additional details were added throughout the approval process to provide what each institution required. The information collected is confidential. The data files we used for analysis have been purged of any information that would make it

possible to identify a particular respondent. The IRB applications, application dates, and approval dates are available from ECAR.

7. The confidence interval (margin of error) refers only to the statistical error associated with the size of a sample, assuming a representative and random sample. This is the only type of error that can be readily quantified. Note, however, that there are other potential sources of error that are non-sample related, such as the wording of the survey questions (may not be clear) and most notably nonrepresentative responses (a large percentage of the students declined to take this survey). Since the response rates in this study were lower than hoped for at a number of schools, one cannot be certain of how representative the respondents are of their respective campuses or of this population in general. Therefore, caution should be exercised in assuming that the findings generalize beyond the sampled students.

8. Note also that percentages in some of the tables do not add up to 100 percent because of rounding. Rounding occurs in the figures as well.

9. Note that the report is available only in Norwegian. Especially noteworthy are their findings that students prefer a moderate amount of technology in courses and that students use their computers most in support of class activities. The Survey of European Universities Skills in ICT of Students and Staff (SEUSISS) is a multinational project funded by the European Commission under the Socrates Program that collects information about the information and communication technology experience, skills, confidence, and attitudes of students and academic staff at seven European universities (SEUSISS, 2002). Their findings are quite similar to ours, as are the 2003 findings of the Students' Perspectives on Technology in Teaching and Learning in European Universities (SPOT+) project, which analyzes students' views on the use of IT at 13 European universities (European Commission, 2003). See SEUSISS Project, 2002.

10. There are a few small discrepancies in the tables appearing in Appendix E due to students' miscoding their institution or class (senior or freshman). Because the students were anonymous, it was impossible for us to go back and correct these errors. But because we rarely use institution in our analysis, the impact on the study is minimal.

11. Nationally, one source from 2002 assessed the average student grade point average at 21 four-year public and private postsecondary institutions as 3.09. See Rojstaczer (2003).

12. Nationally, 21.4 percent of undergraduate degrees are issued in business and marketing, 10.3 percent in social science and history, and 4.8 percent in biological/life sciences (U.S. Dept. of Education, 2003).

13. To recruit students, staff from participating institutions posted advertisements in various campus locations, made announcements in large enrollment classes, and e-mailed students. Food and beverages were provided as incentives to attend. Students who work in general-access undergraduate student computing laboratories or for student technology help desks were also included in the focus groups. Students were advised of IRB regulations that govern the research and their rights and the responsibility of the investigators to protect their rights. Notes were taken or recordings were made and transcripts produced. None of the comments made by students and cited in this study identify any individual student. In some instances, we corrected their English but made no change in meaning.

14. NVivo is a member of QSR/Sage's NUD*IST line of qualitative analysis software tools and is designed specifically to help with grounded-theory approaches to content analysis. NUD*IST stands for Non-numerical, Unstructured Data—Indexing, Searching, and Theorizing. NVivo uses a hierarchical approach to content analysis.

3
Student Use and Skill with Information Technology

… [J]ust don't forget—with IT you're asking students to do homework on their PlayStation.
—An undergraduate student

Key Findings

- Fully 96.1 percent of seniors and freshmen in these 63 institutions own computers.
- Laptop ownership in the 2005 study is 55.6 percent, well above the 46.8 percent ownership of laptops in the 2004 study. Of students in this study who own laptops, 14.1 percent bring them to class.
- Students using modems uniformly report that they have more problems using technology and are less likely to want to take courses that use technology.
- Students use technology primarily for convenience and communications, for both their academic and social lives.
- Almost 90 percent of the students have access to broadband.
- Virtually all students report using computers primarily for writing documents and e-mail, followed by surfing the Internet for coursework and studying. Eighty-eight percent use an electronic library resource to complete a class assignment.
- A student's major is a significant factor in determining his or her use of specialized applications such as PowerPoint and spreadsheets.
- Students report that they use computers on average between 11 and 15 hours per week (excluding cell phone use).
- Students rate themselves as highly skilled in word processing and use of the operating system. They rate themselves as least skilled in creating graphics and Web pages, and creating or editing video/audio.
- Thirty-six percent of the students believe they do not need additional training to use IT in their courses.
- Despite the fact that they self-report that they are often more skilled on many applications, older students more often say they need more training than younger students do.

Trends in Technology Ownership, Usage

In this chapter we present data and analysis that describe student technology usage and skill sets. With regard to technology ownership and use, we set out to determine

- the kinds of information technologies students own and have access to, and at what levels of access and ownership;
- the kinds of information technologies students use in their courses, for academic work, and for entertainment; and
- how much time students spend engaging with different types of information technologies during the school year.

With regard to students' skills with information technologies, we asked:

- How skilled are students in using IT in general?
- How skilled are students in using IT for academic purposes?
- Do skills transfer from use of IT for entertainment to more academic applications?
- Are there age and gender differences? Do freshmen have better or poorer levels of comfort and technology skill than do seniors?

We hypothesized that this generation of students uses many and various types of IT in their academic work and for entertainment. We expected high levels of skill and skill transferability with IT. In particular, we expected to find a great emphasis on technologies that support communications and convenience.

Students Are Equipped with Technologies, and Male Students Win the Gadget Race

Numerous national and institution-specific studies have tracked student access, mobility, and ownership of information technologies. What these studies find is an inexorable trend among college students toward universal ownership, mobility, and access, while recognizing that a digital divide exists at *this moment* and is of public concern. This study strongly indicates and confirms a trend toward universal ownership and access. It did not find evidence of a digital divide among collegiate students by gender, class standing, academic major, institution type, or any other variable. However, the authors of this study are mindful that students who may have limited access to or ownership of technologies are unlikely to be represented in great numbers in this study sample.[1]

We asked students whether they own any of seven technologies (see Table 3-1).

We found that

- only 114 students (0.06 percent) own none of these technologies,
- 1,445 students (8.0 percent) own one technology,
- 6,371 students (35.3 percent) own two technologies,
- 5,508 students (30.5 percent) own three technologies,
- 2,883 students (16.0 percent) own four technologies,
- 1,290 students (7.2 percent) own five technologies,
- 396 students (2.2 percent) own six technologies, and
- 32 students (0.02 percent) own all seven technologies.

Overall, students in this study own, on average, 2.8 of the technologies listed in Table 3-1.

Except for the oldest students in the study, there is surprisingly little variation in technology ownership by age, class (freshman/senior), grade point average, part-time or full-time status, on-campus or off-campus residency, and Carnegie class. Students at private institutions (2.9 mean devices) own slightly more devices than students at public institutions (2.8 mean devices). This may be

Table 3-1. Ownership of Selected Technologies

Technology Owned	Males (N = 6,123)	Females (N = 11,835)	Seniors (N = 10,042)	Freshmen (N = 7,997)	Overall (N = 18,039)
Personal desktop	68.7%	58.0%	70.1%	50.9%	61.6%
Laptop	55.0%	55.9%	49.3%	63.5%	55.6%
PDA	17.0%	10.4%	15.5%	9.0%	12.6%
Smart phone	2.2%	0.8%	1.4%	1.2%	1.3%
Cell phone	86.5%	92.1%	90.5%	89.7%	90.1%
Music device	46.3%	34.2%	34.3%	43.5%	38.4%
Wireless adapter	32.3%	20.9%	26.4%	22.8%	24.8%

attributable to the much higher rate of iPod ownership among respondents from private institutions.

There are, however, gender differences. Male respondents own more (3.1 mean devices) than females (2.7 mean devices), and engineering students (3.4 mean devices) own more of these technologies than others. Of course, engineering disciplines are, overall, male dominated, so these findings are to some extent mutually reinforcing.[2]

We found that 96.1 percent (17,328) own a computer. This compares with 93.4 percent in our 2004 study.[3] Of those who own a computer, 61.6 percent (11,113) own a desktop and 55.6 percent (10,026) own a laptop (see Table 3.1). Interestingly, only one in seven of those who own a laptop (14.1 percent) brings it to class,[4] though students at public institutions are more likely to bring a laptop to class (9.7 percent at private institutions and 15.4 percent at public institutions). Of those who bring laptops to class, students comment on how laptops in classes can be particularly effective when their uses are integrated by the faculty into the class experience. For many, laptops are useful in note taking as well. On the negative side, one student comments, "I don't know a single person, with the exception of computer science students, who brings his or her laptop to class with only the purest of scholarly intentions in mind. Lots of Yahoo games are played and IM messages exchanged under the pretense of incorporating technology into the learning process." Form factor, too, may be an issue. Another student comments, "I hate laptops in class. They are heavy to carry, run out of power, and are noisy when people are taking notes on them during lecture."

It seems likely too that the ongoing institutional quest for standards is a tough one. One student argues, "I don't agree with my school's laptop program, although students should perhaps be required to have their own laptops. But they should be allowed to have whatever laptop they wish. I get a free laptop from my dad. I shouldn't have to purchase another one that doesn't suit me as well simply because the school wants everyone to have matching laptops." Another remarks, "I think that most freshmen end up buying a laptop anyway and it's not fair to force students to buy a certain model, because it limits student choice and it is especially a problem for those who can't afford one." Student perceptions that their institutions are shifting technology costs to them are voiced a number of times in open-ended questions and are discussed later in this study.

Laptops Surpass Desktops as the Students' Platform of Choice

Student ownership of computers is widespread and rising. When we compare the 2005 data with the 2004 data, we see a major change in the increase in laptop ownership (from 46.8 percent in 2004 to 55.6 percent in 2005). We also find in 2005 that 21.1 percent (3,811) own both a desktop and a laptop computer, versus 16.6 percent in 2004. This increase may be attributable to laptops' being the replacement computer of choice. Only 3.9 percent (711) of our 2005 study group do not own a computer of any kind, versus 6.6 percent in 2004. This rising ownership may be in part attributable to the larger percent of students at private institutions in the 2005 study.

We looked to see if there were differing patterns of computer ownership. Ownership of desktop computers is much higher for older students (a steady progression from 49.2 percent for students under 20 to 86.4 percent and higher for students over 40). A higher percentage of off-campus students (73.6 percent) own desktop computers than do on-campus students (48.2 percent), and on-campus students (64.0 percent) are more likely to own laptops than off-campus students (48.0 percent). This may reflect an age-related preference (older students own desktops and live off campus) and the decreasing price differential between laptops and desktops that has occurred in the past five years. A higher percentage of part-time students (81.0 percent) own desktop computers than do full-time students (60.0 percent). Full-time students (56.1 percent) are more likely to own laptops than part-time students (48.7 percent).

Of those students who own laptops, freshmen (63.5 percent) are more likely to own laptops than seniors (49.3 percent). And concomitantly, the younger the student, the more likely he or she is to own a laptop computer. Laptop ownership is highest at baccalaureate (public and private) and private colleges and universities (68.4 percent versus 52.0 percent for public institutions). This is not surprising, as students at private institutions are the youngest in the study. This may also reflect differing economic conditions characteristic of private and public university students. The data suggest that economics play a role in student technology choices. Off-campus students, older students, and students at public institutions are likely to have lower family incomes than their counterparts and therefore have a higher percentage ownership of desktop computers. It's possible, too, that such students are working with older computing platforms. We found no gender differences in laptop ownership.

Laptop ownership at the participating institutions varied from a high of 98.9 percent to a low of 35.7 percent. We would surmise that these numbers reflect institutional requirements as well as personal and family income differences. As one student comments, "The opportunity to get a laptop for your personal use for the entire year is what brought me to this campus and has given me the technical skills that I might not have acquired if not given that opportunity." More engineering students tend to own laptop computers than students in other majors.

Other Technologies Are Being Adopted Rapidly and Differently by Gender

We asked about ownership of personal digital assistants (PDAs), smart phones (combination cell phone and PDA), and cell or digital phones. Such ownership indicates both student mobility and interest in communications. PDAs (12.6 percent) and smart phones (1.3 percent) have not penetrated the market very deeply, and there is less than a 1.0 percent change from our 2004 study. PDAs tend to be owned by older students and by men in our study. Seniors are more likely to own PDAs. Students at the doctoral universities reported the overall highest ownership, by a small margin, of PDAs (on average, about 13 percent).

Cell phone ownership increased from 82.0 percent in 2004 to 90.1 percent in 2005. Women (92.1 percent) are somewhat more likely to own cell phones than men (86.5 percent).

Electronic music devices (iPod and others) are owned by 38.4 percent of students, with males (46.3 percent versus 34.2 percent for females) and freshmen (43.5 percent versus 34.3 percent for seniors) having the highest rates of ownership. We expect these numbers to increase over time, not only for the devices' entertainment value but also because institutions are finding interesting ways to use them in support of instruction.

At the University of Minnesota, for example, medical students are using recordings of heartbeats on iPods to diagnose and identify irregular heartbeats. And at Duke University, all incoming freshmen were given a free iPod and voice recorder. Jo Best of CNet News.com reports, "The university found that 60 percent of the students used the device to record academic material, while 28 percent used the device for storage." Further, "Humanities students, particularly those studying music and foreign languages, made the most use of the devices, though the whole first year of engineering students had to use the device in a project for their computational methods class" (Best, 2005).

We found that 24.8 percent of the students have wireless adapters for their computers. Males (32.2 percent versus 20.9 percent for females) and seniors (26.4 percent versus 22.8 percent for freshmen) have the highest ownership rates. Off-campus resident students are more likely to have wireless (27.2 percent versus 22.0 percent for on-campus students).

Broadband Access Is Widespread

We found that 11.9 percent of the students connect *primarily* through a dial-in service, 75.9 percent use wired broadband, and 12.2 percent connect by means of a wireless network. Wired broadband access is slightly lower than we reported for 2004 (81.5 percent), a finding that may reflect only the wider adoption of wireless access, which is also likely to offer high network speed.

The means of access to broadband, but not the access itself, varies significantly at private and public institutions (see Figure 3-1). Private college students (75.4 percent) are much more likely to gain access through school-operated networks than are public institution students (48.8 percent). This is likely also due to a greater percentage of private college students in this study residing in residence halls (see Figure 3-2). We found that 74.3 percent of the private college students reside on campus, versus 39.3 percent at public institutions. More than 90 percent of on-campus students use the campus network. A large number of public institution students gain broadband access commercially. Overall, 78.3 percent of private institution respondents report access to broadband, compared with 75.2 percent of public institution students. To the extent that wireless access uses broadband, it is possible that in fact almost 90 percent of the students in this study have access to broadband.

On-campus residents (75.0 percent) are more likely to use school-operated wired broadband service than off-campus residents, 58.5 percent of whom use commercial broadband service (see Figure 3-2). Only 8.3 percent of on-campus residents use a commercial service, whereas 78.3 percent of off-campus residents rely on commercial service.

Not surprisingly, freshmen residing on campus access the Internet most often using university networks (see Figure 3-3). Fresh-

Figure 3-1. Students' Primary Internet Access, by Public Versus Private Institutions (N = 17,940)

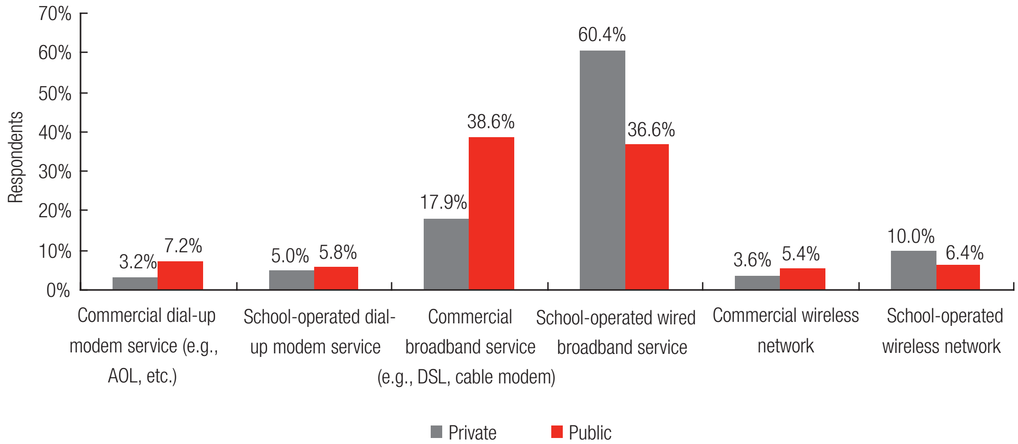


Figure 3-2. Internet Access, by On-Campus and Off-Campus Residence (N = 17,862)

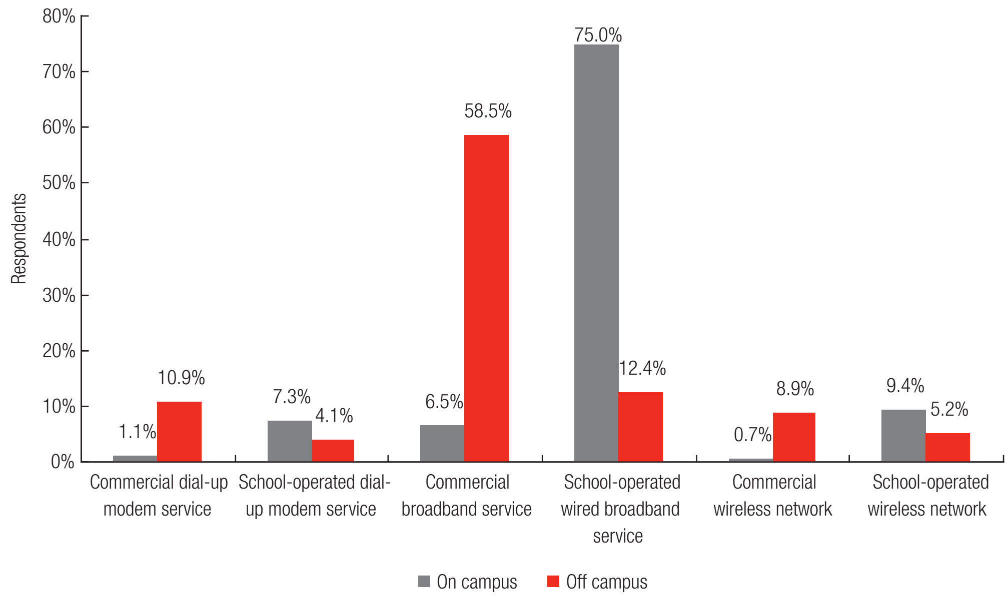
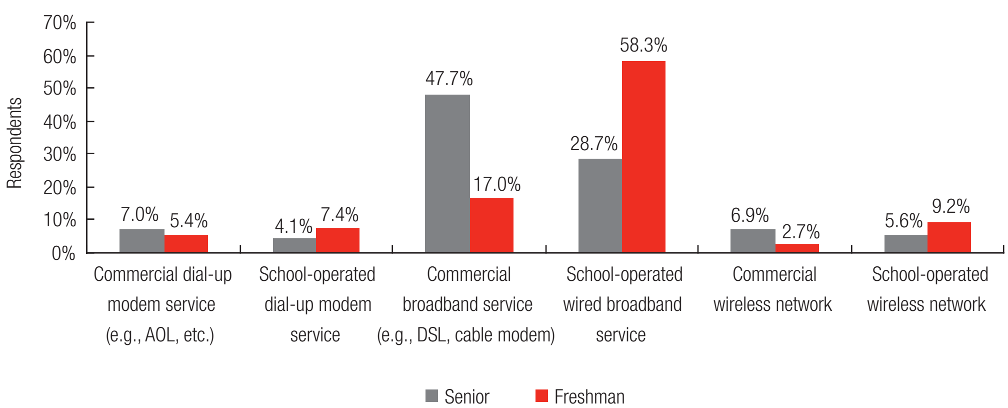


Figure 3-3. Internet Access, by Seniors and Freshmen (N = 17,940)



men, who more often reside on campus, access the Internet dominantly through such networks. On the other hand, 61.6 percent of the seniors in our sample access the Internet via commercial broadband or dial-up services.

Consistent with these findings, part-time students (77.6 percent compared with 42.8 percent of full-time students) are far more dependent on commercial vendors for Internet access and depend to a far greater extent on dial-up network access (14.9 percent of part-time students use dial-up services compared with 5.6 percent of full-time students).

By far the most significant finding with respect to dial-up versus broadband access is a student's perception of barriers to technology use and preference for courses using technology. Students using modems uniformly report that they have more problems using technology and are less likely to want to take courses that use technology. As one student notes, "I have an older personal computer and a modem, and so I have trouble accessing course documents from home. I do not have the extra time needed for me to use the school's labs. Any benefits (which are few) of using IT in my courses are outweighed by the inconvenience." This dichotomy of access to new and fast equipment may in fact be how a digital divide at the collegiate level expresses itself.

Usage Patterns

We asked students what they use technology for and found that virtually all use their computers for writing documents and e-mail, followed by surfing the Internet for coursework and for class activities (see Table 3-2).

Computers and networks are the gateway to the library, as 88 percent of the responding students report using a library resource to complete a class assignment (up from 83.6 percent in 2004). As one Colgate University sophomore puts it, "Technology is very useful for doing research in the library. I've had an electronic card catalog since my first year of grade school. I don't know how to search a library without a computer." From the qualitative interviews, we also learned that students perform many of these activities simultaneously. One student told us that "multitasking is the way things get done now. I frequently research and write several papers at the same time while watching movies."

The least frequently engaged activities are creating Web pages (24.9 percent) and editing video/audio (24.1 percent), though rates of engagement in these specialized activities are higher in 2005 than reported in 2004.

There was less downloading of music reported in 2005 than in 2004, which may be attributable to the higher percentage of women respondents in the 2005 study. Female respondents download music far less than men (55.6 percent of female respondents use this technology, versus 71.3 percent of male respondents). Female respondents reported a weekly mean of 2.85 on this activity, compared with a mean time of 3.56 spent by male respondents,[5] based on a scale where 2.0 represents less than one hour per week and 3.0 represents one to two hours. Reductions in music downloads may also reflect the impact of campus policy changes, educational efforts, or even legal actions taken on behalf of copyright holders to stem illegal downloads. Note that students were not asked whether file downloading was done legally or illegally.

Age is a factor in the use of the computer for recreational purposes. Eighty-five percent of 18- and 19-year-olds download music. This drops to 75.0 percent by age 22 and then quickly drops off to less than 50 percent. Figure 3-4 shows average hours of use and progression of entertainment technology by age group. From a mean of 3.64 for downloading music and 2.45 for playing computer games for 18- and 19-year-olds, the means

Table 3-2. IT Activities Engaged in by Students

Activity	N	Senior	Freshman	Total
Creating, reading, sending e-mail	17,865	99.7%	99.7%	99.7%
Writing documents for your coursework	17,902	99.1%	98.7%	98.9%
Surfing the Internet for information to support your coursework	17,936	98.7%	98.1%	98.4%
Class activities and studying using an electronic device	17,961	96.4%	96.0%	96.2%
Surfing the Internet for pleasure	17,925	94.7%	95.0%	94.8%
Using a library resource to complete a course assignment	17,960	88.8%	86.9%	88.0%
Creating, reading, sending instant messages	17,782	74.2%	89.7%	81.1%
Downloading or listening to music or videos/DVDs	17,891	68.2%	83.8%	75.1%
Online shopping	17,905	77.2%	65.3%	71.9%
Creating presentations (PowerPoint)	17,909	73.2%	54.6%	65.0%
Completing a learning activity or accessing information for a course using a CMS	17,910	64.6%	61.9%	63.4%
Creating spreadsheets or charts (Excel)	17,943	71.2%	51.7%	62.5%
Playing computer games	17,865	57.3%	64.9%	60.7%
Writing documents for pleasure	17,825	59.3%	61.9%	60.4%
Creating graphics (Photoshop, Flash)	17,837	49.3%	47.2%	48.7%
Creating Web pages (Dreamweaver, FrontPage)	17,821	26.1%	23.4%	24.9%
Creating and editing video/audio (Director, iMovie)	17,854	23.4%	25.0%	24.1%

steadily decline to 1.67 and 1.90, respectively, for use of online music and games by students aged 50 or older.[6]

While a majority of students (60.7 percent) play computer games (especially Internet-based games), those who report doing a lot of computer gaming are predominantly male (mean of 2.76 for males versus 2.04 for females).[7] We can't at this time determine whether age-related differences reflect a growth in entertainment-related IT activities by young people or a diminution of these activities by older people (or both).

Excessive use of the computer for playing games has a negative impact on academic grade performance. We found that students who report playing computer games the most have the lowest grade point averages. A University of Wisconsin–Madison biomedical engineering student states, "My roommates do video gaming. They are addicts! One of them is an aeronautical (engineering) major, and over spring break he spent eight hours a day doing this (video gaming). I also had a roommate who had to leave school because of a low GPA from gaming." Students at Bridgewater State College report to us that online poker is the "hot" application. A female art student remarks, "I think every man on campus plays poker online."

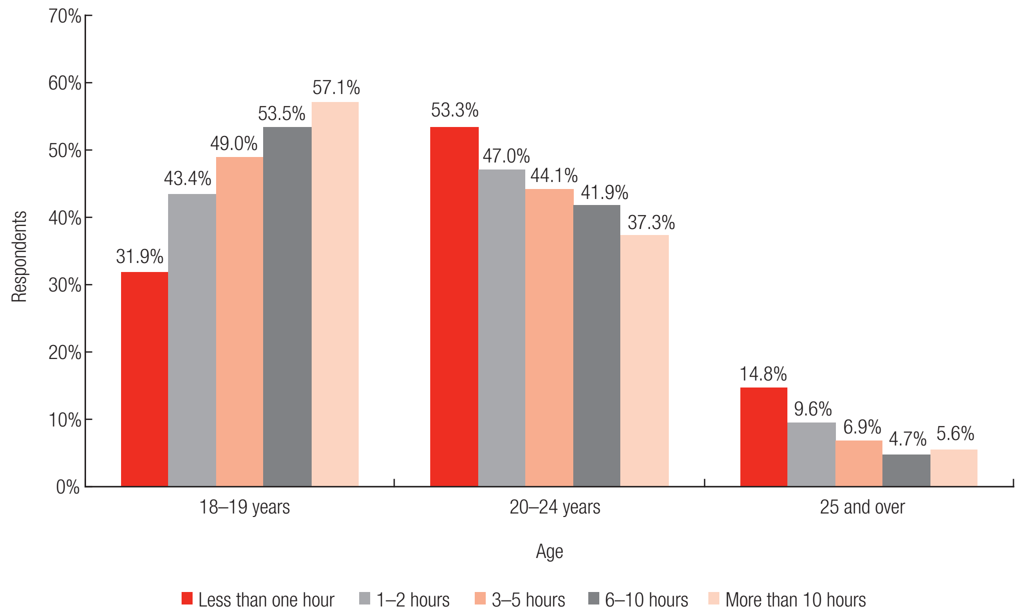


Figure 3-4. Hours per Week Downloading Music, by Age

When asked if the skills a student acquires using the Internet for entertainment transfer to coursework, a South Dakota State University political science major reported, "Technology can definitely interfere with classes—like homework time. Last year in one of my classes I had to record how I spent my time for a week. I was shocked to find out that I spent 24 hours a week on MSN.com!"

At Michigan State University, a 2003 study found that more than 61 percent of 1,300 MSU undergrads surveyed said they spent three hours a day on the computer for recreation. The number of students reporting academic harm, such as lower grades or dropping a class, jumped from about 9 percent in 2000 to 15 percent in 2004. The problem of excessive use was worse among men than women: 20 percent of men reported that it harmed them academically, while 10 percent of women did (George, 2005).

Freshmen are more likely to use instant messaging than seniors. Instant messaging is really a generational issue: We find that 93 percent of the 18- and 19-year-olds in the study use instant messaging. Usage drops off quickly to 62.0 percent for 25-year-olds and to 30.0 percent and lower after age 40.

Seniors and older students report greater use of spreadsheets, presentation software, and online shopping than freshmen or younger students. Also, men are more likely to use spreadsheets (67.4 percent versus 59.5 percent for women), create Web pages (34.8 percent versus 19.9 percent for women), and create graphics (34.9 percent versus 18.5 percent for women). These differences deserve closer study. Gender differences may, for example, reflect unequal gender distributions in academic majors that have been shown to strongly influence IT application choice and use. In our study, for example, 3.8 percent of the women are majoring in engineering or computer science, versus 23.6 percent of the men. Similarly, 15.4 percent of the women are business majors, versus 22.3 percent of the men.

Figures 3-5 to 3-7 show, by age group, the reasons why students use spreadsheets, PowerPoint, and graphics.[8] For the youngest students who use spreadsheets, a class requirement is the most significant reason for use, followed by a desire to improve course performance. In the absence of a course requirement, students are not likely to learn these applications. A South Dakota State University sophomore reports, "Students don't have advanced technology skills in these areas because they don't need to. Why haven't the skills increased? Some students might explore and increase their skills for fun, but most would not. If there isn't that desire to do it on their own, then they won't put out the extra time to do it."

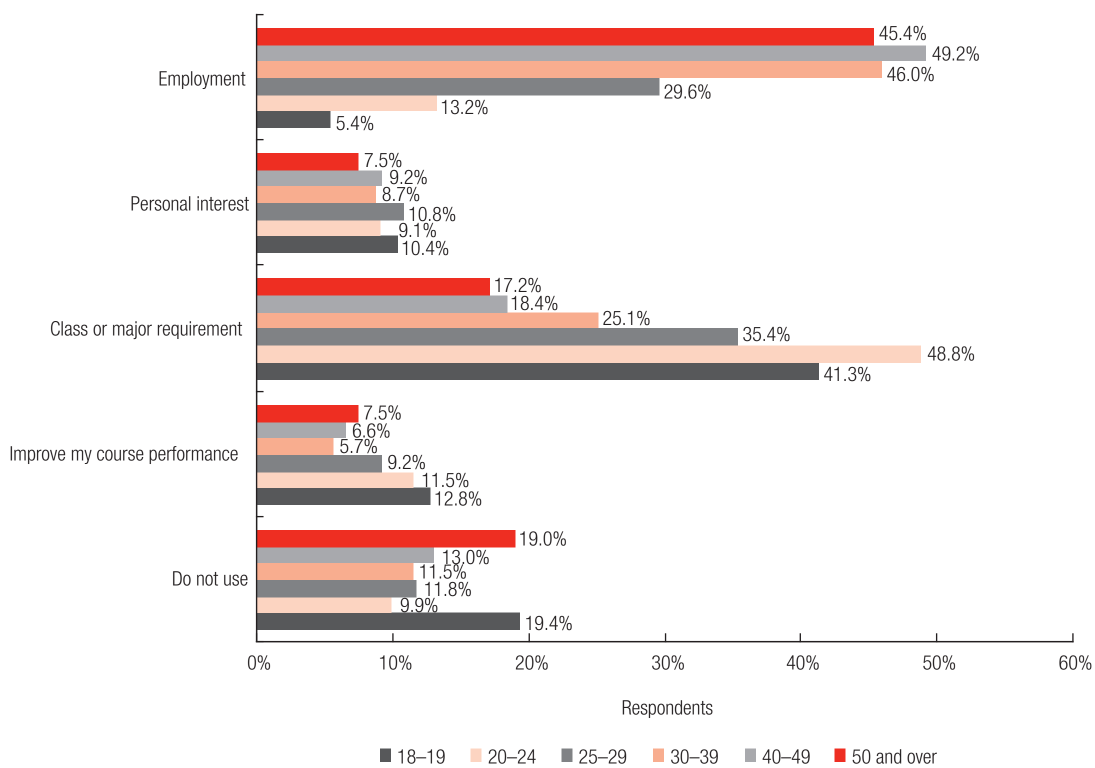
For older students, employment is the most significant reason to use spreadsheets, followed by a course requirement.

With PowerPoint, a class requirement is most important for all age groups, with the exception of 40- to 49-year-olds. The second most important reason is employment for the older students and a desire to improve class performance by younger students.

Lastly, when we look at graphics (there is a similar pattern for audio/video and for creating Web pages), personal interest becomes most important for all age groups. The younger students use it most. Older students are more likely to use it for employment reasons. Note that as personal interest becomes the predominant factor, use drops off significantly, reinforcing the importance of the curriculum.

A side issue that arose in the qualitative discussions is a concern about the additional cost to students that comes with the required use of specialized applications. One student noted, "I purchased my computer as an incoming freshman. It did not come with Microsoft Office. Nearly all of my classes require that I use PowerPoint and require an hour-plus long presentation. If so many courses require PowerPoint, it should be provided to students for their personal computers free of charge."

Figure 3-5. Reasons for Use of Spreadsheets, by Age



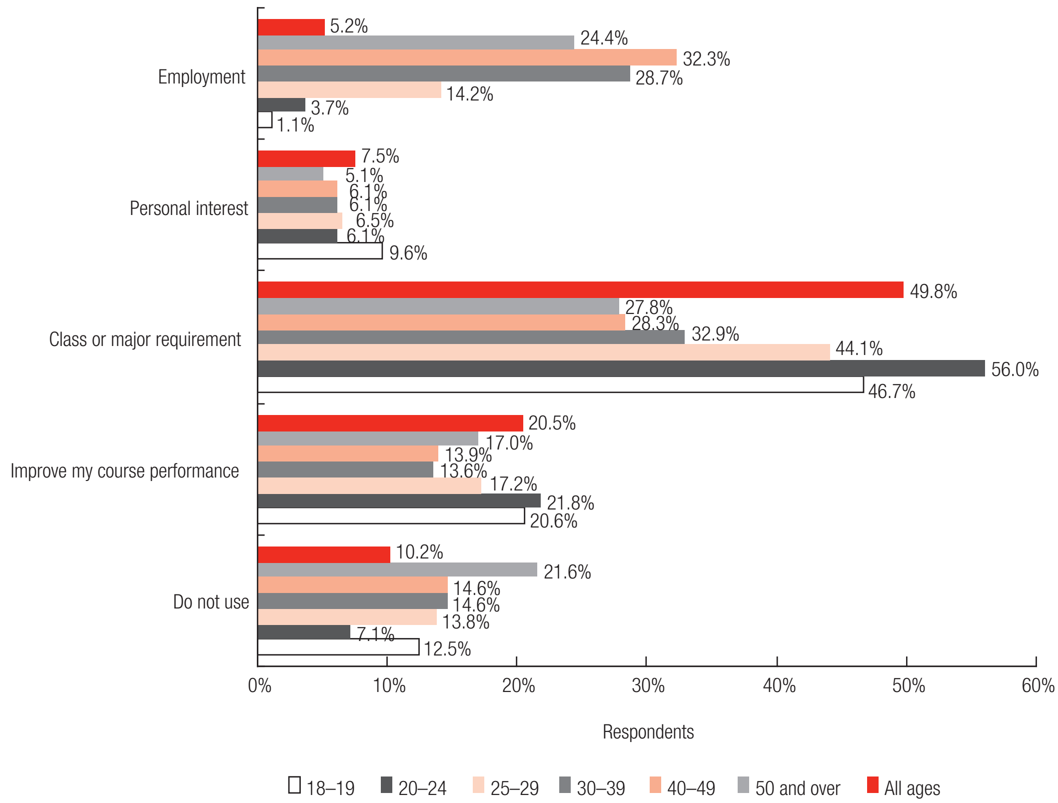


Figure 3-6. Reasons for Use of PowerPoint, by Age

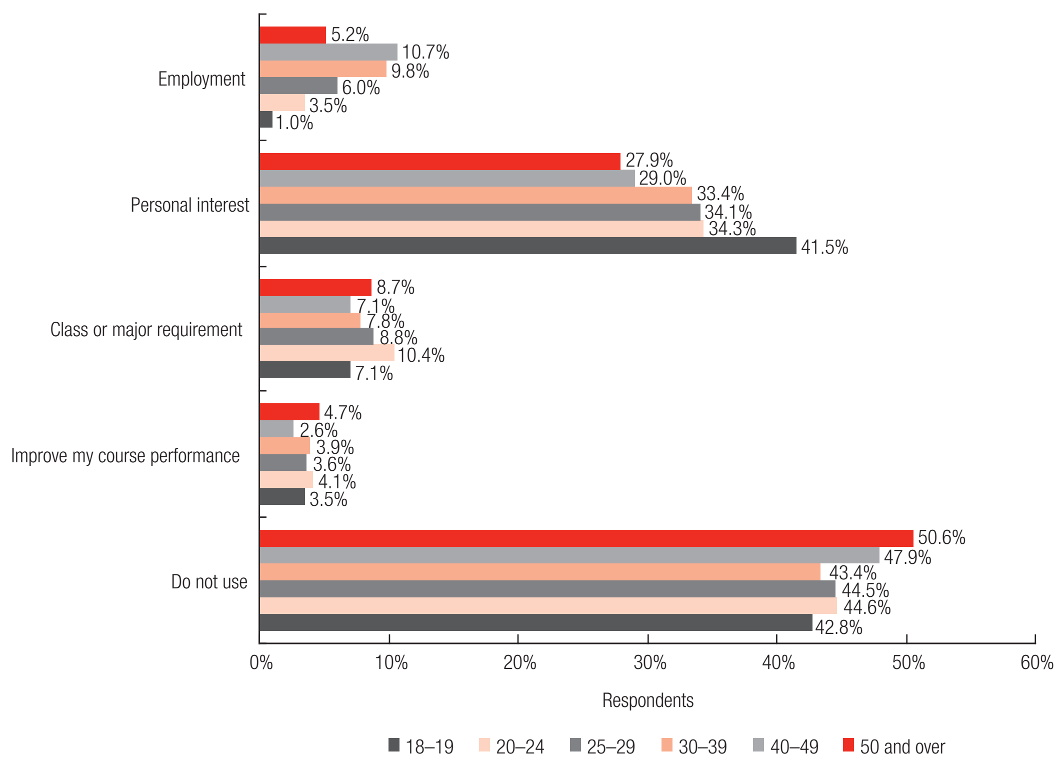


Figure 3-7. Reasons for Use of Graphics Software, by Age

The 2004 study found that IT application usage was closely associated with a student's academic major. This was particularly the case in the use of specialized applications such as spreadsheets and PowerPoint. The 2005 study confirms this finding (see Table 3-3). Note the overall higher level of use by engineering and business majors. Note, too, the particular discrepancy between engineering students (79.3 percent for spreadsheets and 74.5 percent for presentation software) and fine arts students (47.6 percent for spreadsheets and 54.5 percent for presentation software) in the use of these specialized applications. The differences by major in the use of graphics, audio/video, and Web page creation software are much smaller, but importantly and interestingly, fine arts students begin to approach the use level of engineering students with these applications. Overall usage is up slightly from what we found in our 2004 study.

The importance of the curriculum is more noticeable when we look at the student's major and standing as a freshman or senior (see Table 3-4). Note that in most cases, seniors are more likely to use specialized applications than their freshman counterparts. Freshmen with majors such as engineering and business, however, in many cases use these applications more than seniors in other disciplines. There is less differentiation with graphics, video and audio, and Web page creation software, where the use is more evenly distributed, although engineering students continue to stand out.

Because of their extensive use of IT reported in the 2004 study, we chose to interview engineering students for the 2005 study. In these interviews, the University of Wisconsin–Madison engineering students emphasize the use of technology in their courses. They are very pleased with the amount and depth of their undergraduate technology experience. One student expressed his gratitude for all the technology in use in his courses. "Courses encouraging or forcing you to learn new technology help you and will dramatically help you in the workforce. You can pick up new technologies much more quickly." Another notes, "When I did my internship, I

Table 3-3. Use of Specialized Applications, by Student's Major

Major	Spreadsheets	Presentations	Graphics	Create video/ audio	Create Web pages
Engineering/computer science (N = 1,901)	79.3%	74.5%	63.9%	38.6%	46.1%
Business (N = 3,193)	78.5%	78.6%	50.6%	25.3%	27.5%
Physical sciences (N = 1,337)	76.2%	67.2%	50.5%	24.0%	22.9%
Life sciences (N = 2,729)	67.9%	68.1%	46.1%	19.4%	18.1%
Social sciences (N = 3,348)	57.6%	62.2%	43.9%	20.6%	21.3%
Education (N = 2,507)	54.9%	66.4%	48.9%	22.1%	26.0%
Humanities (N = 1,954)	52.0%	58.0%	43.6%	22.4%	22.8%
Fine arts (N = 1,369)	47.6%	54.5%	51.8%	30.3%	27.4%

Table 3-4. Use of Specialized Applications, by Student's Major and Class

Major	Spreadsheets	Presentations	Graphics	Create video/ audio	Create Web pages
Business: seniors	89.4%	88.2%	51.4%	24.1%	27.6%
Business: freshmen	62.1%	64.3%	49.4%	27.1%	27.4%
Engineering/computer science: seniors	84.4%	81.3%	65.5%	37.0%	50.3%
Engineering/computer science: freshmen	71.1%	65.7%	61.7%	40.7%	40.5%
Life sciences: seniors	76.3%	78.2%	45.1%	17.1%	16.2%
Life sciences: freshmen	59.2%	57.0%	47.1%	21.8%	19.4%
Social sciences: seniors	62.9%	67.8%	43.5%	20.1%	21.0%
Social sciences: freshmen	48.5%	52.6%	44.7%	21.4%	21.7%
Education: seniors	60.1%	71.9%	48.3%	21.3%	28.4%
Education: freshmen	56.1%	57.3%	49.8%	23.3%	22.1%
Physical sciences: seniors	83.7%	77.1%	50.1%	21.5%	24.4%
Physical sciences: freshmen	57.9%	56.3%	51.0%	26.7%	21.2%
Humanities: seniors	55.1%	61.6%	42.7%	21.3%	23.6%
Humanities: freshmen	47.1%	52.3%	45.1%	24.1%	21.5%
Fine arts: seniors	51.3%	57.9%	59.4%	30.6%	29.9%
Fine arts: freshmen	43.0%	50.2%	58.2%	29.9%	24.4%

was able to quickly pick up new technologies, and I was soon helping other engineers learn to use the tools."

Hours of Use

We were also interested in how many hours each week students use their computer and for what applications (see Table 3-5).[9] Students indicate that they spend, on average, between 11 and 15 hours per week using their computer. Clearly, they spend much time using technology in support of academic purposes. Course activities, document preparation, searching the Internet to support coursework, and other activities consume considerable time and reflect directly on students' academic purposes. Least used are specialized applications such as those for creating graphics and audio/video (less than one hour per week).

Students spend many hours every week using their computer. And they use it for a wide range of purposes. In the qualitative interviews, students explained that technology is an integral part of their lives. One Brandeis University senior stated, "When I get up in the morning, the first thing I do is not to turn on the TV or the radio, but put my computer on! It's where I do everything—weather and music."

Table 3-5. Hours Spent per Week on Technology-Related Activities

Activity	N	Average Number of Hours Used
Excluding cell phones, hours each week using an electronic device	17,964	11–15 hours
Course activities and studying using electronic device	17,281	3–5 hours
Writing documents for your coursework	17,701	3–5 hours
Creating, reading, sending instant messages	14,421	3–5 hours
Creating, reading, sending e-mail	17,811	1–2 hours
Surfing the Internet for pleasure	16,996	1–2 hours
Surfing the Internet for information to support your coursework	17,652	1–2 hours
Downloading or listening to music or videos/DVDs	13,437	1–2 hours
Playing computer games	10,836	1–2 hours
Completing an activity using a CMS	11,356	1–2 hours
Using a library resource to complete a course assignment	15,798	Less than 1
Online shopping	12,876	Less than 1
Creating spreadsheets or charts (Excel)	11,214	Less than 1
Creating presentations (PowerPoint)	11,636	Less than 1
Writing documents for pleasure	10,773	Less than 1
Creating graphics (Photoshop, Flash)	8,680	Less than 1
Creating Web pages (Dreamweaver, FrontPage)	4,438	Less than 1
Creating and editing video/audio (Director, iMovie)	4,303	Less than 1

At Colgate University, all electronic devices connected to the campus network must be registered. Judy Doherty, director of the Student Technologies Resource Group, notes that hundreds of Xboxes and PlayStations are currently registered to the network. And she explains, "This is where the students live. The network is there for all their needs—academic or entertainment." A Colgate senior warns, "PlayStation3 is going to be a network hog." Obviously, network bandwidth demands are going to continue to increase as student demands for IT also grow.

Students, in interviews, also noted some drawbacks to IT use. A University of Wisconsin–Madison engineering student reports, "I use technology all the time. I use technology when I could do it in my head. I am so dependent on my calculator. I can't do math in my head anymore. Also, I am learning technology. I am not developing my social skills." A Colgate University mathematics major sophomore echoes, "Technology in courses makes me lazy. I cannot do a line of arithmetic. It is meaningless and tedious. I don't even use my calculator anymore. I do my homework in *Mathematica.*"

There is a clear pattern, however, when measured in terms of hours used: Technology is used first for educational purposes, second for communications, and third for entertainment (see Table 3-5). We also see some clear gender differences in the range of hours spent on each activity. On the whole, men report spending more time each week on their computers, but the difference is attributable to the use of the computer for entertainment (see Figure 3-8). These differences are exacerbated by age, as younger students spend more time on these activities than older students.

We performed a regression analysis to determine what factors contributed to hours of use of various technology applications (see Table 3-6). Factors vary by application, although it's possible to group the factors by academic application, communications, and entertainment. Academic usage is strongly related to the student's academic major and class status (senior/freshman). Communications and entertainment relate closely to gender and age. Note that, for the most part, these factors all have a low level of significance.

Findings from the qualitative interviews support the significance of the student major. From our student interviews, a picture emerges of student technology use being instrumental in nature and driven by the demands of the major and the classes students take. A music major reports, "IT use all depends upon your major. Music majors must know the Sibelius music program for composition and harmony courses." A University of Wisconsin–Madison engineering student states, "My engineering courses all use technology. Yet when I take courses in philosophy or English, IT use is, of course, more limited."

Student Technology Skills

Undergraduate students need to develop two types of skills: information literacy or fluency, and the technical skills needed to use the tools. The American Library Association (1989) defines information literacy as skills necessary "to recognize when information is needed and the ability to locate, evaluate, and use effectively the needed information."

Information literacy and technology skills are closely related. According to Mark Hoffman and Jonathan Blake (2003), "Technology is becoming the vehicle for information, and the evaluation of (and ethical use of) information is becoming one of the primary applications of technology. As such we are developing a single notion of literacy that demands fluency in both technology and information." D. Scott Brandt (2001) states that technology skills or literacy are a necessary precursor to information literacy, and

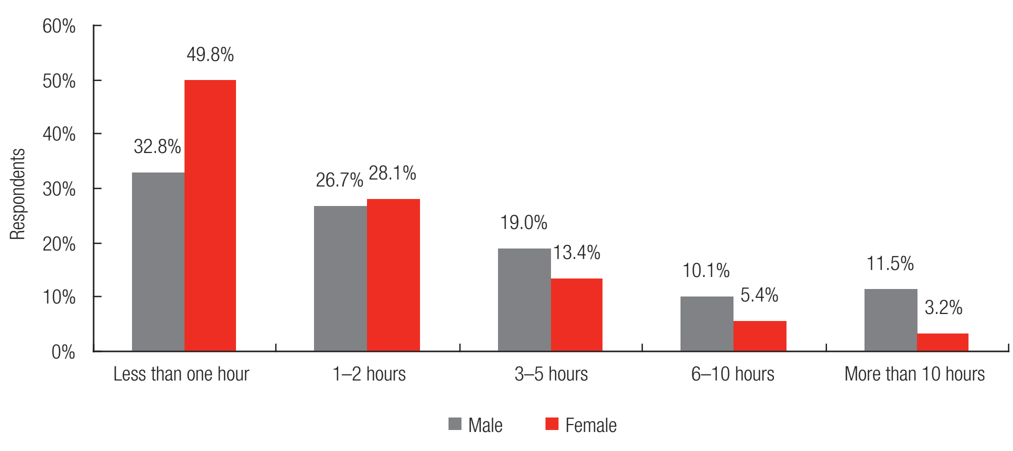


Figure 3-8. Weekly Hours on Computer Games, by Gender

Table 3-6. Factors Explaining Use

Activity	Factor 1	Factor 2
Hours spent each week using an electronic device (excluding cell phone)	Engineering	Male
Course activities and studying using an electronic device	Engineering	Senior
Using a library resource to complete a course assignment	Social sciences	Senior
Surfing the Internet for information to support your coursework	Senior	Engineering
Writing documents for your coursework	Humanities	Social sciences
Creating, reading, sending e-mail	Female	
Creating, reading, sending instant messages	Age	
Writing documents for pleasure	Humanities	Fine arts
Playing computer games	Male	Age
Downloading or listening to music or videos/DVDs	Age	Male
Surfing the Internet for pleasure	Male	Age
Online shopping	Business	Senior
Creating spreadsheets or charts (Excel)	Senior	Business
Creating presentations (PowerPoint)	Senior	Business
Creating graphics (Photoshop, Flash)	Fine arts	Engineering
Creating and editing video/audio (Director, iMovie)	Male	Fine arts
Creating Web pages (Dreamweaver, FrontPage)	Engineering	Male

that the latter cannot be achieved without the former. Accordingly, student technology skills have been identified as a crucial factor affecting undergraduate students' ability to gain the most from their college experience (Kaminski, Seel, and Cullen, 2003).

Defining technology skills is made difficult because of rapid changes in software that require new and different skills. Recognizing this dynamic, the National Research Council in 1999 defined technology skills as *technology fluency,* "a process of lifelong learning in which individuals continually apply what they know to adapt to change and acquire more knowledge to be more effective at applying information technology to their work and personal lives." Technology fluency includes three sets of skills: contemporary skills, foundational concepts, and intellectual capabilities. Contemporary skill is the ability to use contemporary technology applications. Foundational concepts are basic principles and ideas that underpin IT and give users insights into its possibilities and limitations. Intellectual capability is the user's ability to apply technology in complex situations and to conduct problem-solving activities using IT (National Research Council, 1999).

While we do not use the phrase technology fluency in this study, our research is premised upon the National Research Council's definition. We are interested in students' ability to use common applications but also their ability to use technology to enhance their learning.

Level of Skills

We asked the students about the level of skill they felt they have attained for each application (see Table 3-7). We were careful to define what we meant by levels of skills. The following definition was given to the students: very unskilled = not used the software; unskilled = have used the software but not regularly; skilled = full use of basic features but not advanced features; very skilled = ability to use advanced features, link the software with other software, troubleshoot problems, and upgrade/patch the software. Note that our findings are based on student self-assessment and are not a true measurement of student skills. Better measurement tools are needed. But the data are informative and can guide future initiatives to improve technology use and policymaking. The means do not differ from those in the 2004 study.

The students rated themselves highly skilled in word processing (mean of 3.52), followed by operating system use (mean of 3.04). They rated themselves least skilled in graphics (2.40), Web pages (2.14), and video/audio (2.01) software.

We performed a regression analysis to try to better understand different skill levels (see Table 3-8). Confirming earlier findings, our analysis shows that student major again appears to be a significant factor in determining skill levels. Also, skill levels are higher for students who indicate that the use of the software is a class or major requirement. Seniors tend to rank themselves higher than freshmen, which we also interpret to mean that they have used the software longer as part of the work in their major.

The overall highest levels of self-reported computer and application skills are among business and engineering students. But when we look at graphics skills and editing video and music, majoring in fine arts is significant. This suggests that choice of major requires the development of higher-level skill sets with particular applications. Business students are more likely to use presentation applications

Table 3-7. Skill Level

Activity	N	Mean	Std. Deviation
Word processing (Word)	17,951	3.52	0.548
Computer operating systems (Windows, OS X)	17,371	3.04	0.773
Presentation software (PowerPoint)	17,191	2.98	0.745
Spreadsheets (Excel)	17,264	2.88	0.760
Online library resources	17,144	2.85	0.687
Course management systems	14,416	2.67	0.822
Computer maintenance	16,853	2.47	0.927
Securing your electronic device (firewalls, antivirus software)	17,102	2.47	0.922
Graphics (Photoshop, Flash)	14,686	2.40	0.850
Creating Web pages (Dreamweaver, FrontPage)	11,210	2.14	0.913
Creating and editing video/audio (Director, iMovie)	10,656	2.01	0.867

Scale: 1 = very unskilled, 2 = unskilled, 3 = skilled, 4 = very skilled

Table 3-8. Factors Explaining Skill Levels

Activity	N	Factor 1	Factor 2
Word processing (Word)	17,951	Senior	Age
Spreadsheets (Excel)	17,264	Engineering	Business
Presentation software (PowerPoint)	17,191	Business	Senior
Graphics (Photoshop, Flash)	14,686	Engineering	Fine arts
Creating and editing video/audio (Director, iMovie)	10,656	Male	Fine arts
Creating Web pages (Dreamweaver, FrontPage)	11,210	Engineering	Male
Online library resources	17,144	Senior	Social sciences
Computer operating systems (Windows, OS X)	17,371	Male	Engineering
Computer maintenance	16,853	Male	Engineering
Securing your electronic device (firewalls, antivirus software)	17,102	Male	Engineering

and spreadsheets; fine arts students are more likely to use graphics applications.

Respondents' qualitative statements acknowledge the importance of IT use in courses as contributing to their overall skills. One student commented, "By enrolling in a class that utilized information technology, my computer skills are growing, I feel more competent when working on the computer, and I am learning how to troubleshoot. I have learned many valuable computer skills while taking this online course." Another student remarks, "Having a laptop given by the university has allowed me to gain a lot more knowledge in using a computer."

Skill Level Comparisons Among Students

We asked the students to rate their skills against those of their classmates (see Figure 3-9). Almost half (49.3 percent) rate themselves at the same level as most students, 37.6 percent rank themselves as more skilled or much more skilled, and 13.1 percent rate themselves as less skilled or much less skilled.

Gender Differences in Perceived IT Skills

Males rate themselves higher, with a mean skill level of 3.68 versus a mean of 3.12 for females, using a scale where 1 = very unskilled, 2 = unskilled, 3 = skilled, and 4 = very skilled. The literature on student IT skill self-assessment suggests that students overrate their skills in general, with freshmen overrating their skills more often than seniors and men more often than women (Lee, 2003).

Differences in self-reported skill levels are also reflected in the various applications and activities (see Figure 3-10). The overall highest level of reported skill, by both genders, is with word processing, followed by the computer operating system. Men report a higher skill level than women for all applications and activities, with the exception of using online library resources, course management systems, and word processing. We find the largest discrepancy in reported skill use in the areas of security, computer maintenance, creating Web pages, and creating and editing video and audio.

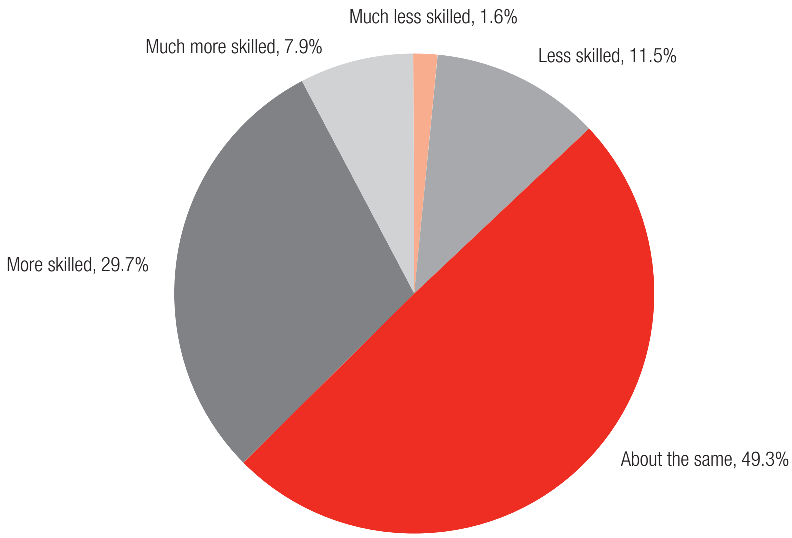
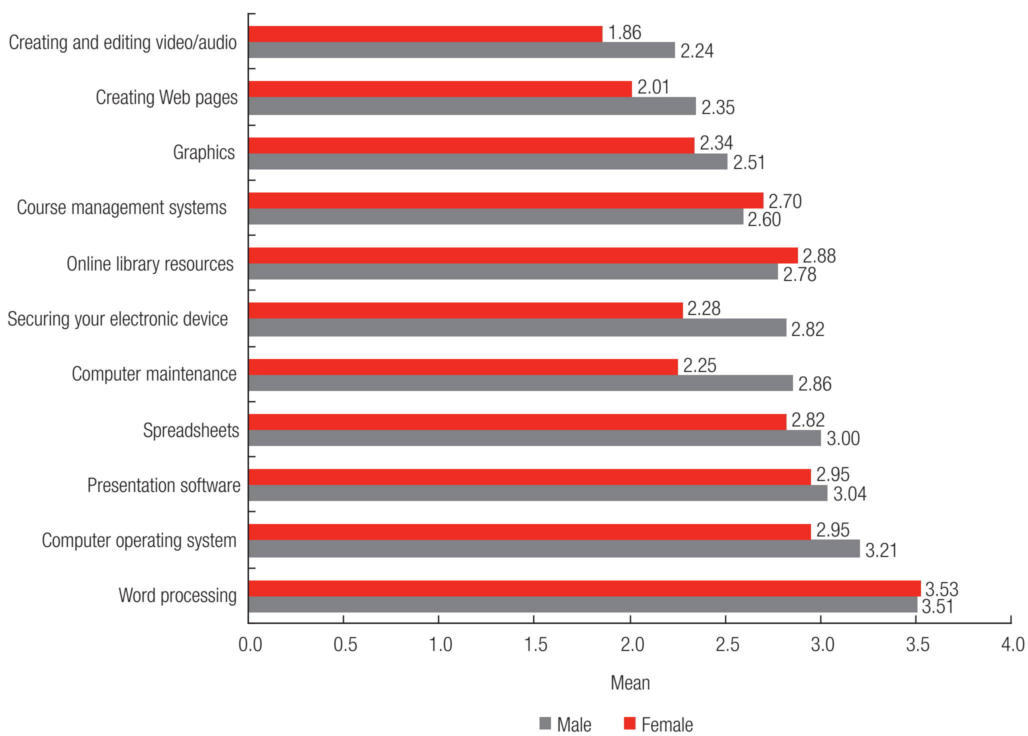


Figure 3-9. Students' Self-Reported Skill Level Compared with Other Students' Skills (N = 17,915)



Scale: 1 = very unskilled, 2 = unskilled, 3 = skilled, 4 = very skilled

Figure 3-10. Perceived Application Skills, by Gender (N = 17,838)

Age Differences in Perceived IT Skills

We found the highest self-reported level of skills for the group aged 20 to 24 (mean of 3.39), followed by the group aged 25 to 29 (mean of 3.34) (see Figure 3-11). Respondents over age 50 report the lowest skill level (mean of 2.95). The overall differences are not very great, especially in core areas such as word processing, presentation software, and use of online library materials. The data suggest that skill and confidence with IT decline linearly with age.

Age differences are also reflected in the various applications and activities, but we see less difference here than for gender. For the most part, one can see the replication of the skill pattern shown in Figure 3-12 of respondents by age. The 20–24 age group self-reports the highest level of skills. An exception is audio/video and graphics, where the 18- and 19-year-olds report the highest level of skill. The youngest group reports the lowest level of skill on spreadsheets. Note that because of the low number of respondents in the 40–49 and 50-and-over age groups and their similar self-reported level of skills, we combined these two groups in Figure 3-12 to make it more readable.

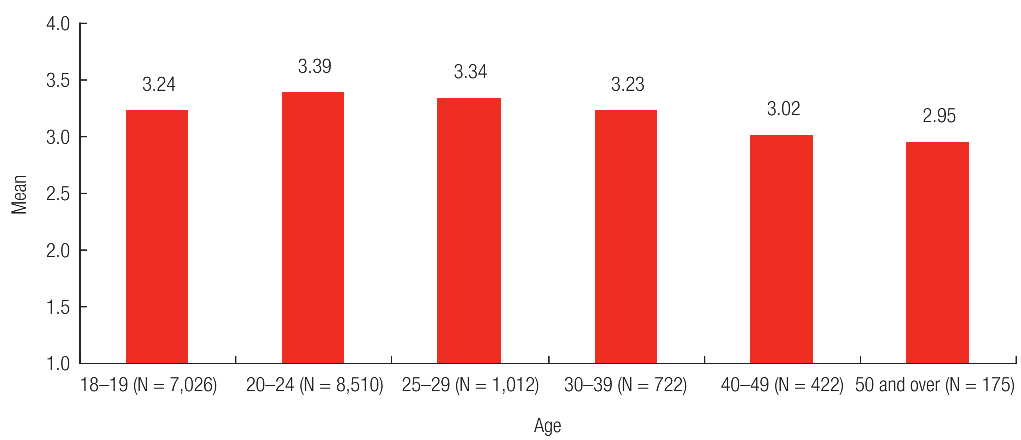
We compared students' self-reported skill levels vis-à-vis their classmates by technology and activity (see Figure 3-13). While they rate their overall skill level too high, in our opinion, they differentiate among various activities. They recognize that their skill levels are not as high with specialized applications such as video/audio and graphics, when compared with more basic applications.

Also, some technologies show more equal perceived skills (not as large a gap between students who consider themselves more or much more skilled than other students and those students who consider themselves less skilled or much less skilled than other students). This narrowing of the gap occurs for use of course management systems, online library searches, and word processing (see Table 3-9).

Impact of Skill Level on Preference for Technology in Courses

The perceived level of skill in using technology relates to a student's preference for technology in courses (see Figure 3-14). In other words, believing that you are skilled—that is, self-confident with IT—is closely associated with how much IT you wish to use in courses. Nearly 60 percent (57.3) of the students who rated themselves much more skilled than their peers in using technology prefer a significant amount of IT in their courses. Conversely, of those who rated themselves much less skilled, more than 60 percent would prefer either

Figure 3-11. Perceived IT Skills Compared with Other Students' Skills, by Age (N = 17,867)

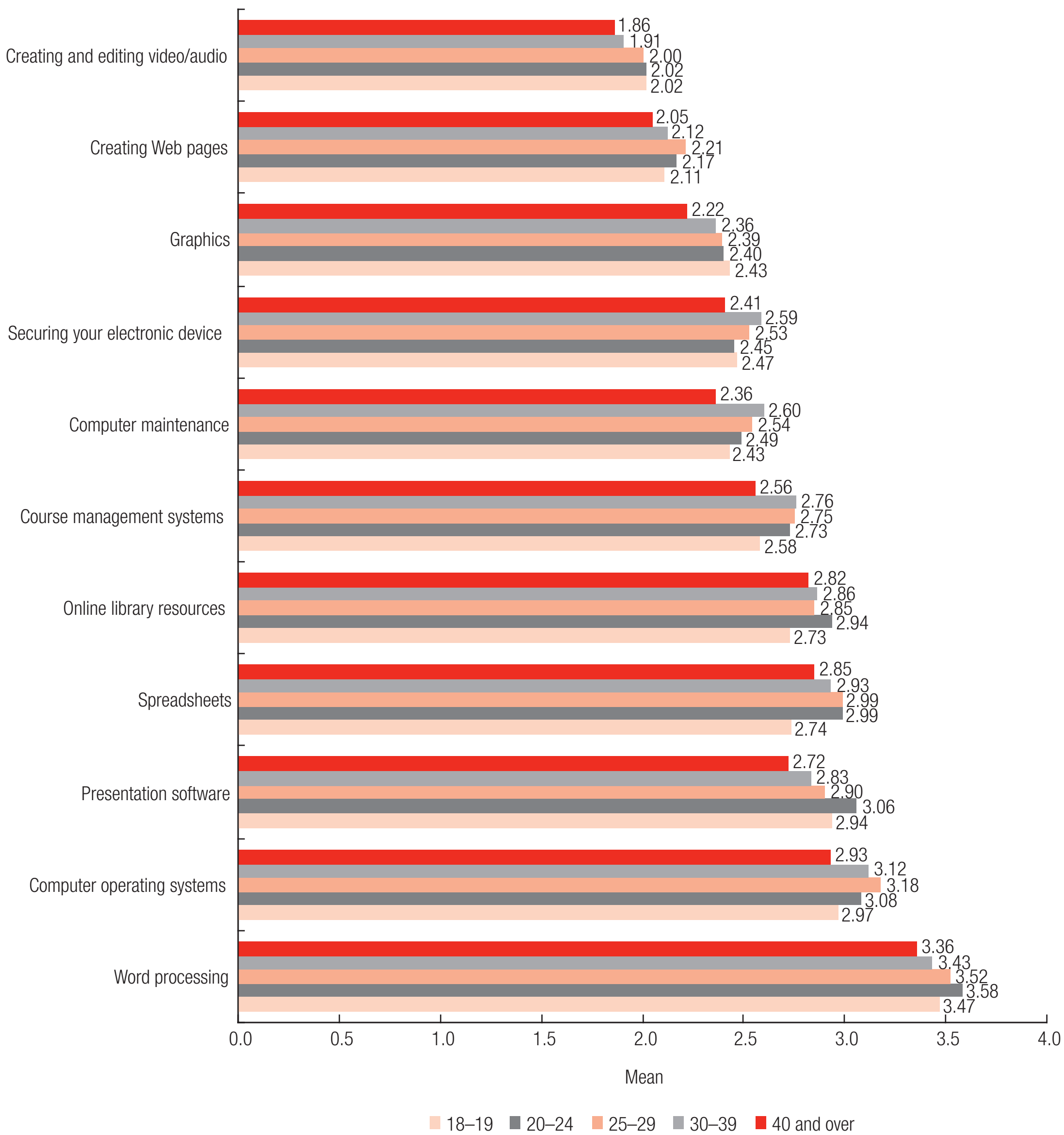


Scale: 1 = very unskilled, 2 = unskilled, 3 = skilled, 4 = very skilled

no IT or limited IT in courses. This suggests that training students early and well in IT may unlock many benefits of an institution's investment in educational technology.

In our qualitative interviews, students have much to say about student technology skills. A Colgate University mathematics major says, "Student skills vary based on experience. Some students don't know what the computer looks like inside—the architecture or the programs. They learn only what they need to learn. When they ask, 'Where did that file go that I just created?' they don't know where to find it. They only know simple routines." A University of Wisconsin–Madison junior agrees: "Most students are bad at troubleshooting their computers. Only a few students can reprogram their computer. I bet only 1 percent of campus students can do it. They do, however, help each other out in the dorms."

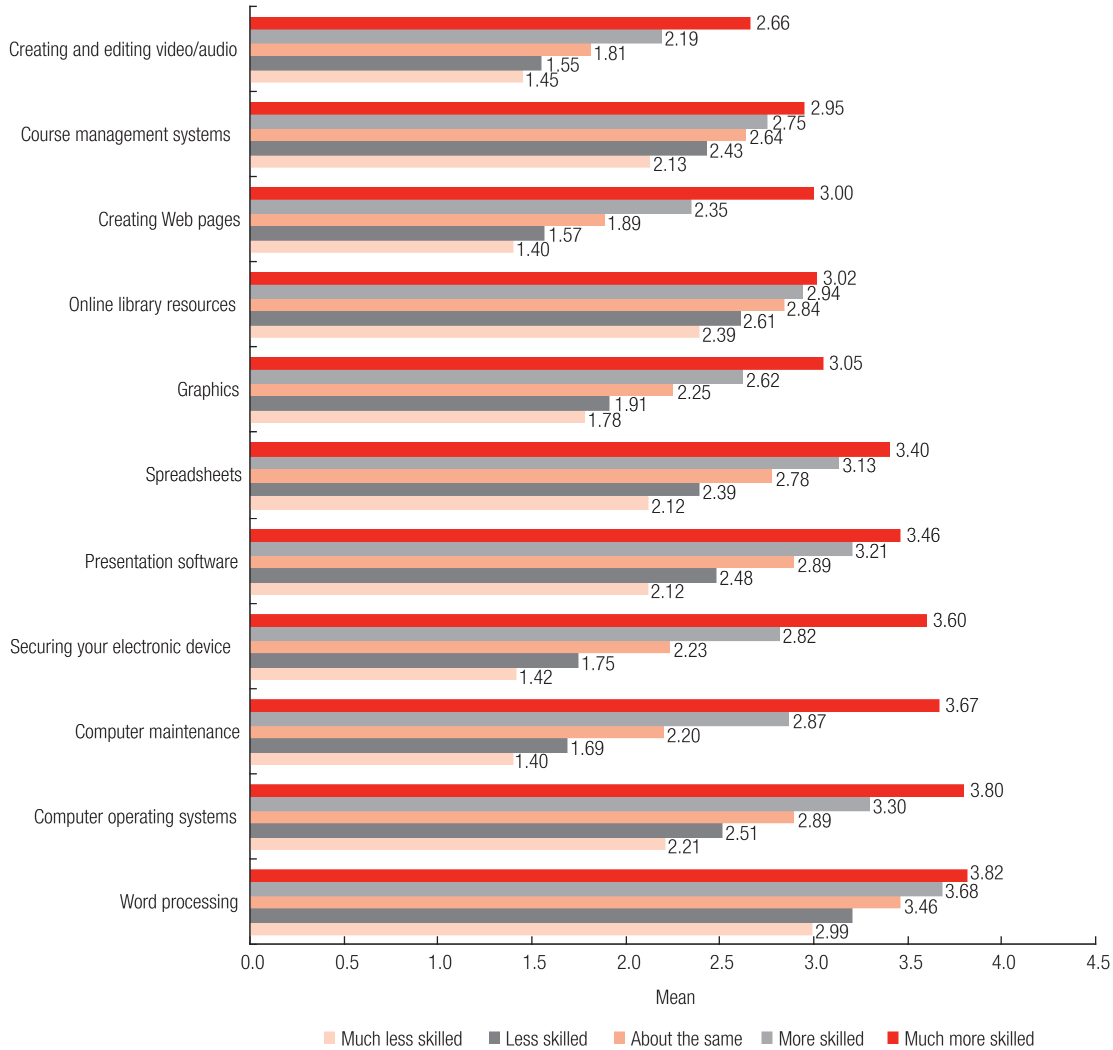
Another Colgate student states, "I do not consider myself particularly skilled with the computer. I can use all the programs that I want



Scale: 1 = very unskilled, 2 = unskilled, 3 = skilled, 4 = very skilled

Figure 3-12. Perceived Application Skills, by Age (N = 17,846)

Figure 3-13. Skill Levels for Specific Activities, by Student Self-Reported Skill Level Compared to Other Students (N = 17,840)



Scale: 1 = much less skilled, 2 = less skilled, 3 = about the same, 4 = more skilled, 5 = much more skilled

Table 3-9. Self-Reported Differences Among Students' IT Skills

Skills Compared	Mean Difference	N
Word processing	0.83	17,844
Spreadsheets	1.28	17,161
Presentation	1.34	17,088
Graphics	1.27	14,599
Video/audio	1.21	10,586
Web pages	1.60	11,143
Course management systems	0.82	14,329
Online library	0.63	17,045
Operating systems	1.59	17,271
Maintenance	2.27	16,758
Security	2.18	17,002

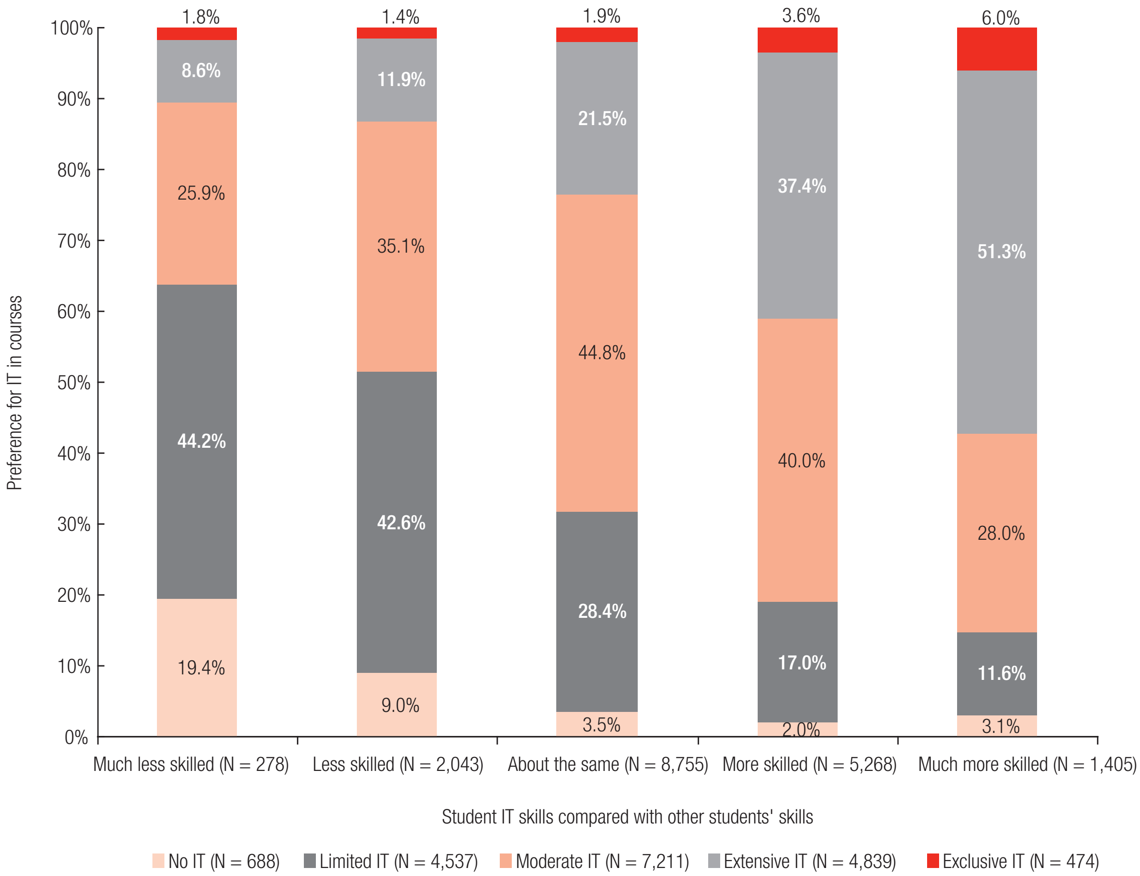


Figure 3-14. Preference for Technology in Courses, by Students' Perceived Skills Compared with Other Students' Skills

to. If something goes wrong, though, I will call Source [the student computer help desk] or call someone up. I use the MS Office suite, games, and the Internet. I have a fine knowledge about the computer, but if something goes wrong, I probably would not fix it myself."

In addition, a sophomore business student notes, "Students here on campus can spend a lot of time on their computers, but they do not know much about how they work. They only stay within a certain box. They are afraid to try something new because it might break their computer. I learned by experimenting—trial by fire. Maybe if students were put into a situation where they could go nuts—where it does not matter if they break their computer. Have backups available so if they mess up the software it can be restored. Students could learn how to troubleshoot their own problems and become more adventuresome."

A Bridgewater State College business student summarizes: "Everybody from our generation will be technology inclined. They can copy and paste. Their computer, however, might have all the problems in the world because they don't know anything about maintenance. Now computers are akin to the early days of cars. If you wanted to drive a car, you used to have to know how to build it yourself. Then it became so ubiquitous that anyone who can hold a steering wheel can drive."

Need for Training

In response to the statement "My school needs to give me more training on the information technology that I am required to use in my courses," more than 36 percent of the students report that they do not need additional training to use IT in their courses (see Figure 3-15). A typical comment is, "Not for me, but for other students, more training is needed so that we as students can utilize the IT on campus that our tuition/fees are paying for." Or, "All of my IT skills were learned in high school, and I developed them on my own as I needed them." Almost 27 percent report the need for more training, and the remaining 36.7 percent are neutral.

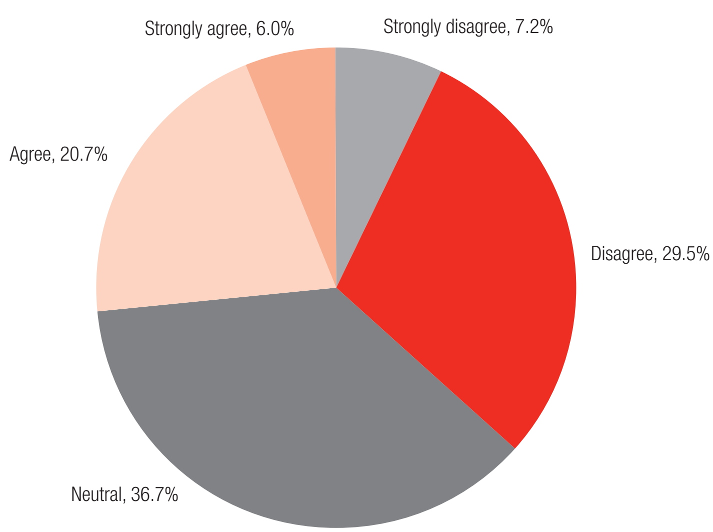
We looked to see which students indicated the need for more training, and it was clearly older students, which may signal the need for additional services for that population (see Figure 3-16). Conversely, the youngest group reports the least need for training, which may be a result of not having had to cope with more specialized applications.

We noted little difference of opinion on the need for training by gender, between seniors and freshmen, by grade point average, or by major. One older student notes, "There is a huge need among new immigrants and adult students for extra technology training provided by patient instructors who are willing to help those of us who did not have IT in high school or a foreign country." Another student remarks, "Personally, it has been very difficult for me to complete my course assignments because the only programs I am able to use are Windows, Word, e-mail, and the Internet. I spend hours searching, and I get lost with so much information."

The qualitative data suggest that students have very basic office suite skills and some ability with e-mail, instant messaging, and basic Web surfing. But they appear to have difficulty moving beyond very basic types of functionality. They do not seem to recognize the enhanced functionality of the applications they own and use. Problem-solving skills also appear questionable, which may be why students have problems coping with new demands or anything out of the ordinary.

A Brandeis University senior reports, "I work on the help desk. I can say, as the person on the other end of the phone, there are two different kinds of people. There are some people who are awesome and will listen to your suggestions. Then there are those who will not admit that they need to learn a few more pointers. I think this is likely due to

Figure 3-15. Need for Training on IT Used in Courses (N = 17,941)



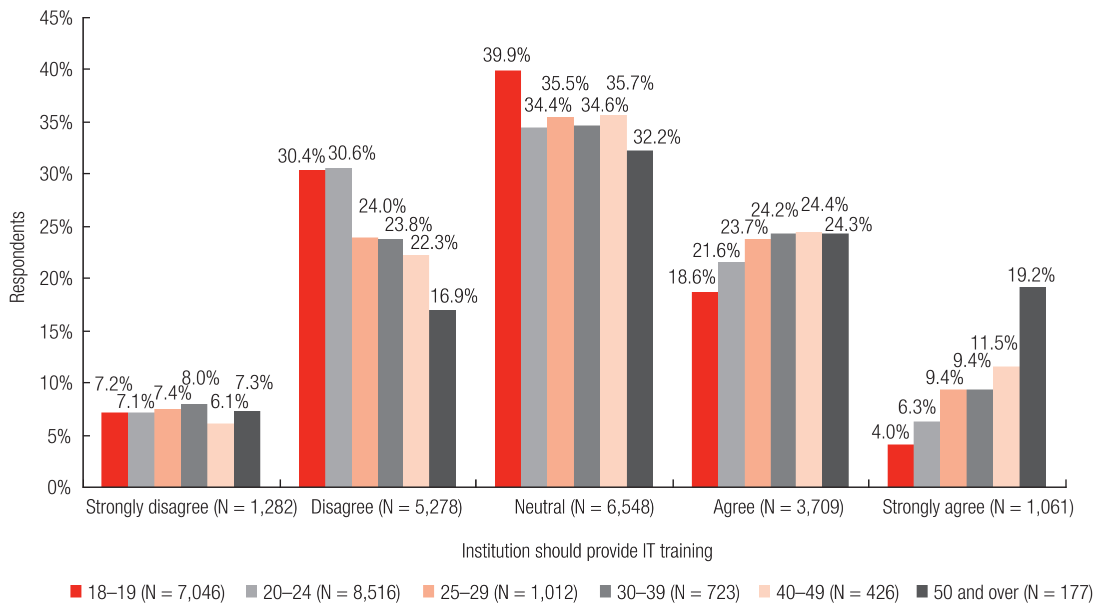


Figure 3-16. Need for Training on IT Used in Courses, by Age (N = 17,878)

the student's pride. We are a top university, and students don't want to admit they are lagging behind."

A University of Wisconsin–Madison mechanical engineering student notes, "I'm good at e-mail and IM. I can't live without it [IM]! For graphic production, video, sound editing, and Web page development, I think training is necessary. We need training, but we pick it up quickly. I play in a band and do sound editing. I put together tracks and slice and mix them. We [the band members] took an hour-long class. That was enough to get us started, and then we figured the rest out." A student who reports, "If courses require any use of special technology whatsoever, adequate instructions and lessons are needed to help the student complete the assigned task," supports this observation. "It can never be assumed that someone knows how to use technology, because a lot of people do not."

Training would obviously help some students cope with risk. A senior at Colgate University advises, "Students will click on anything. Spyware is for reading! They should be trained not to do this."

But training isn't always necessary. A sophomore at Bridgewater State College notes the impact of a laptop program on student skills: "It is hard not to be proficient on the PC, especially now with the laptop initiative on campus. It forces everyone to migrate over from pen and paper onto computers. Now the professors expect that we will e-mail our essays and other assignments for class."

The above quotes demonstrate that while students might appear both confident and comfortable with technology, many students are not—despite the current myth or impression that students are all very comfortable with technology because they grew up with it. They may know how to surf the Web or do e-mail, but they don't always know how to use technology to learn effectively or work efficiently.

In some cases the problem may not be a lack of training but rather a lack of interest in using technology. One student suggests, "If the university wants to have online and paperless courses, there needs to be student course management system training and perhaps PowerPoint and Web design requirements. This would, however, ignore the fact that some students are simply not interested in information technology."

Conclusion

The literature on student technology use and skills paints a picture of today's undergraduate student as being comfortable with IT. Our findings both support and contradict this literature. Whereas the students in our survey are clearly comfortable with a wide range of information technologies that support document creation and communications, they often arrive at our institutions somewhat unskilled and even insecure about those technologies that are tied generally to course management or specifically to the academic discipline.

We found student access to and ownership of technology to be high, though access to a computer off campus did seem to be something of an issue for some students. Students use IT primarily to manage coursework, communications, and entertainment.

Students' skill with software applications varies significantly and is very much influenced by the requirements of their majors. Often it is not learned prior to coming to the university. The curriculum requirement of the academic discipline matters.

Students rate themselves highly skilled in the use of communications and word processing software and use of the Internet. They rate themselves less highly skilled with graphics and presentation software. Seniors tend to rank their skills more highly than freshmen, suggesting that training and requirements at universities contribute to improving technology skills.

Our qualitative data suggest that students are possibly rating their skills higher than they ought. Students report difficulty with problem solving, dealing with new kinds of applications or technology, and troubleshooting their computers. These data suggest also that transfer of skills between uses of IT for entertainment and academic purposes is questionable and certainly needs more empirical evidence. Using technology for entertainment appears to contribute to a general comfort with technology and typing skills, but this doesn't seem to be a huge contribution.

In the next two chapters we explore further how student use and skill plays out in their use of technology in courses and the use of CMS software.

Endnotes

1. There is a significant body of scholarship on access to IT, often phrased in terms of the "digital divide." See, for example, Cooper and Weaver (2003), Norris (2001), Warschauer (2003), and Mack (2001). This literature emphasizes the need to examine factors (such as race, class, ethnicity, and geography) that shape the broader aspects of Internet use and what implications this has for public policy.

2. One University of Wisconsin–Milwaukee student asked us to qualify whether he should just include computers that work or all of them. He owns a desktop PC, a laptop, a UNIX machine, an iPod, a cell phone, and two machines that don't work anymore. While this student certainly owns more than the usual number of devices, he represents the tendency among students to collect electronic devices.

3. These numbers also compare favorably with the findings of *Student Monitor,* which reports that 87 percent of students own a PC. See <http://www.studentmonitor.com/index1.html>.

4. Several students comment on the value of the laptop in class, especially when the instructor incorporates its use into the lesson. One student states that he uses the computer in class to take notes, which is an improvement because he cannot read his own handwriting. Another student says, "By taking notes on my laptop, I am able to record a near transcript of what the teacher is saying. For example, in art history, I can type what the teacher says while simultaneously inserting images of the slides she is showing. This makes studying a breeze. You never have to figure out which discussions apply to which slides." However, one student notes that he doesn't need a laptop for taking notes because "I carry an MP3 recorder to class."

5. This is based on a scale where 1 = do not use, 2 = use less than an hour, 3 = use 1 to 2 hours, 4 = use 3 to 5 hours, 5 = use 6 to 10 hours, 6 = use 11 to

15 hours, 7 = use 16 to 20 hours, and 8 = use more than 20 hours.

6. This is based on a scale where 1 = do not use, 2 = use less than an hour, 3 = use 1 to 2 hours, 4 = use 3 to 5 hours, 5 = use 6 to 10 hours, 6 = use 11 to 15 hours, 7 = use 16 to 20 hours, and 8 = use more than 20 hours.
7. ECAR figures closely mirror those of other studies. For example, Jones (2003) reported that 70 percent of college students reported playing video games at least once in a while, while 65 percent described themselves as regular or occasional video game players.
8. Figure 3-5 to 3-7 exclude responses of "Other."
9. The table excludes students who do not use the application.

4

Information Technology in Courses

Technology gets rid of the busy work so we can do higher-level thinking and work.

—A University of Wisconsin–Madison civil engineering major

Higher education is investing substantial resources in information technologies to support student services, teaching, and learning. Much of this investment has been in administrative software, networks, and other elements of a general communications infrastructure. Increasingly, investments are being made in support of teaching and learning. What is the return on this investment in equipment, applications, and training of faculty and students? How much technology do students want? How and for what purposes do they use IT in their courses? Is IT being used well? Is the use of IT in courses improving the undergraduate learning experience? What concerns do students express about IT in their courses?

In *ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control,* we found that students preferred a moderate amount of technology in their courses and that they used it primarily for convenience, for communications, to manage their work and assignments, and to monitor their grades. Only 12.7 percent of the students reported that IT's primary benefit in courses was improved learning. Because some portion of higher education's investment in IT in courses is premised on a belief that IT will

Key Findings

- Students prefer a moderate amount of technology in courses.
- Students see IT in courses as making a positive contribution to teaching and learning.
- Seniors and older students tend to prefer more technology in courses than freshmen and the youngest students in the study.
- Engineering, business, and life sciences students prefer more technology in courses than students in other disciplines.
- Overall, students give their instructors good marks in their use of technology in courses.
- Students who perceive instructors' IT skills to be effective report being engaged increasingly in the course, being more interested in the subject matter, and understanding complex concepts better.
- Students who consider themselves more skilled in using IT than their peers also see themselves as more engaged and interested in the course and subject matter. These students also believe that they are better able to use IT to help them understand complex concepts.
- According to survey respondents, the primary benefit of technology used in courses is convenience, followed by communication with the instructor and other students (connection), management of course activities (control), and improved student learning.
- Student concerns and expectations include ready access to and reliability of information technologies, bandwidth, and online resources and services.

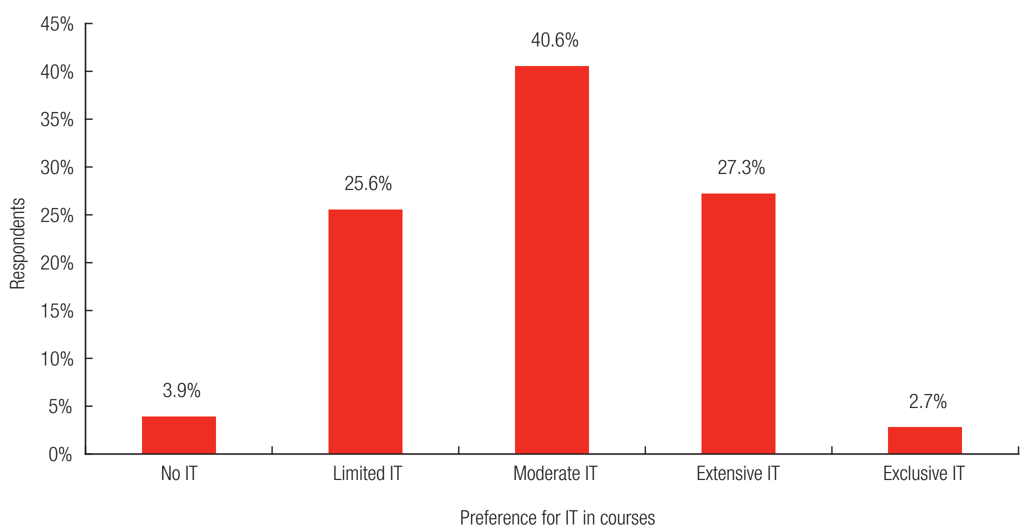
improve learning, we added several questions to the 2005 survey that address learning more squarely. An objective of this study is to better understand how, for whom, and under what circumstances IT in courses contributes to learning.

Student Preference for Technology Use in Courses

What are student preferences with respect to the use of technology in courses? We expected that college or university students who grew up with the Internet would prefer courses that make extensive use of technology. We further expected to find that demand for technology in direct support of learning is increasing. Instead, we found that students' answers to the question "How much technology do you prefer in your classes" was an almost perfect Bell curve, with a mean preference for a "moderate" use of technology in courses (see Figure 4-1). The mean (2.99), median (3.00), and mode (3) are squarely at the moderate level of preference for technology use on a scale of 1 to 5, with 1 being "I prefer taking courses that use no technology" and 5 being "I prefer taking courses that use technology exclusively." We find that 30 percent of the students prefer taking courses that use technology extensively or exclusively and an almost equal number (29.5 percent) of students prefer either limited technology or none at all in their courses. Most students (40.6 percent) prefer a moderate use of technology in courses. This overall preference distribution is very slightly lower than what we found in the 2004 study.

According to Sarah Guri-Rosenblit (2003), "Both students and academic faculty seem to like the traditional classroom encounters, even when given the opportunity of being exempt from attending a class, and provided with all the needed materials and assignments online." She refers to a University of California, Berkeley, study that found that only 16 percent of students surveyed were willing to watch lecture Webcasts entirely online instead of going to the lecture hall, and 84 percent of the students indicated that they preferred to attend the face-to-face encounters, even though they could have studied all the materials and watched the videotaped lectures at home (Harley et al., 2002). Guri-Rosenblit concludes, "It seems that many forecasts that predicted the replacement of the campus university by the new technologies have not been substantiat-

Figure 4-1. Student Preference for Use of IT in Courses (N = 17,856)



ed at all in reality, and the traditional styles of learning and teaching still reign dominantly in most higher-education settings."

We expected that the youngest students in our study would have the strongest preference for IT use in courses. To our surprise, they have the least preference (mean of 2.86) (see Figure 4-2). The age group 30 to 39 has the strongest preference for the use of IT in courses (mean of 3.25). This preference by the latter group may reflect that group's likely need to balance competing academic, employment, and family demands. The findings may also corroborate other studies (Hartman, Moskal, and Dziuban, 2005) that report older learners show more engagement (in online learning) and Net Gen learners show disappointment, perceiving "a lack of immediacy in their online courses" and feeling "that faculty response times lagged behind their expectations."

The same pattern emerges when we look at the preferences of freshmen and seniors (see Figure 4-3). Seniors' preferences skew more to greater use of IT in courses than freshmen's, although we would note that their preferences are still weighted toward a moderate use of technology in courses. This finding suggests that despite their clear comfort with core technologies such as e-mail, text messaging, IM, word processing, and so forth, and their well-reported access to broadband, Web, and video games, younger students have less exposure to IT in the classroom context, are therefore less comfortable with these technologies, and express a lower preference for them. Although freshmen arrive on campus "communication ready," they appear not yet ready to incorporate tools like Excel, PowerPoint, and other specialized programs into their coursework.

We tried to obtain a better understanding of the factors that influence the preference for technology use in courses. We looked at the following factors: previous experience with the use of technology in courses, faculty skill using technology, number of hours students use technology weekly, respondents' perceived comparative levels of skill using computers, institution, major, grade point average (GPA), and demographics.

We found that a student's previous positive experience in a course that used IT is strongly associated with a preference for technology. It is not surprising that if the instructor uses

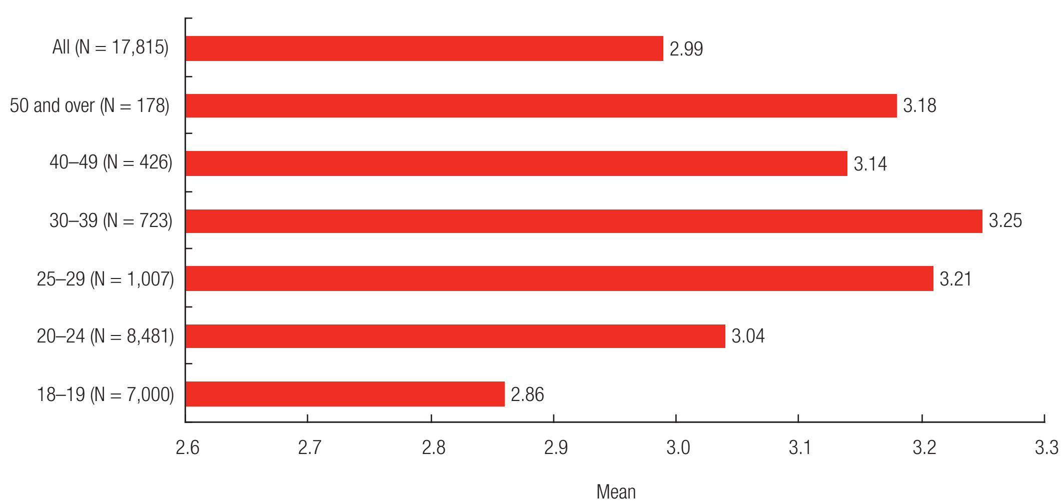
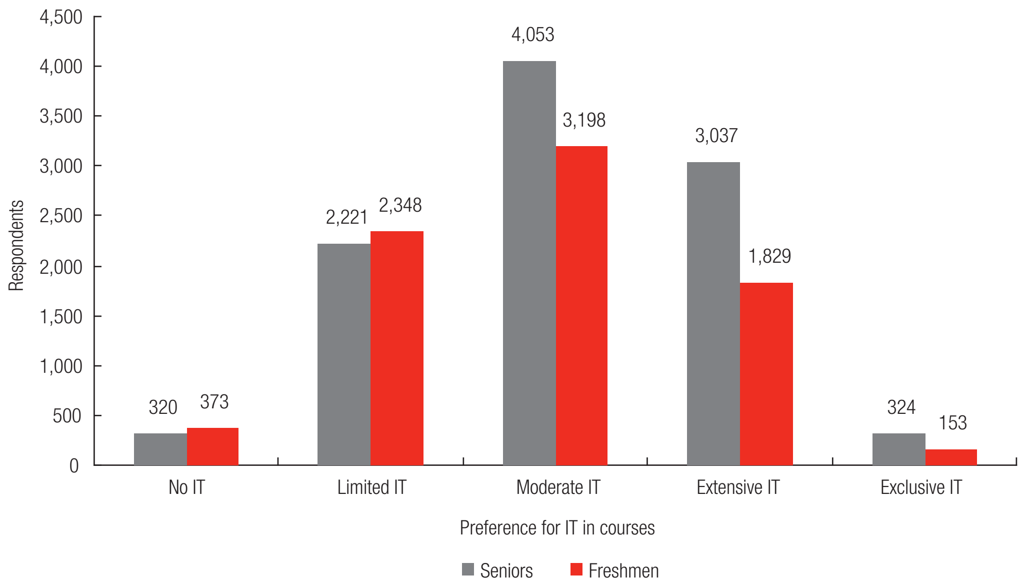


Figure 4-2. Preference for IT in Courses, by Age (N = 17,815)

Scale: 1 = I prefer taking courses that use no IT, 2 = I prefer taking courses that use limited IT, 3 = I prefer taking courses that use moderate IT, 4 = I prefer taking courses that use extensive IT, 5 = I prefer taking courses that use IT exclusively

Figure 4-3. Preference for IT in Courses, by Senior and Freshman Students



technology well, students will come to appreciate its benefits. This may explain why seniors have a higher preference level for technology use in courses than freshmen. Noteworthy, too, is the finding that a student who gets better grades in courses using technology likes those courses better. But also significant is the finding that students who feel they have more control (planning, apportioning time) over their course experience because of the use of technology also strongly prefer a high level of technology in courses. Using the scale from Figure 4-2, we found differences by gender (for males a mean of 3.08, for females 2.95), on-campus (2.89) and off-campus residency (3.08), and full-time (2.97) and part-time (3.24) students.

We did note some significant variation by Carnegie class. Students at doctoral institutions (mean of 3.07) prefer a greater use of technology than students at baccalaureate institutions (2.77). We believe some of these differences are due to the absence of engineering programs and an overweighting of fine arts and humanities majors at many baccalaureate institutions. When we exclude engineering and business students from the analysis, the differences all but disappear. Additionally, the students at baccalaureate institutions in our sample are younger overall than those at the doctoral and MA institutions. It also seems likely that students who attend BA institutions expect more interaction with faculty and peers in small class settings.

A student's major is an important predictor of preferences for technology in courses (see Table 4-1). Engineering, business, and life sciences students have the highest preference for technology in the courses, and seniors in these majors have a higher preference for technology than their freshman counterparts. Of the eight majors identified in this study, only students in these three fields have a preference for technology in courses above a mean of 3.00, and only in engineering did a majority of the students have a preference for extensive or exclusive use of IT in courses. Humanities students have the least preference for technology in courses, with a mean of 2.73.

Assessing Technology's Impact in Courses

We asked students to evaluate the impact of technology use in their courses (see Table 4-2). Note that each impact score is above

Table 4-1. Preference for IT in Courses, by Student's Major

Discipline	N	No IT	Limited IT	Moderate IT	Extensive IT	Exclusive IT	Mean
Engineering	1,880	1.5%	11.8%	34.0%	48.4%	4.4%	3.42
Business	3,162	2.3%	18.2%	41.5%	34.2%	3.8%	3.19
Life sciences	2,698	2.8%	24.4%	41.7%	28.9%	2.2%	3.03
Physical sciences	1,330	3.7%	25.8%	43.8%	25.4%	1.4%	2.98
Education	2,483	3.3%	30.2%	43.9%	20.4%	2.2%	2.88
Social sciences	3,327	4.7%	30.4%	40.9%	22.0%	2.1%	2.86
Fine arts	1,354	6.1%	30.1%	38.1%	23.0%	2.4%	2.85
Humanities	1,934	5.7%	35.2%	40.1%	17.2%	1.4%	2.73

Table 4-2. Impact of IT in Courses

Impact	N	Mean	Std. Deviation
The use of IT in courses has helped me better communicate with my instructors.	17,947	3.89	0.868
The use of IT in courses has resulted in prompt feedback from my instructors.	17,907	3.77	0.880
The use of IT in courses has helped me better communicate and collaborate with my classmates.	17,909	3.70	0.915
I primarily use IT in courses to improve the presentation of my work.	17,910	3.56	0.902
Courses that use IT allow me to take greater control of my course activities.	17,895	3.51	0.931
The use of IT in courses has helped me better understand complex or abstract concepts.	17,942	3.23	0.922
I am more engaged in courses that require me to use technology.	17,953	3.21	1.004
The instructors' use of technology in my courses has increased my interest in the subject matter.	17,919	3.14	0.936

Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree average, which indicates that students have a positive feeling about the use of IT in their courses. The highest scores are given to improved communications—communications with instructors (mean of 3.89), feedback from instructors on coursework (3.77), and communication with classmates (3.70), where the scale is 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Related to this is the ability to improve the presentation of one's work (3.56) and to take greater personal control of course activities—planning and apportionment of time (3.51). Activities related to comprehension of complex concepts (3.23), engagement (3.21), and interest in the subject matter (3.14) are positive but more neutral in respondents' perspective.

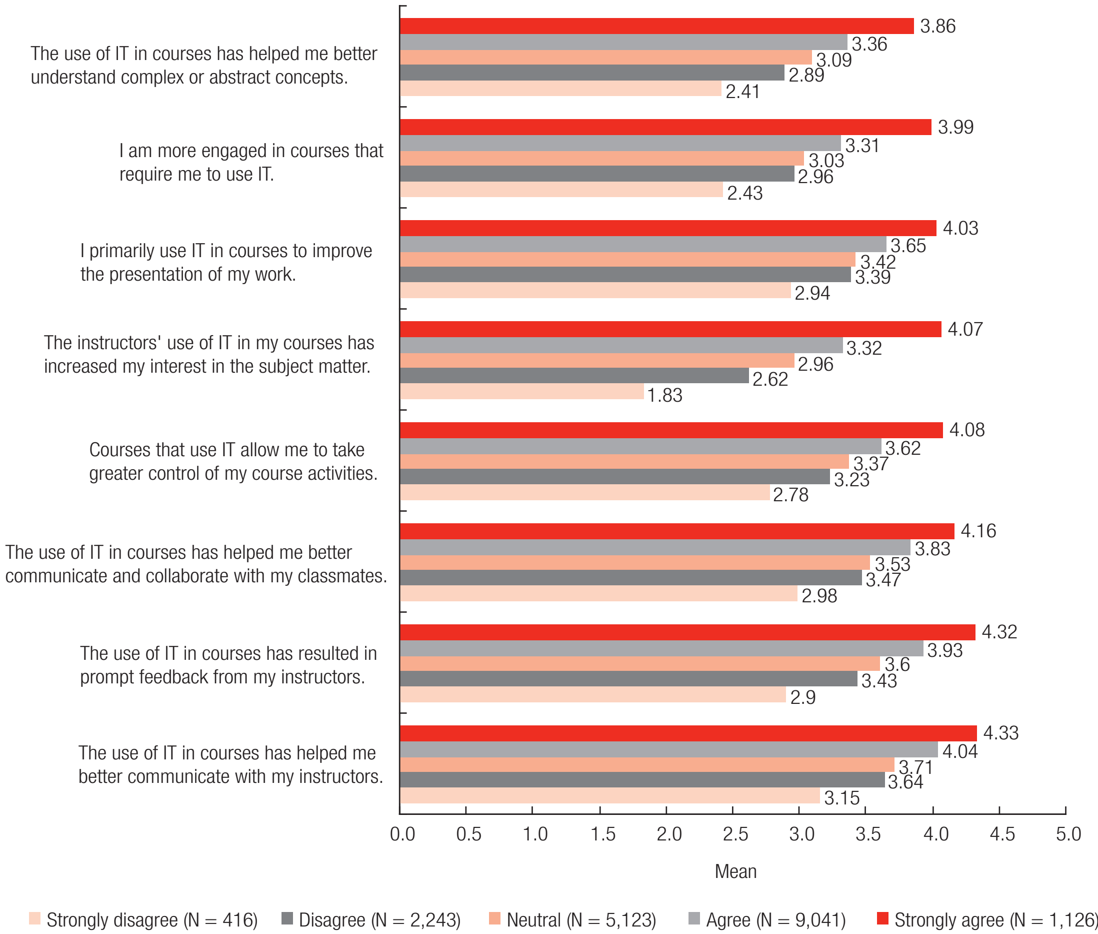
The importance of improved communications was also established in the earlier ECAR *Faculty Use of Course Management Systems* study (Morgan, 2003). Improving communications was one of the top five reasons faculty gave for using a CMS. Fifty-nine percent of faculty reported that using a CMS increased faculty-to-student communication. Also, the 2004 National Survey of Student Engagement found that 79 percent of seniors and 67 percent of first-year students used e-mail to communicate with instructors.

An interesting finding is that students overall do not feel that use of IT in courses greatly increases student engagement with course activities (3.21 mean, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). This contrasts with faculty perception reported in the earlier faculty ECAR study, where 65 percent of faculty reported that they perceived that there is more activity between student and content when IT is used in courses (Morgan, 2003). When we take into account students' perceptions of faculty skill in using technology, however, the story changes markedly. We recognize that student perceptions about faculty technology skills may in fact reflect deeper student perceptions about faculty's choice of pedagogy, or teaching style. This deserves further research.

Notwithstanding this, perceptions of instructor skill in using IT in courses appear to make a significant difference on the student's perception of IT's impact in the courses (see Figure 4-4). Perceived instructor skill has the biggest impact on improving communications with the instructor and instructor feedback, but it also affects engagement and interest in the subject matter, and comprehension of abstract concepts. A Brandeis student notes, "I have taken economics and math courses that use modeling and simulations. For example, in a psychology class we studied sensation. It was very cool to see a Flash presentation about how an eye works. It is definitely a special occasion when something like that is used—perhaps something the professor developed himself. This professor, for example, developed a beautiful picture of an eye and wanted to share it with the class."

If we look at the difference in the means between students who rate their instructors' IT skills highest versus those who rate them lowest, we see that the perceived skill of the instructor has the greatest impact on engagement, interest in the subject matter, and understanding complex concepts, where the mean differences are greatest (see Table 4-3). Where the perceived skill of the instructor is less relevant to the activity, the mean differences are significantly lower. The greater the difference in the means, the more significant the relationship between the variables.

Note that despite a significant number of complaints about faculty IT skills in the open-ended questions, especially with respect to PowerPoint, the students give the faculty good grades when asked whether their instructors use IT well in their courses. Fewer than 15 percent are critical, 28.5 percent



Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Figure 4-4. Impact of Instructor Skill Using IT, by Impact of IT in Courses

Table 4-3. Impact of Instructor Skill, by Impact of IT in Courses

Instructor Skill	Mean Difference	N
The use of IT in courses has helped me better communicate with my instructors.	1.18	17,912
The use of IT in courses has resulted in prompt feedback from my instructors.	1.42	17,869
The use of IT in courses has helped me better communicate and collaborate with my classmates.	1.18	17,876
Courses that use IT allow me to take greater control of my course activities.	1.30	17,861
The instructors' use of IT in my courses has increased my interest in the subject matter.	2.24	17,890
I primarily use IT in courses to improve the presentation of my work.	1.09	17,882
I am more engaged in courses that require me to use IT.	1.56	17,925
The use of IT in courses has helped me better understand complex or abstract concepts.	1.45	17,908

are neutral, and 56.7 percent are positive or very positive. On a scale of 1 to 5, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree with the statement, "Overall, my instructors use information technology well in my courses,"[1] the mean score was 3.46, with a standard deviation of 0.873.

Figure 4-5 supports the earlier conclusion that students who agree and strongly agree that their instructors use IT well are much more likely to say that they are more engaged in courses that use IT. For example, we see that 40.0 percent of students who strongly agree that their instructors use IT well in courses also strongly agree that they are more engaged in courses that use IT. In contrast, of the students who strongly disagree that instructors use IT well, only 10.1 percent strongly agree that IT increases their engagement in courses. We find very similar patterns for increased interest in the subject matter (see Figure 4-6) and understanding complex concepts (see Figure 4-7).

Just as faculty skills have an impact on outcomes, so do students' IT skills, but less so (see Table 4-4). Students who consider themselves more skilled than their peers are more engaged in the course and interested in the subject matter and believe themselves to be better able to use IT to understand abstract concepts. They believe that they are more likely to use technology to improve the presentation of their work. Importantly, there is less of a difference with communications, where Chapter 3 shows all students' skill levels to be more even.

If we look at the difference in the means between students who rate their IT skills highest versus those who rate them lowest, we see that the student's perceived skill has the greatest impact on engagement in courses where the mean difference is greatest.

Where the student's skill is less relevant to the activity, the mean differences are significantly lower. The mean differences are significantly lower for student skills than for faculty skills.

Figure 4-8 supports the earlier conclusion that students who believe that they are much more skilled than their peers are much more likely to say that they are more engaged in courses that use IT. For example, we see that 27.2 percent of students who say they are much more skilled also strongly agree that they are more engaged in courses that use IT. In contrast, of the students who consider themselves much less skilled than other students, 22.9 percent strongly disagree that IT increases their engagement in courses. We find a similar pattern for increased understanding of complex concepts (see Figure 4-9).

Students with engineering and business majors indicate that technology used in their courses increases their understanding of complex concepts and provides more opportunity for practice and reinforcement. This may suggest that these disciplines or their faculty are further ahead in the incorporation of software applications (including learning objects, tools, and simulations) for their students than faculty in other disciplines. Seniors, too, provide overall higher scores than freshmen.

We see very minor differences by gender, age, campus residency, part-time or full-time status, and Carnegie class. And surprisingly, students who indicate that they need more training in the use of IT in support of course activities score only slightly lower overall on the impact of IT in their courses. We find some minor but significant differences on engagement, interest in the subject matter, and understanding of complex concepts that relate to hardware and access difficulties. Owning older machines and having no access to broadband compromises these outcomes. Older machines affect communication activities much less.

From these data we surmise that technology use in courses serves predominantly

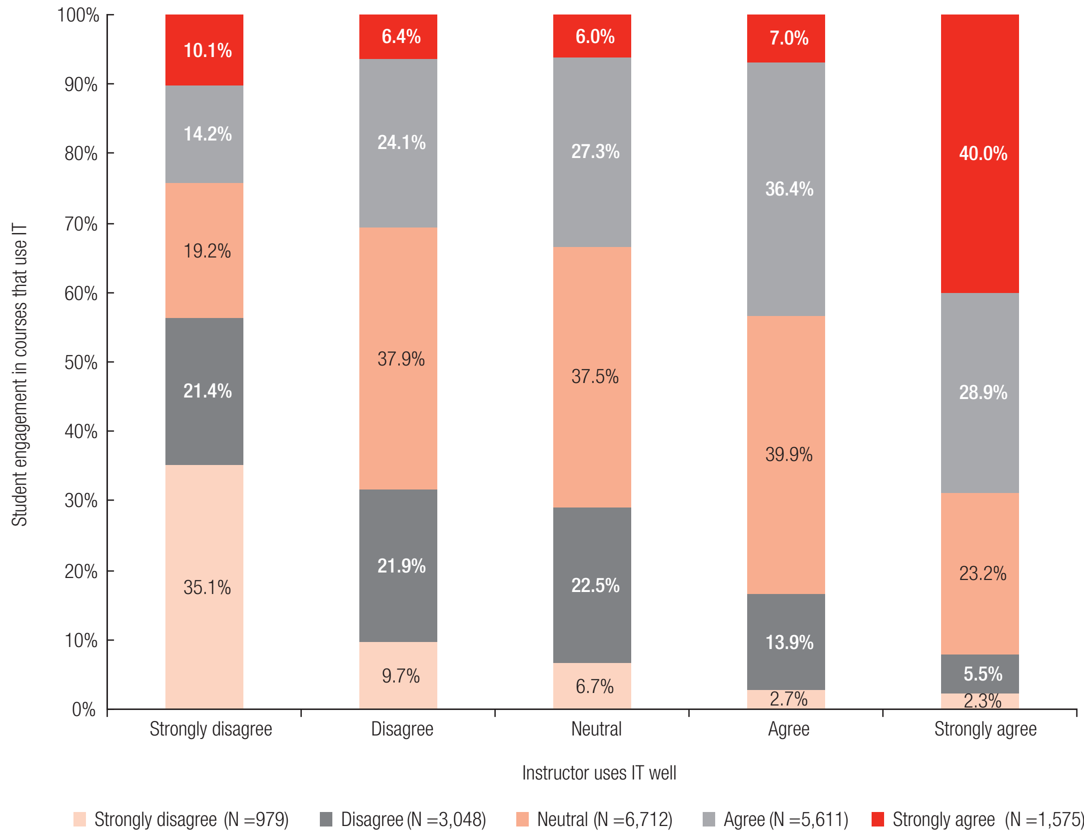


Figure 4-5. Student Engagement in Courses That Use IT, by Instructor Skill Using IT

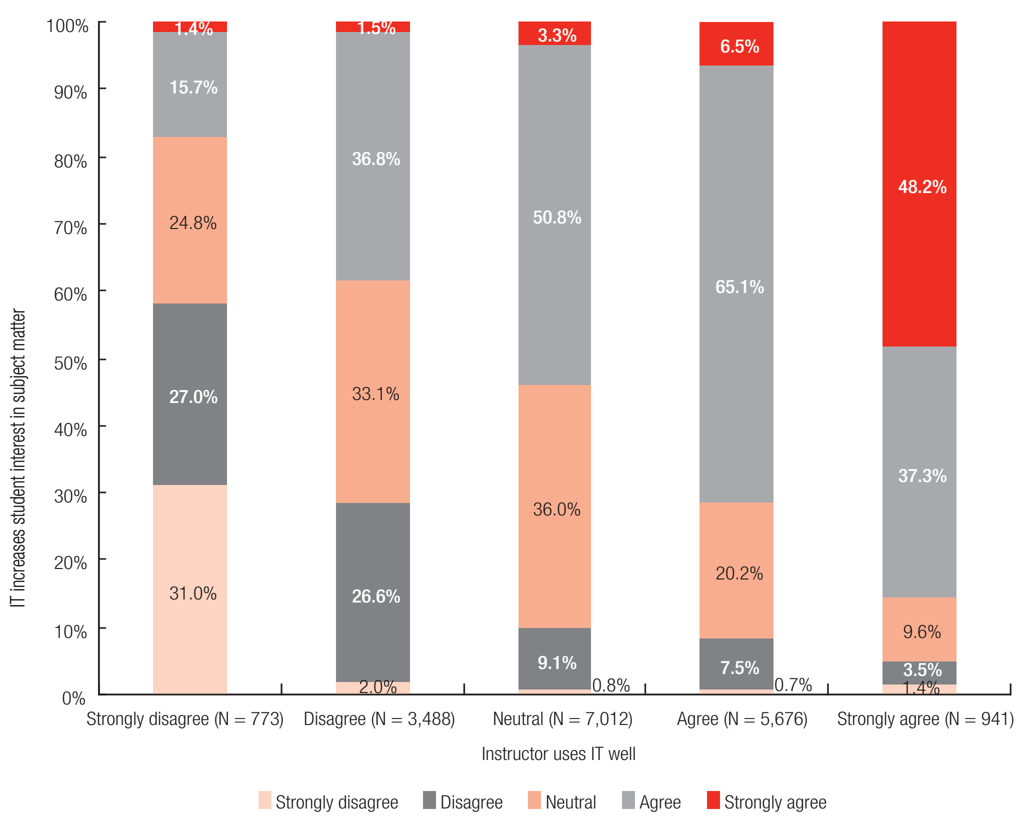


Figure 4-6. Student Interest in Subject Matter, by Instructor Skill Using IT

Figure 4-7. Student Understanding of Complex Concepts, by Instructor Skill Using IT

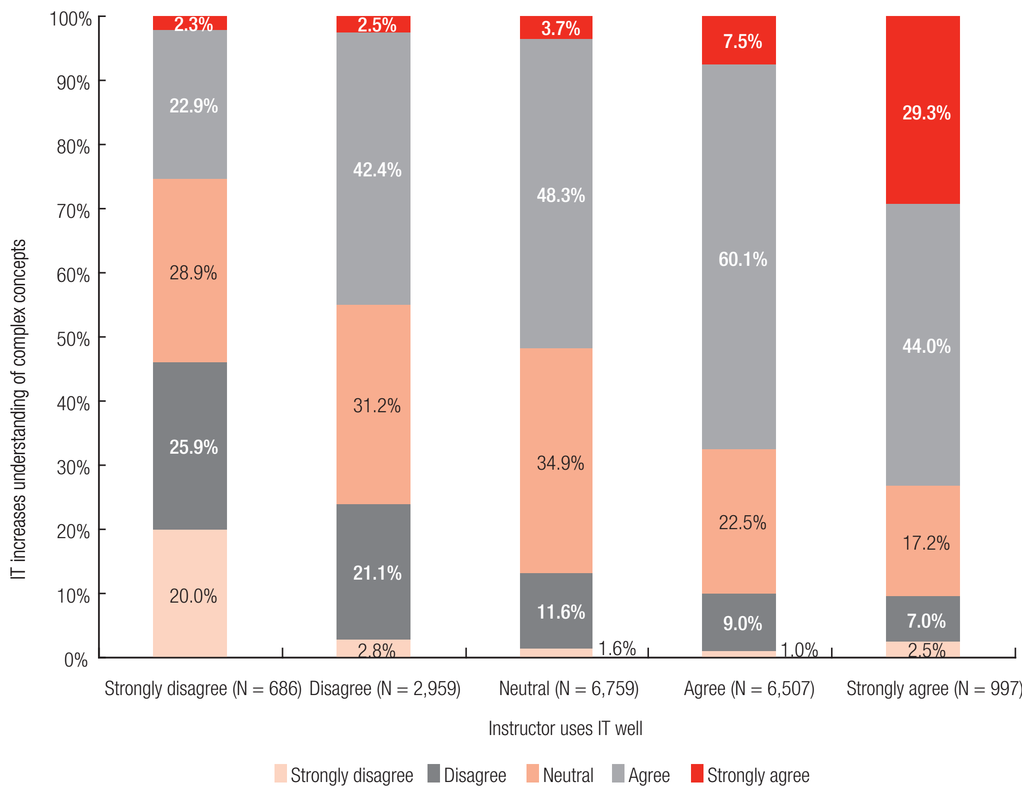


Table 4-4. Impact of Self Reported Student IT Skills Compared with Other Students' Skills on the Effectiveness of IT in Courses

Student Skills	Mean Difference	N
The use of IT in courses has helped me better communicate with my instructors.	0.47	17,839
The use of IT in courses has helped me better communicate and collaborate with my classmates.	0.60	17,802
The use of IT in courses has resulted in prompt feedback from my instructors.	0.30	17,800
I primarily use IT in courses to improve the presentation of my work.	0.71	17,804
I am more engaged in courses that require me to use technology.	1.29	17,845
The use of IT in courses has helped me better understand complex or abstract concepts.	0.74	17,834
The instructors' use of IT in my courses has increased my interest in the subject matter	0.59	17,812

Scale: 1 = strongly disagree, 2 = agree, 3 = neutral, 4 = agree, 5 = strongly agree

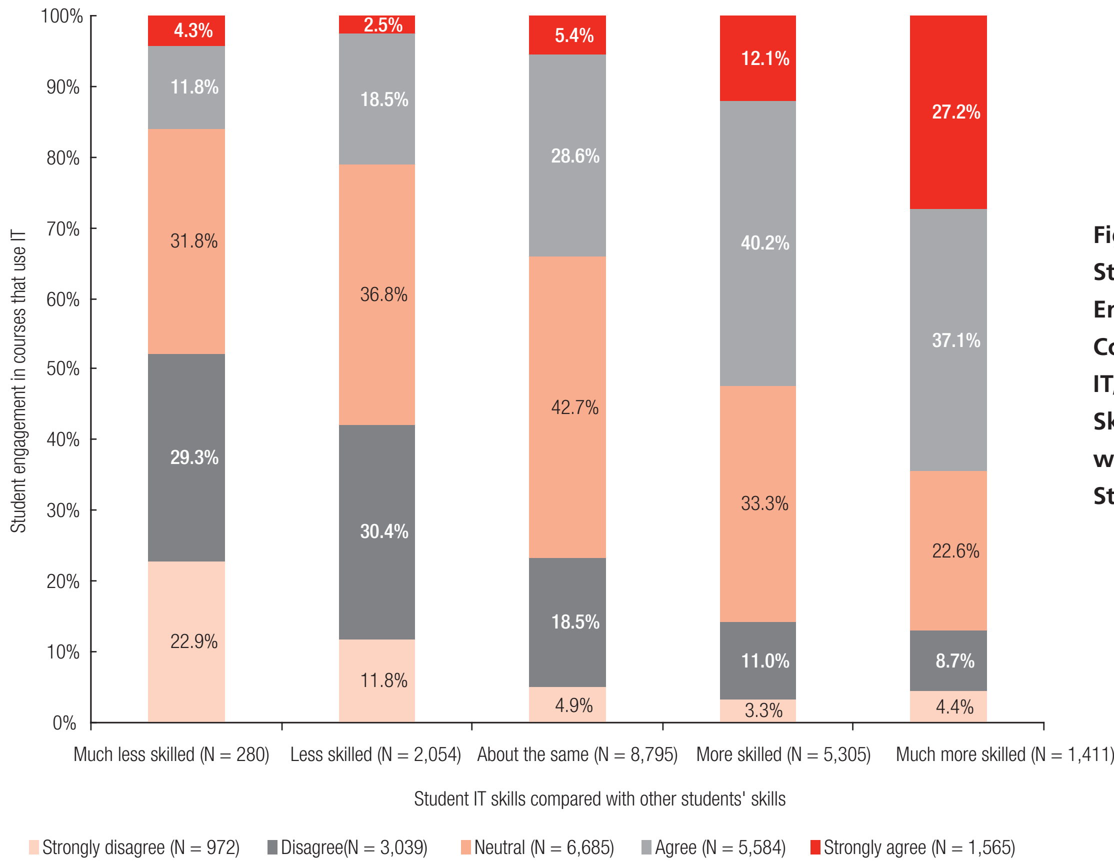


Figure 4-8. Student Engagement in Courses That Use IT, by Student IT Skills Compared with Other Students' Skills

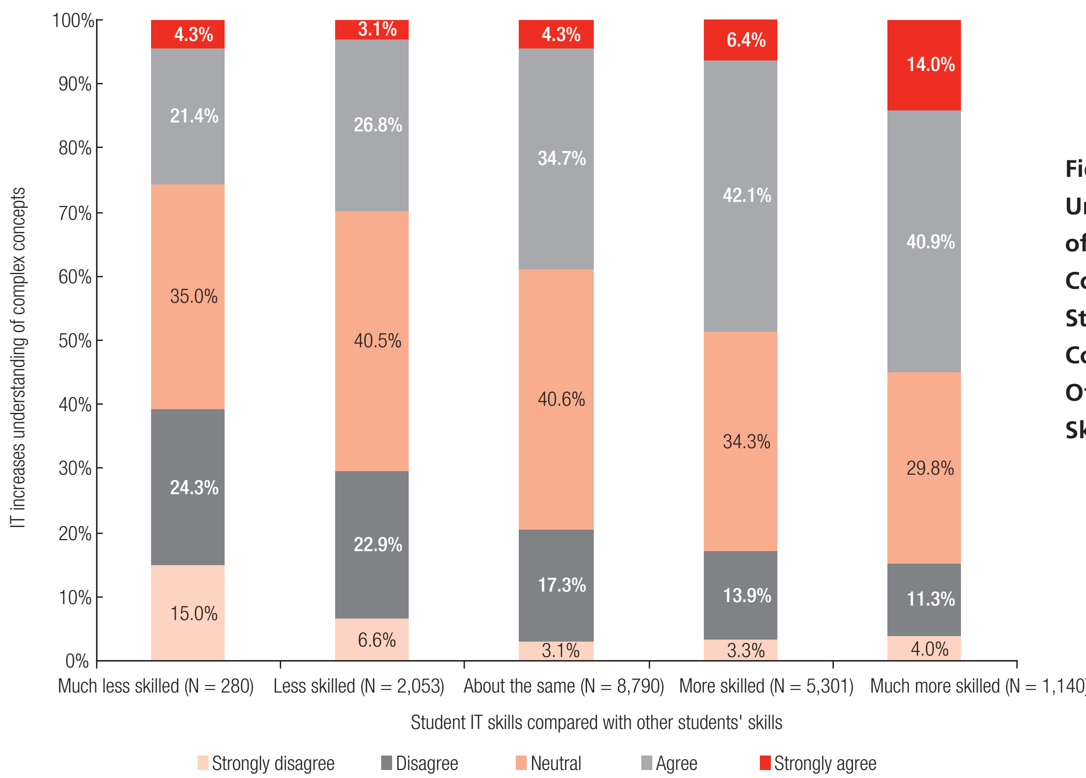


Figure 4-9. Understanding of Complex Concepts, by Student IT Skills Compared with Other Students' Skills

administrative and communication purposes. Instructor and student IT skills are critical if technology is going to have a positive impact on student interest in the subject matter, engagement, and comprehension of complex and abstract concepts in courses.

The qualitative data reinforce these conclusions. According to one Franklin W. Olin Engineering College student, "Technology facilitates learning in our math class. We used MathLab to show us complicated concepts that were quite hard to figure out by hand. It gave us a better understanding about the application of mathematical problems in areas like economics or psychology. We saw how these concepts can be applied to real people in the real world—which I thought helped the learning process." A Colgate University freshman also talks about how technology strengthens student interest in the subject matter: "In my class about inventing the atomic bomb, we used our course management system for everything. We even had a chat with our alumni—some of whom are World War II veterans and discussed their experiences." Another Colgate student states, "For science classes, the animations help you get (information) into your head more easily than words."

Benefits of IT in Courses: The Student's Perspective

We asked students to identify the most valuable benefit of using technology in courses (see Figure 4-10). By far the most valued benefit is convenience (50.3 percent), followed by communications (19.7 percent). Management of course activities (13.5 percent) and learning (12.7 percent) are next. Only 2.8 percent of students perceive no valuable benefit whatsoever. These findings are very nearly the same as those we found in the 2004 ECAR study. It is important to note that convenience, connection, and control all contribute directly and indirectly to learning[2] (Pascarella and Terenzini, 1976, 1991).

Convenience

In both open-ended survey comments and interviews, students have much to say about the convenience that IT offers. A student at South Dakota State University reports, "Technology is definitely a convenience for students, but it's a convenience for the professor as well. They [professors] can put materials online and use PowerPoint. We both benefit." A senior notes, "Convenience is a big deal. PDF files online are great! I like to have access to materials at one o'clock in the morning." Another states, "The convenience is having everything I need online so that when I have a spare minute I can access things at work. Also of major importance is being able to see grade progress at all times."

Communications

Students feel that IT improves communication with the faculty. Technology makes it possible to have out-of-classroom contact. Via e-mail, they can set up meetings with faculty or e-mail a question and get a quick response—especially important when working on a project. One student explains, "It is much easier to e-mail assignments or ask a professor a question through e-mail than wait until class, especially when you only have one class a week with that professor." Another student reports, "With everyone's busy schedules, it is not always possible to meet in person. But with IT, I can send an e-mail at my convenience and they can respond at their convenience."

Managing Course Activities

Students greatly value the ability to assume greater personal control of their activities. One student notes, "When syllabus, assignment descriptions, digital drop box, and instructor communication are all centralized on the

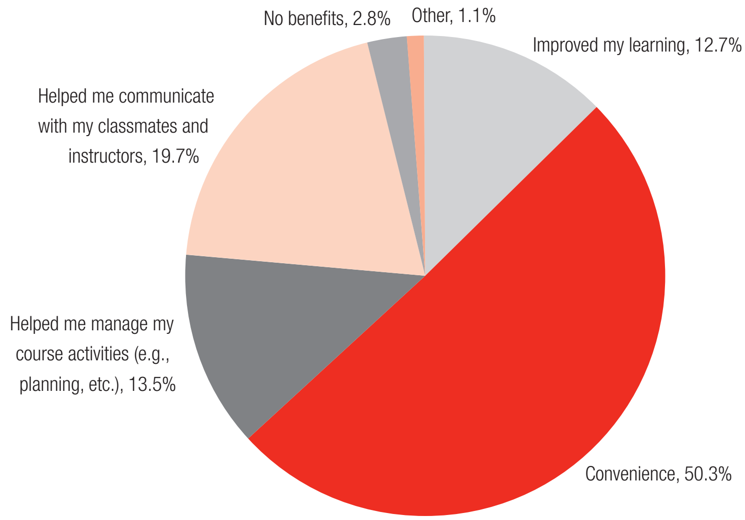


Figure 4-10. Student Perceptions of the Primary Benefit from Using IT in Courses (N = 17,984)

class IT site, the class becomes much easier to manage, plan, and succeed in." Another student remarks, "It is much easier to take a test, study, or turn in assignments on my own time and on my own computer." Another says, "It allows me to take a test when I feel ready, even if it is midnight." Of course, the gains enabled by IT are harvested differently. One student remarks, "My course management system helped me stay up to date and on track with everything," while another notes, "IT lets me get things done quicker." A third respondent argues from a different perspective: "I can now go to class and not pay attention."

Learning

While learning may not be seen as the primary benefit of IT use in courses, nearly two-thirds (64.1 percent) of the responding students perceive that IT used in courses improves their learning (see Figure 4-11). The remaining students are largely neutral (28.8 percent), and only 7.0 percent perceive that IT does not improve their learning. One student says that the use of IT to apply theory to reality improves learning: "I find that learning from theory alone results in a very limited learning experience. IT greatly enhanced my learning." Another student astutely observes that "No longer is education merely the transfer of knowledge from a professor to a student, but it is about the total transfer experience using all of the senses to receive and to process the information."

Numerous students comment on how technology influences how education occurs. One student reports, "In my Physics 100 class, we use clickers. They are like little remotes, with A to H buttons that the students have. The professor puts a question up and then we all click in the answer we think is right. Then, we all see the results, and if most of the class gets it wrong, we go over it again. It helps the professor recognize if we understand the concepts, and it helps the students learn what we need to work on."

For those students who indicate that IT in courses improves learning, without question the single most important factor is the instructor's skill, regardless of the student's age, gender, or major (see Figure 4-12). According to one student, "It is not the technology that improves learning; it all depends on the professor and what he is presenting."

In the qualitative interviews, students talk about instructors' teaching skills generally and about their use of IT in particular. One

Figure 4-11. IT in Courses Improves Learning (N = 17,908)

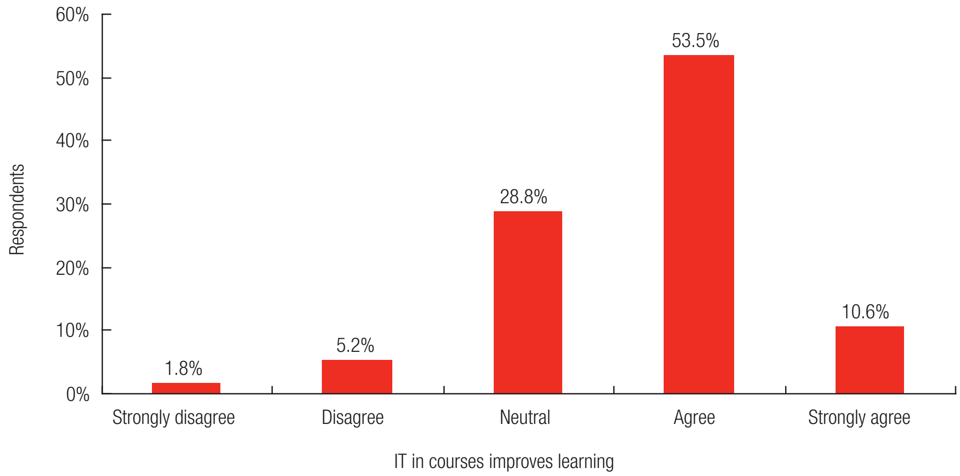
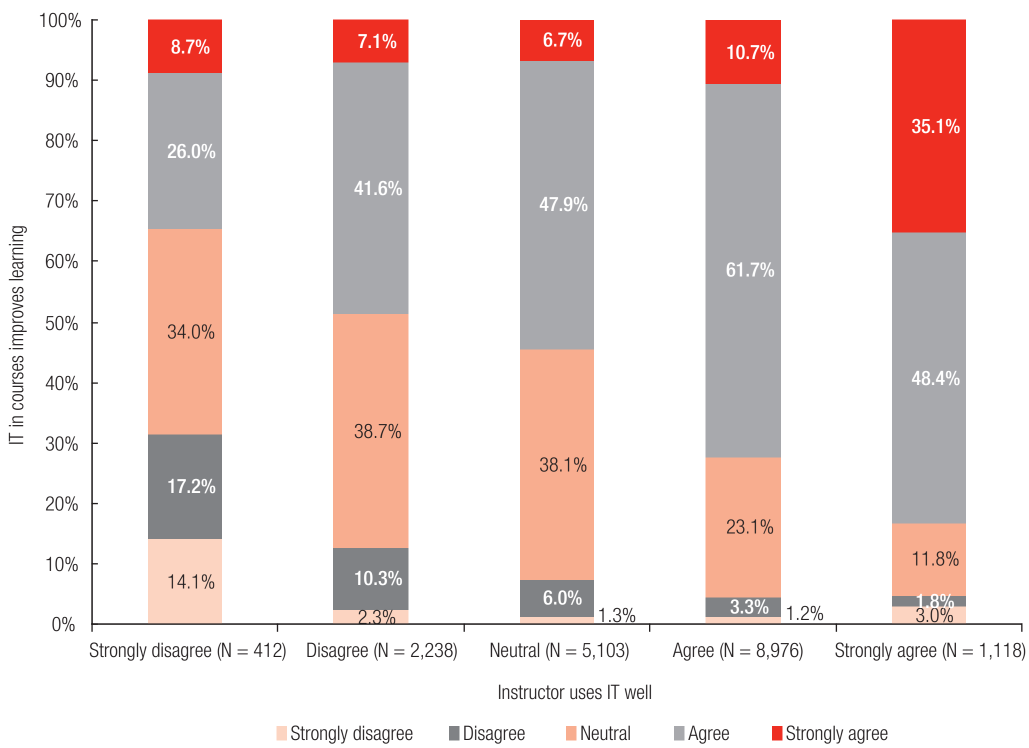


Figure 4-12. IT Impact on Learning, by Instructor Skill Using IT



Brandeis University student notes, "I have had professors who are great at making content available on the course management system, but I have seen professors who are pathologically afraid to touch a computer." Another student echoes, "It depends on the professors. One professor is very computer illiterate. A couple of others know how to do very basic functions like e-mail. It is a mixed bag." One undergraduate says that "Technology is great as long as the professor is smarter than the device. I have had quite a few classes cancelled or cut short because of technical difficulties."

The most common comment from students in the qualitative interviews is that IT can help faculty present information and concepts visually, which helps students learn better. Some examples given by students include mathematical and 3D modeling. A less commonly cited factor, but one identified at several institutions, is how technology in courses gives students access to real-time and real-world data and experiences as well as to programs they will use in their professional lives. A freshman engineering student reports, "IT is very useful when done right. In my circuits class, we use technology to simulate circuits and then read data from the circuit into a computer program in real time. It helps you understand how things work."

Student Technology Concerns

We asked students about their technology concerns (see Table 4-5). No issue elicited great concern among respondents. We tried to identify the students who were most concerned with certain problems and found very few differences overall. Male respondents are less concerned than female respondents with troubleshooting computers and viruses. Not surprisingly engineering students show less concern in this area than others.

Seniors are more likely to own older computers than freshmen.

Among technology concerns listed, students' biggest concern is computer viruses, worms, and Trojan horses, followed by spam e-mail. Many students expressed frustration with the proliferation of viruses and spam on their computers. One remarked, "I feel like my computer has a lot of viruses and problems and that there is nothing I can do about it." Another suggested that "A lot of things that we find out about viruses are things that the

Table 4-5. Student Technology Concerns

Concern	N	Mean	Std. Deviation
Computer viruses, worms, or Trojan horses	17,975	2.71	0.951
Spam	17,927	2.55	0.934
Slow or inadequate network access	17,915	2.48	1.066
My technical skill level in troubleshooting my computer	17,932	2.18	0.896
The age of my computer hardware and software	17,965	2.10	0.965
Inadequate access to printing	17,976	2.04	0.959
Inadequate technical assistance and help available to me on campus	17,954	2.04	0.927

Scale: 1 = not a concern, 2 = small concern, 3 = significant concern, 4 = major concern antivirus programs can't fix. You have to restart in safe mode, and a lot of students don't know how to do that. They don't know how to run different types of virus scans, like going to the registry."

Regarding spam e-mail, one student lamented, "Campus mail spam is overwhelming. The filters do not work. It's easy to miss e-mails from the university and those from my professors on a regular basis."

Students are very impatient with slow and unreliable network connections. One student remarked in graphic terms, "My school relies on an archaic system and has failed to make improvements to the system other than occasional facelifts to pacify student and professor frustration. The latest result of the use of the fossil was a system access shutdown to students, by the Office of the Registrar, to allow professors to place grades online during fall 2004. With the increase in student population expected to rise to as many as 30,000 within the next 10–15 years, the current system will prove to be an absolute and totally useless piece of trash unless overhauled."

The campus network's speed and quality may be a competitive differentiator: "The Internet on this campus sucks! You all need to figure out a way for us not to get so many damn viruses and not have such a slow system. We pay too much to go to school here to not get a top-notch system. Where's all the money going? It's obviously not going towards improving our Internet situation." Speed and access are the network watchwords. According to one student, "There should be more wireless networks around the campus, and in-house wireless would be nice too. The Internet connection should also be faster for a university." Another student justly complains, "I resided in a triple [room] for the semester, and much to my dismay, we found that there were only two ports for our RJ-45 [Ethernet] networking cables. Luckily we had a hub to use, but I think all rooms designated as a triple should have the correct amount of ports."

Some students also report their lack of IT skills at troubleshooting their computer. Says one respondent, "Students generally don't know the basics of maintaining or troubleshooting their computer." Another student adds, "Troubleshooting is not my strength. I was having all kinds of problems with my machine. I had the campus repair office fix it. Now I have the latest—Spybot. I could probably do some troubleshooting now from what I learned from my previous efforts."

The age of computer hardware and software is not a big problem from the students' perspective. Some students do, however, report frustrations. Says one student, "I am often frustrated at the slow computers. It takes me a lot longer to do my work, and often times I have to avoid using the lab if I am concerned with completing work in a timely manner." Another pleads, "If you could please save me from these archaic UNIX systems that this university stubbornly insists on sticking with, I'd be indebted to you for life. The technology is way behind, and contrary to their belief (they're really just in denial), the UNIX systems are very inefficient. Educational growth would rise exponentially if they would just let their foolish notions go."

Access—both technical and economic—to printing is a small concern overall for survey respondents. It clearly is a concern for some. One student reports, "The issue of access to printing is very heated among many of my peers. I am very glad that my school gives us an allowance to print at the school computers, but I wonder if they take into consideration that many professors also assign substantial online readings that we are expected to print out. At the halfway point for this semester, I was already out of my allowance on school computers, and I had been using that money to print out assigned readings only. I certainly hope that my school is not implying that I ought to do my readings online and never print out a hard copy. I know some students who do this, but I feel at a distinct disadvantage when I do not have something to mark up and take with me to class."

Finally, most students report little concern about IT support services—but this may not mean that these services function well. In fact, it is interesting to note how reviled IT support services are by some respondents. One student quipped, "We used to joke that it was not the 'Help Desk' but the 'Helpless Desk.'" Some students argue that one campus hand giveth while another taketh away: "The amount of technology on this campus is great, but God forbid you have a problem with it. There need to be people ready and willing to help no matter what the problem. And how about keeping an information systems manager or staff around with the library staff? Most people don't use and/or get computer problems from 9:00 a.m. to 4:30 p.m." And one student says bluntly, "Overall, I would rate the information technology department as unsatisfactory."

Conclusion

Colleges and universities have invested large sums of money in technology. Much of this investment has been in networks and other elements of a general communications infrastructure. These institutions have also invested in improving business processes that affect the student experience in particular (Kvavik and Goldstein, 2005). These investments appear to be paying off. Students seem to see these investments as contributing significantly and primarily to convenience and facilitating communications. We have made life much easier for students in the administrative area, where a great many lines have disappeared, one-stop shopping concepts have been embraced broadly, and most of student commerce with the institution is conducted electronically.

Institutional investment in technologies that impact the course experience—like course management systems, learning objects, and simulations—have been adopted more recently and perhaps more unevenly. Some students in this study acknowledge that technology improves learning, and we suspect this occurs most frequently where there is a deliberate institutional or faculty strategy to change and improve the learning experience. As with any tools, in the end it is more about pedagogy and institutional will and less about hardware and software. Many students are using software applications such as PowerPoint, Excel, and course management systems. By themselves these tools do not create or constitute an improved learning experience. Rather, students understand that it is incumbent on the faculty member to understand these tools' promise and performance in support of improved learning and to use them accordingly. Our data suggest that we are at best at the cusp of technologies being integrated meaningfully into pedagogy in ways designed to improve student learning.

Endnotes

1. The wording in the 2004 survey was different: "The use of technology in my classes met my expectations." The mean of 3.54 in 2004 to this related question was not significantly higher than in 2005.
2. Pascarella and Terenzini (1976) reported that the frequency and quality of student-faculty interactions significantly predict freshman academic outcomes such as college satisfaction and attrition. Other studies point to the importance of student-student communications to academic performance, persistence, and retention.

5

The Promise and Performance of Course Management Systems

Almost every course I've taken has used a course management system. I find it invaluable for accessing papers, assignments, and syllabi.
—An undergraduate student

A course management system (CMS) is a suite of software designed and marketed to colleges and universities for use in teaching and learning. Common course management companies and systems in the higher education environment include, but are not limited to, ANGEL, Blackboard, Desire2Learn, eCollege, First Class, Oncourse, Sakai, Moodle, and WebCT.[1] Today's typical CMS includes tools for course content organization and presentation, communication and student assessment tools, grade books, and tools for managing online course material and activities. Increasingly, course management systems are enabling faculty and administrators to track and analyze students' CMS use and to derive a better understanding of how students learn and how to improve student learning.

Key Findings

- Of the 72 percent of students who report using a course management system (CMS), more than 75 percent report a positive or very positive experience with it.
- The more students use a CMS, the more they like it.
- Students most value tracking grades on assignments and tests and accessing sample exams and quizzes in a CMS.
- Students least value online discussions in a CMS.
- Perceptions about instructor IT skills are strongly associated with students' satisfaction with course management systems.
- Students who agree or strongly agree that courses using IT allow them to take greater control of their course activities have the most positive experience with a CMS.
- Students report that using a CMS improves their learning.

Faculty can use other technologies, such as PowerPoint, in conjunction with a CMS to assist in teaching and learning. Lecture notes can be posted as PowerPoint slides to a course site and accessed via a CMS. They can also be combined with a learning management system to facilitate noncredit instruction. Course management systems are just that, management systems. In some ways they can be viewed as a first wave (or perhaps a second wave following the "thwarted innovation" wave of the mid-1990s) in what has been heralded a learning revolution (Oblinger and Rush, 1997). It's possible that learning activity management systems, learning objects, and newer technologies will focus their espoused impacts more directly on learning itself.

Despite the growing acceptance and use of course management systems in higher education, little is known about how students use them or their effects on learning. Much of the work done to date is in the form of student satisfaction surveys by individual higher education institutions seeking to understand how these systems are being used and how to improve their use. There is little comparative analysis by institution and student demographics (Hanson, 2003). This chapter seeks to develop a broader overview of how students perceive and use CMS features and to what advantage. Several other studies cited throughout this study appear in the bibliography.

This study is also informed by faculty observations of CMS use at the University of Wisconsin System institutions and elaborated upon in the ECAR study *Faculty Use of Course Management Systems* (Morgan, 2003). Using these data in addition to our own lets us contrast faculty and student perceptions of course management systems and gain some insight into effective practice. We expect to find that faculty and students agree that course management systems are useful and convenient tools for distributing and managing information and for communication. We also expect that their perceptions differ on how effectively faculty are using course management systems and their impact on learning.[2]

Today's Course Management Systems

It is fair to say that when students comment on technology used in their courses, they are often making reference to the use of a CMS. Today, a CMS is often the first technology undergraduate students experience in university courses, just as a Web-enabled enterprise administrative system is the first technology students encounter in support of admission and related administrative student services.

The number of students who have used a CMS has increased dramatically since these systems were first introduced about eight years ago. Fully 72 percent of this survey's respondents have taken a course using a CMS. While the number of students reporting some CMS experience is high, the number of faculty who use these systems regularly and the percentage of CMS-enabled courses offered by institutions overall are growing, but they're still not likely to be high (Morgan, 2003). While students take the vast majority of their courses without using this tool, our data suggest that students are critical of this varying pattern of use.

Course management systems and their implementation are a work in progress. They promise to reduce time and space restrictions on learning for students and faculty, much as their predecessor enterprise administrative systems did for student administrative services. Used properly, they have the potential to improve students' access to information and communication with their instructors, enhance the quality of learning, and increase learning productivity (Twigg, 2001). Instructors can use course management systems to convey information more effectively and to better meet the needs of students with varied learning styles. These systems make it possible to enrich the interactions students have with each other and with their instructors. While the direct relationship between course management systems and student learning needs more study, students in our study are positive about course management systems. These systems are clearly gaining acceptance and momentum.

Course management systems also offer the promise of increasing learning productivity. A CMS can allow students to learn more and faster, in part by automating or rationalizing the "administrivia" of instruction (convenience), in part by streamlining communications (connection), and in part by expediting and refining faculty feedback, thereby enabling students who use them to focus on learning-related tasks. Over time, institutions hope to see a return on their CMS investments through higher retention and graduation rates and higher levels of student satisfaction. A question we ask is whether we can demonstrate measurable returns on an institution's CMS investment.

This chapter addresses the following questions about students and course management systems:

- What value do course management systems provide in teaching and learning in higher education?
- How many students in the survey have used a CMS and how do they rate their experience using it?
- What do students perceive to be the primary benefits of a CMS?
- What impact does CMS use have on the students' learning experience?
  - Do students report that CMS use improves communication with the instructor?
  - Do students report that CMS use improves collaboration and communication with their classmates?
  - Do students report that CMS use improves the promptness, helpfulness, and value of the feedback they receive from their instructors?
  - Do students report that CMS use enhances their ability to manage information and their time?
  - Do students report that course management systems help them learn?

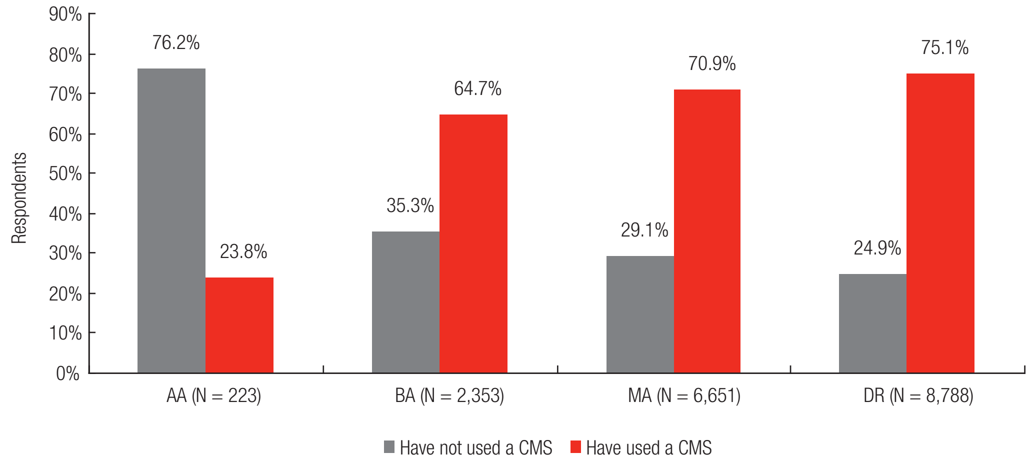
Student CMS Use

Seventy-two percent of the student respondents to our survey have taken a course that used a CMS. This differs from our findings in the 2004 survey, where 83 percent had used a CMS. Note, however, that the institutions included in the 2004 survey had all used course management systems for some years and the use at each of the 13 institutions exceeded 59 percent of all students. This is not the case in 2005. In this year's study, some institutions have only recently adopted course management systems. We see a significant difference of use among the 63 institutions, ranging from a low user rate of 12.2 percent to a high of 95.8 percent. We think the number of users is high and growing.

Not surprisingly, seniors (76.1 percent) are more likely to have taken a course that used a CMS than freshmen (65.8 percent). The longer students attend an institution that has implemented a CMS, the more likely it is they have encountered a course using the system. And because a CMS is normally an institution-wide application, it is no surprise that there are no significant differences of student use by age, gender, major, grade point average, part-time or full-time status, or campus residency.

We did find differences by Carnegie class (see Figure 5-1). More students (75.1 percent) at doctoral institutions have taken a course that used a CMS than students at AA institutions (23.8 percent). Note, however, that the number of AA students in this study is too small for generalization, so these numbers must be read cautiously. It is nonetheless likely, in our judgment, that usage differences by Carnegie class are significant, and these possible differences deserve greater study. The differences in CMS use between respondents at doctoral and BA institutions must also be read with caution due to a smaller number of respondents from BA institutions. This caution applies to private institutions generally. Further, any differences we might ascribe to institution mission (Carnegie classification) might be partially explained by the presence or absence of business and engineering programs in institutions of differing missions. Business and engineering students in our sample are more likely than other students to have taken a course using a CMS. We find the majority of these students in our study at doctoral institutions.

Figure 5-1. Students Who Have Used a CMS, by Carnegie Class



Student Experience with a CMS

Most students we surveyed have had positive experiences with course management systems. We asked the students who have taken a course using a CMS to describe their overall experience (see Figure 5-2). Of the students who have used a CMS, 75.2 percent report a positive or very positive experience, 19.8 percent are neutral, and only 5.0 percent are negative or very negative. Only 99 of the 18,039 students who responded to the study said they were very negative about a CMS. These figures are virtually the same as in the 2004 study.

We looked for factors that contribute to a positive CMS experience and found three of moderate significance. Students who agree or strongly agree that courses using IT allow them to take greater control of their course activities (planning, apportioning time, noting success and failure) report the most positive experience with a CMS. The next strongest relationship is the perceived general skill of the instructor in using IT for instruction, followed by instructors' use of IT to provide prompt feedback to students. Interestingly, student skill in using course management systems is not much of a factor. With respect to faculty skills, one student notes, "The problem with programs such as course management systems is that their usefulness depends on the instructor. If they know how to properly and successfully use it, then it will be helpful. If they are not particularly computer literate, it becomes an obstacle and a hindrance."

We asked whether students who preferred to take courses with little or no technology have an equally negative attitude toward course management systems (see Figure 5-3). They do not. Almost 50 percent of students who prefer no IT in courses report a positive or very positive experience with a CMS. Concomitantly, we found that students who have a very positive or positive experience using a CMS overwhelmingly report a preference for extensive or exclusive use of IT in courses.

We note that there are insignificant experiential differences by gender, age, major, part-time or full-time status, and on-campus or off-campus residency. Students at doctoral institutions evaluated course management systems slightly more positively than did students at other institutions, but we attribute that to the fact that these systems are more in use at doctoral institutions. Our data show that the more hours students spend using course management systems, the higher they rate their experiences with them. One under-

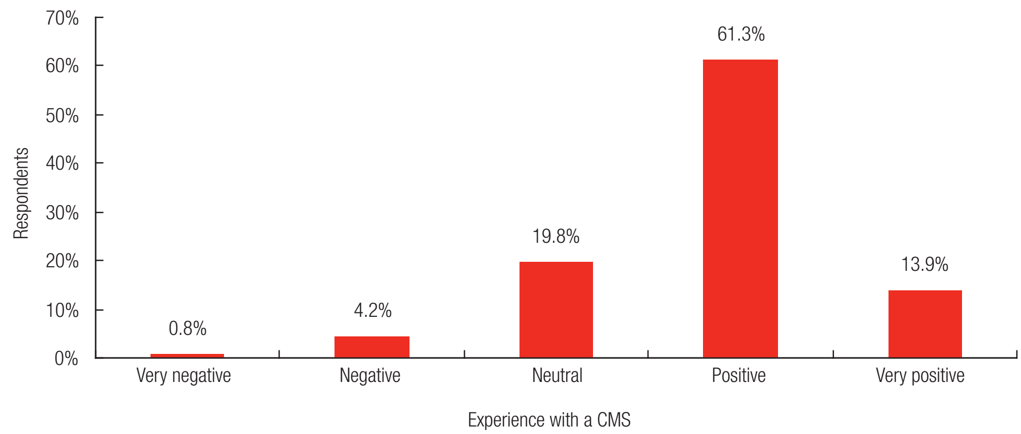


Figure 5-2. Students' Overall Experience Using a CMS (N = 12,177)

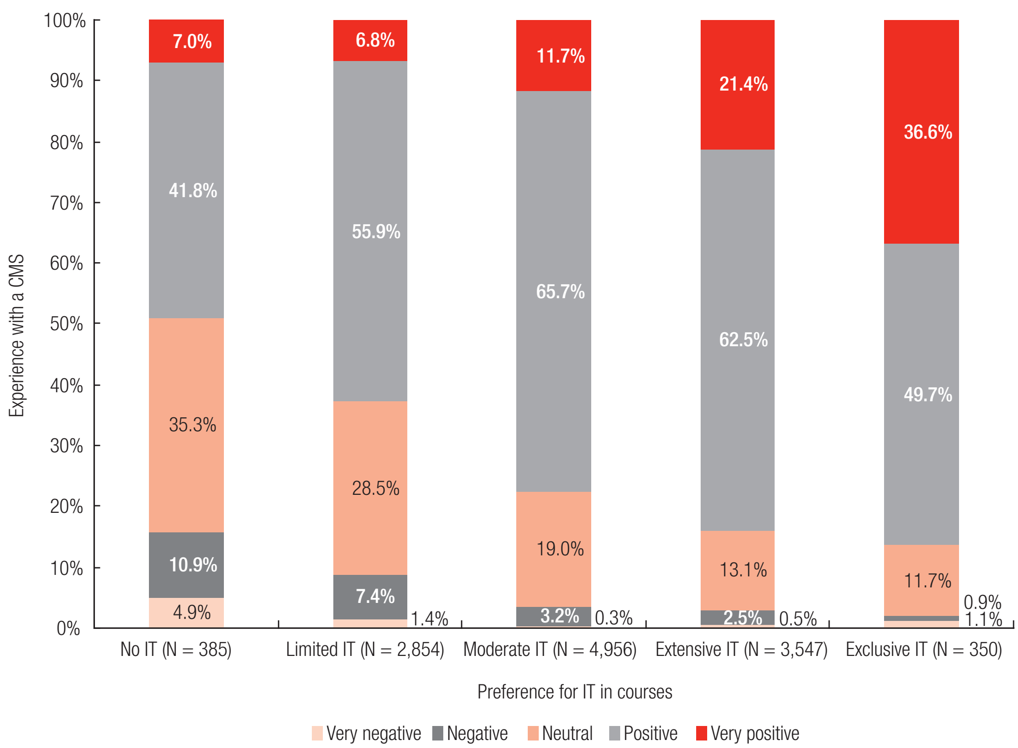


Figure 5-3. Experience with Course Management Systems, by Student Preference for IT in Courses

graduate reports, "I really wished that more professors used course management systems to organize their classes. It is a wonderful tool that keeps both students and professors honest and organized." Another states, "The CMS works great when professors list class notes for printing so that more material can be covered quicker and clearer during class and then reviewed later for studying."

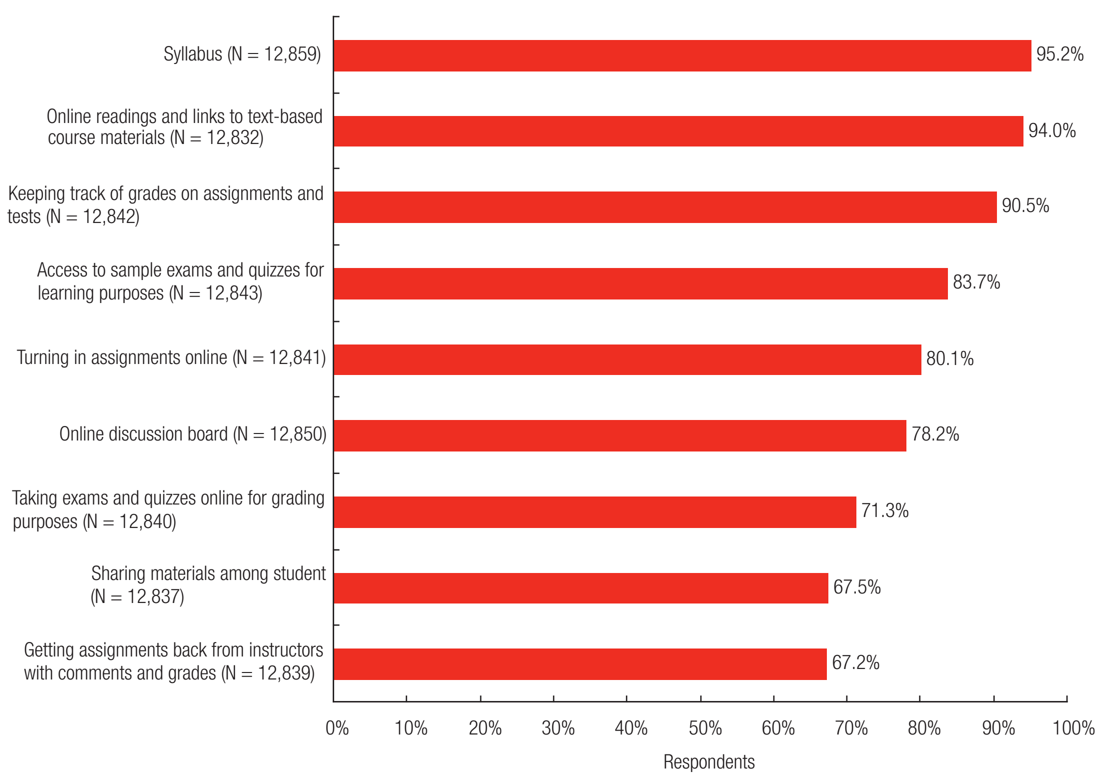
Some students were negative: "The CMS has some bugs to be worked out. I basically feel it is used primarily for grade feedback and assignment submission. I am not sure it improves my learning; it is more of a convenience." For some, course management systems offer the potential of abuse. "I know enough about computer security to know that it is disturbingly easy to compromise confidential information of students and faculty using a CMS. User names and passwords are frequently sent over unencrypted and insecure network connections (in the clear over http). In addition, these tools are often expensive and inflexible, and full of errors."

Student Use of CMS Features

Course management systems offer many features in support of learning and course administration. We asked the students who had used a CMS which features they had used (see Figure 5-4). We found that administrative features are used most, with syllabus (95.2 percent) and online reading (94.0 percent) receiving the highest percentages. Less used are the CMS features that enable sharing materials among students (67.5 percent) and getting assignments back from faculty (67.2 percent).[3]

Student feedback on course management systems is fairly consistent: They seem to like many of the features but wish faculty members used them more extensively and frequently. One student commented, "Each semester it is hit or miss as to which classes will use a CMS and which classes will not. I think all professors should use the system to some degree, for example, to upload syllabus, assignments, and readings." A Bridgewater State College student notes, "In one of my classes, the professor puts the reading assignments on the CMS. The other day, a couple of other students and I tallied up all the pages for our reading assignment. Over 200 pages would have been handed out in paper. But, since it's in electronic form, we just read it online. Ecologically it is good to read it on the screen because it saves trees." Another states, "I saved about $120 because when the professor posted the readings on the CMS, I did not have to buy the book. I printed out pages as I needed them." Still another advises, "I wish more instructors would use the CMS because it keeps students aware of what is going on. For example, when assignments are due, what grade they have, and the course outline/syllabus." And finally, another notes, "I like the use of the CMS for communication and listing assignments."

Figure 5-4. CMS Features Used by Students



Perceived Benefits of Course Management Systems

In addition to querying students on their use of various CMS features, we asked them whether they found various CMS features or functions valuable (see Table 5-1). Respondents value keeping track of grades on assignments and tests most (2.57), closely followed by accessing sample exams (2.50), where a mean score of 2.0 = valuable. We found that 60.5 percent of students find keeping track of grades very valuable and 54.1 percent find access to sample exams very valuable. Both contribute to students' ability to monitor and improve their course performance.

The next valued set of features is administrative in nature—convenience items such as syllabus (2.36), turning in assignments online (2.27), getting assignments back from instructors (2.27), access to online readings (2.25), and taking exams online (2.18).

Interactive communication items—sharing materials among students (2.09) and online discussion board (1.86)—are less valued. With the exception of the online discussion board, all students consider the features valuable or very valuable. Note that 33.4 percent of the students who use a CMS evaluate online discussions as not valuable. Not surprisingly, students who feel the features to be most valuable rate their experience with a CMS the most positively. And students who rate their instructors' skill using technology highest find the features most valuable.

In one focus group at the University of Wisconsin–Madison, a few students got into a debate about whether online discussions in their courses are good or bad. One student explains, "In one of my classes we had to participate in an online discussion by the end of the day. It turns out it wasn't a discussion at all. We all started posting entries just before midnight so that we'd posted something. We didn't discuss anything. We just dumped comments to the discussion board at the last minute." Another student disagrees: "In my course that used an online discussion board, we got into a serious discussion about the course content. It carried over to the next class period, too."

Table 5-1. Perceived Value of CMS Features

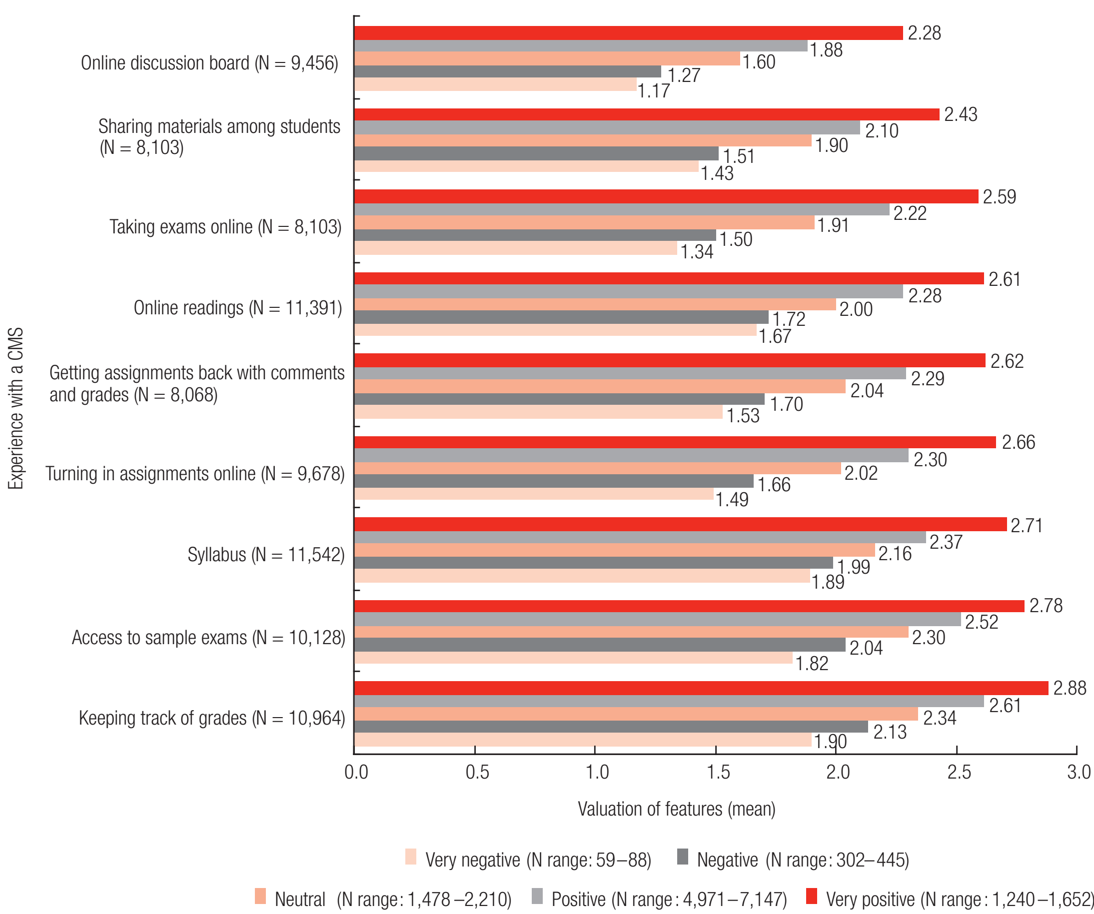
Feature	N	Mean	Std. Deviation
Keeping track of grades on assignments and tests	11,627	2.57	0.565
Access to sample exams and quizzes for learning purposes	10,748	2.50	0.578
Syllabus	12,236	2.36	0.582
Turning in assignments online	10,291	2.27	0.666
Getting assignments back from instructors with comments and grades	8,624	2.27	0.674
Online readings and links to text-based course materials	12,065	2.25	0.615
Taking exams and quizzes online for grading purposes	9,149	2.18	0.709
Sharing materials among students	8,664	2.09	0.648
Online discussion board	10,052	1.86	0.716

Scale: 1 = not valuable, 2 = valuable, 3 = very valuable

Students who report having a very positive experience with a CMS find the features to be more valuable than other students do (see Figure 5-5). Another interesting finding is that regardless of whether students have a very positive or very negative experience with a CMS, they rank the relative value of the features alike. Online discussions are liked the least, for example, regardless of CMS experience. Even students who have a very negative experience with a CMS consider over half of the features to be valuable (mean of 1.5 or higher).

Numerous students comment on how much they like seeing their grades online. A University of Wisconsin–Madison student expresses her desires thus: "I wish more of my teachers would use the CMS to post assignments and test/quiz scores and grades. This would help a lot of students out and let them know how they're doing in the class without going through the process of talking to the professor and then (he/she) not having the grades readily available." One Bridgewater State College student reports, "I like the 'view grade' feature of the CMS. You can see how you are doing and compare yourself to others in the class. It gives me some basis to talk to my professor about my performance. In other classes you just see your paper/test and have no idea how well you are doing compared to other students." In the open-ended comments, another student says, "I wish all my instructors posted grades online."

Figure 5-5. Experience with a CMS, by Valuation of Features



Scale: 1 = not valuable, 2 = valuable, 3 = very valuable

These comments corroborate a rich literature that finds a strong correlation between student-faculty communications and student academic performance, persistence, satisfaction, and retention (Pascarella and Terenzini, 1976, 1991).

Of course not all students view course management systems in positive terms. One opines, "I like all aspects of information technology except taking online tests…." Another says, "Also, online tests are not fair to everyone; there are no examiners for online exams." A third student comments, "The CMS is relatively inconvenient for me. It takes more time than I would like to take to use it."

Course Management Systems and IT's Impact in Courses

Students who report a positive experience with a CMS are more likely to agree that the use of IT in courses has a significant positive impact on their engagement, interest in the subject matter, presentation of their work, understanding of complex concepts, and so forth, than are students with a neutral or negative CMS experience (see Figure 5-6). Note that improved communication with the instructor is highly valued regardless of the overall experience with a CMS. This may or may not be attributable to a CMS, however, as faculty can use e-mail independent of a CMS.

Course Management Systems and Learning

Our data show that course management systems contribute to convenience, connection, and control, and of these, students most value convenience. The big question, of course, is whether a CMS contributes to learning. Students say that it does (see Figure 5-7). Nearly 85 percent of students who have a very positive experience with a CMS also agree or strongly agree that the use of IT in

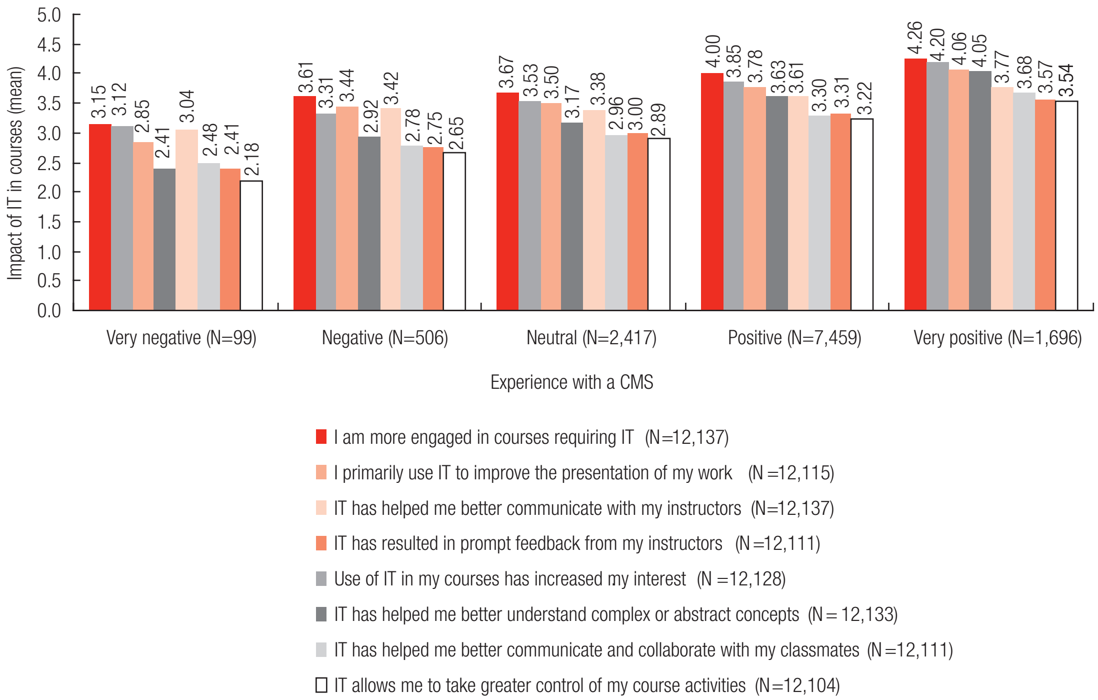
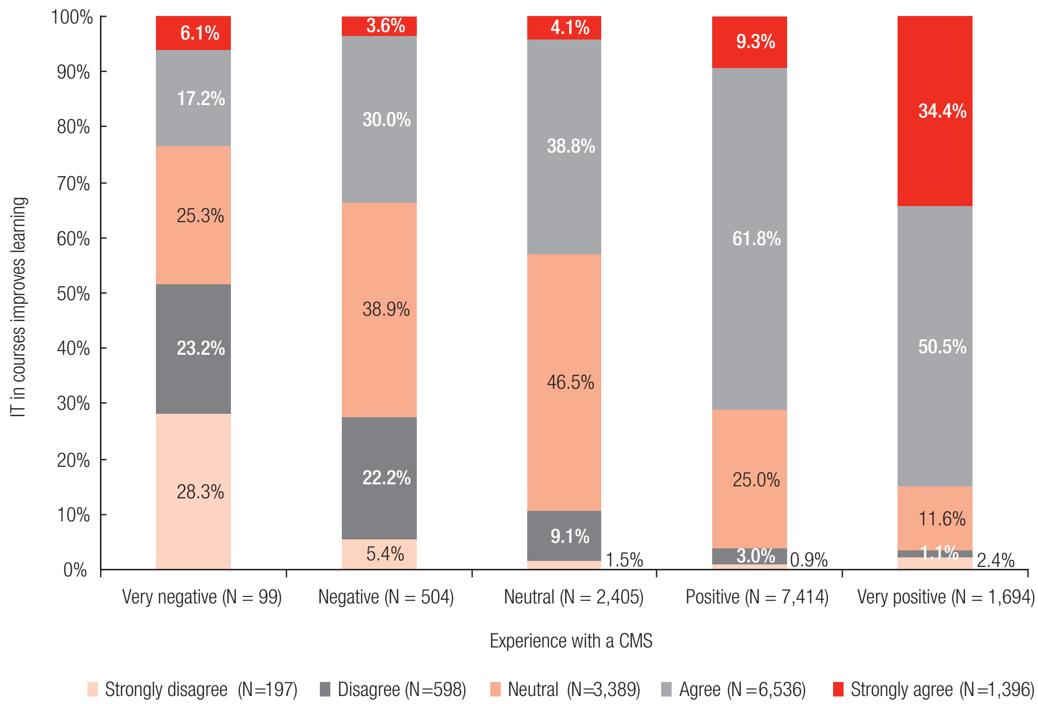


Figure 5-6. Impact of IT in Courses, by CMS Experience

Scale: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree

Figure 5-7. Impact of IT on Learning, by Experience with a CMS



courses improves their learning. Conversely, if the CMS experience is negative, the student is more likely to indicate that the use of IT in courses does not improve learning. More than 50 percent of students who reported a very negative experience with a CMS also disagree or strongly disagree that IT in courses improves learning. While this student feedback does not constitute formal evidence of IT's impact on learning, it is certainly heartening and worthy of note.

When we do a regression analysis, the first factor contributing to whether IT improves learning is perceived faculty skill in using IT, followed by the respondent's experience using a CMS. We also know that faculty IT skill contributes to a student's positive experience using a CMS, and so it is not surprising that this is the most important factor. And it is likely that a positive experience using a CMS is something of a surrogate for faculty skill. Nevertheless, our analysis shows that a positive experience using a CMS has a perceived impact on learning. This is also seen in Figure 5-6, which describes the student experience with a CMS and students' self-reported understanding of complex and abstract concepts in their courses. These encouraging findings call for more research that addresses learning using additional methods other than those used in this study.

We conclude from the quantitative data, student comments on our survey, and our qualitative interviews that a CMS very likely facilitates activities that contribute to learning: reinforcement, self-assessment, practice, improved communication with the instructor and classmates, easier and ready access to learning materials, and so forth. We also conclude that the effectiveness of these tools for student learning depends to a great extent on the skill of the faculty who use this tool. When used poorly, a CMS can have the opposite effect, as some students conclude that it negatively contributes to their learning. Fortunately, most students view the CMS positively and also give their instructors good grades on their IT skills. As faculty members continue to use these systems and improve their skills, we should expect future ECAR surveys to show an upward trend of CMS' impact on learning.

Students make numerous comments on how course management systems contribute to their learning. A Colgate University sophomore notes, "Technology should play a supplemental role in the classroom. The discussion on the CMS can be a rich discussion. That way you can use resources to their fullest extent by the sharing of ideas. It helps more people out of the unparticipating shell. A CMS discussion also fuels class discussion." Another Colgate student says, "One professor put the outline of every lecture on the CMS. It was easy to follow where he was going. I could see what he was leading to."

Students also offer advice. "Overall I love the concept of the CMS. Putting study guides there is a big help. It would be nice if all of my classes were on the CMS. Universities should seriously consider requiring all assignments and quizzes to be given online and to make lectures optional. That way students can find their own learning groove and settle into a pattern that works the best for them." Another respondent notes, "Everyone should use online course management systems—make it mandatory for all instructors because until all courses are accessible it will never really take off as the next big thing."

Conclusion

In sum, ECAR data show that students find course management systems improve their course management. Students rate the ability to keep track of grades on assignments and tests most highly of all CMS features. Students value CMS features that foster convenience and that facilitate their management of course activities. They also acknowledge learning benefits from CMS use when these systems are incorporated well into instruction.

Endnotes

1. To see a comprehensive list of course management systems (and to evaluate their features), see the Western Cooperative for Educational Telecommunications (WCET) EduTools at <http://www.edutools.info/course/compare/byproduct/index.jsp>.
2. Readers are advised to use insights drawn from the 2003 study cautiously. The rate of CMS adoption and diffusion has been rapid, and it is likely that if the 2003 faculty use of CMS study were repeated today, faculty perceptions, adoption, and uses of course management systems would be more strongly positive, deeper, and varied.
3. The "use" responses in Figure 5-4 are cumulative figures that reflect the percentage of students who have once or more than once used the CMS feature specified. Exposure to a CMS feature depends upon what each faculty member decides to use, and the combination of features chosen will vary by faculty member. By taking courses from multiple faculty members, the students are likely to have been exposed to most CMS features. The *Faculty Use of Course Management Systems* study confirmed our findings that more faculty members used the content presentation tools such as Syllabus and fewer used the interactive tools such as the grade book and quizzing (Morgan, 2003).

6
A Little Wind Ruffling the Curtains at Dawn

…change comes like a little wind that ruffles the curtains at dawn…like the stealthy perfume of wildflowers hidden in the grass.
—John Steinbeck

Change is subtle, in the words of Steinbeck, but it is also mandatory. Subtle or not, W. Edwards Deming reminds us that change and survival are intertwined: "It is not necessary to change. Survival is not necessary." And one can miss the ruffling of curtains unless one makes an effort to listen closely and attentively. In our case, listening to students and observing changing patterns of behavior are fundamental to changing the learning environment and to effectively deploying technology in support of learning.

What changes are observable from the ECAR 2004 and 2005 data on higher education students and technology? Are IT ownership patterns changing? How are student uses of technology changing? Are student IT skill levels increasing, and if so, why, by whom, and with what technologies? Are information technologies increasingly improving our students' undergraduate experience? If so, in what areas and how is improvement being realized? Are student expectations about the uses of IT understood by the academy, and are they being met? Do we know what these expectations are? Do students currently view IT in courses as transforming or supplementing teaching and learning? If not, then what do we need to do to make their expectations a reality?

We address these questions by first juxtaposing two portraits of student behavior and expectations. The first builds on the works of Oblinger and Oblinger (2005), Frand (2000), Prensky (2001), Seely Brown (2002), and their colleagues. This work defines and identifies characteristics of Net Generation students. We place each characteristic into the ECAR framework—convenience, connection, control, and learning. The second portrait uses ECAR data—both quantitative and qualitative, and especially the latter—to describe the respondents' experience with IT. What are more than 8,000 students telling us in the 384 pages of commentary they provided through two open-ended survey questions and in student focus groups at seven institutions? How different are the two portraits of student behavior, and if they are different, what needs to happen to achieve better alignment?

One significant and recurring theme in Oblinger and Oblinger's latest collection of articles is the importance of engaging students in a dialogue to better understand how they learn, what they expect, and how they use technology. "Only by understanding the Net Generation can colleges and universities create learning environments that optimize their strengths and minimize their weaknesses" (Oblinger & Oblinger, 2005). In the same volume, Gregory R. Roberts observes, "Few efforts have been made to directly engage students in a dialogue about how they would like to see their faculty and institutions use technology to help students learn more effectively" (Roberts, 2005). This chapter represents such a dialogue.

Guri-Rosenblit (2003) questions the extent to which higher education's leaders are motivated to drive change. She notes that Charles Vest, then president of the Massachusetts Institute of Technology, stated clearly in his 2000–2001 annual report that "The residential university will remain an essential element of our society, providing the most intense, advanced, and effective education. Machines cannot replace the magic that occurs when bright, creative young people live and learn together in the company of highly dedicated faculty." Guri-Rosenblit concludes, "There is no wonder then that most applications of IT in well-established campus universities are used to enhance classroom interaction or to substitute part of the teaching/learning activities, not to replace them" (Guri-Rosenblit, 2003).

This chapter begins with some observations about changing patterns of the student experience with IT, based on a comparison of the survey data collected in this 2005 study and in the *ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control* (Kvavik et al., 2004). Next, it examines the portrait of the Net Generation student attributes as defined by Oblinger and Oblinger in the context of what students in this study tell us. And lastly, using students' commentary from the Web-based survey and qualitative interviews, we present a series of recommendations for institutions for improving their systems and services and thus enhancing their students' IT experience.

Comparing Results of 2004 and 2005 ECAR Studies

Eleven of the 13 institutions that participated in the *ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control* also participated in 2005. The number of respondents from those 11 institutions rose slightly in 2005: 4,246, versus 4,083 in 2004. The demographics are remarkably similar. The two cohorts virtually mirror one another in terms of age and proportion of seniors and freshmen, and of distribution by academic major. The only difference is gender, where 67.2 percent of the respondents are women in 2005, versus 61.8 percent in 2004.

We compared technologies used, hours IT is used weekly, self-reported IT skill level, preference for use of IT in classes, and perceived benefits of IT. The differences are for the most part minor and statistically insignificant, but some are noteworthy. Below, we discuss the more interesting differences for students at the 11 institutions that participated in both surveys.

Ownership of Electronic Devices

Ownership of laptop computers is up 3.4 percent, from 46.3 percent in 2004 to 49.7 percent in 2005. Likewise, cell phone ownership is up 7.1 percent, from 81.6 percent in 2004 to 88.7 percent in 2005. This may be partially attributable to the higher percentage of women in the survey, who own more cell phones than men do in our two studies. PDAs and smart phones made no further penetration in this market between last year and this year.

Internet Access

More than 90 percent of 2005 respondents report broadband access, compared with 76 percent in 2004, and we see a significant shift to commercial broadband service (from 27.3 percent in 2004 to 39.8 percent in 2005) and away from college- or university-provided broadband service (from 49.0 percent in 2004 to 39.6 percent in 2005).

Use and Weekly Hours of Use

A year-over-year comparison of use by activity shows isolated but important differences (see Table 6-1). Notwithstanding appropriate caveats about the limits of ECAR 2004 data, it is reasonable to conclude that 2005 represents a year in which media may be moving into the educational mainstream. The use of software for creating and editing video and audio, creating presentations, and creating Web pages grew significantly from 2004, though from only a moderately sized base. Also of possible importance are decreases in CMS use, downloading of music and video, and playing computer games. There may be a gender issue here, as females constitute a greater share of our 2005 sample. Our data show that females are less likely to play computer games or to use frequently and intensively those IT applications that are often associated with engineering and business education. These usage trends, however, are quite interesting and potentially important.

Weekly hours of use (see Table 6-2) remained stable on a year-over-year basis, although the increase in reported hours of use in presentation activity is worth noting.

Perceived Levels of IT Skills

With the exception of PowerPoint, students self-report a lower perceived level of skill with all applications in 2005 (see Table 6-3). But most differences are insignificant and may be attributed to providing better definitions of what constitutes skills to students

Table 6-1. Technologies Used, by Year

Activity	Used in 2005	Used in 2004	Change
Creating and editing video/audio (Director, iMovie)	23.4%	20.6%	13.6%
Creating presentations (PowerPoint)	64.9%	58.1%	11.7%
Creating Web pages (Dreamweaver, FrontPage)	23.0%	21.3%	8.0%
Using a library resource to complete a course assignment	87.7%	84.3%	4.0%
Creating graphics (Photoshop, Flash)	47.7%	46.5%	2.6%
Creating, reading, sending e-mail	99.9%	99.5%	0.4%
Classroom activities and studying using an electronic device	96.4%	96.4%	0.0%
Writing documents for your coursework	99.0%	99.6%	-0.6%
Online shopping	68.8%	69.8%	-1.4%
Surfing the Internet for pleasure	94.0%	97.1%	-3.2%
Creating, reading, sending instant messages	79.7%	82.6%	-3.5%
Creating spreadsheets or charts (Excel)	61.0%	65.5%	-6.9%
Downloading or listening to music or videos/DVDs	73.9%	80.3%	-7.9%
Using a CMS	69.7%	76.8%	-9.2%
Playing computer games	61.3%	69.7%	-12.1%

Table 6-2. Change in Weekly Hours of Use, by Survey Year

Activity	Mean 2005	Mean 2004	Change
Creating presentations (PowerPoint)	1.57	1.43	9.8%
Using a library resource to complete a course assignment	1.83	1.74	5.2%
Creating graphics (Photoshop, Flash)	1.73	1.67	3.6%
Creating and editing video/audio (Director, iMovie)	1.66	1.61	3.1%
Writing documents for your coursework	2.82	2.76	2.2%
Creating, reading, sending e-mail	2.52	2.48	1.6%
Online shopping	1.54	1.51	2.0%
Playing computer games	2.02	2.00	1.0%
Surfing the Internet for pleasure	2.54	2.52	0.8%
Creating Web pages (Dreamweaver, FrontPage)	1.81	1.80	0.5%
Creating, reading, sending instant messages	2.72	2.93	-0.7%
Classroom activities and studying using an electronic device	3.02	3.12	-1.0%
Downloading or listening to music or videos/DVDs	2.59	2.62	-1.1%
Creating spreadsheets or charts (Excel)	1.61	1.64	-1.8%
Using a course management system	1.86	1.96	-5.1%

Scale: 1 = less than 1 hour, 2 = 1–2 hours, 3 = 3–5 hours, 4 = 6–10 hours, 5 = more than 10 hours

Table 6-3. Change in IT Skill Levels, by Survey Year

Activity	Mean 2005	Mean 2004	Change
Presentation software (PowerPoint)	2.96	2.91	1.7%
Word processing	3.50	3.53	-0.9%
Spreadsheets (Excel)	2.83	2.86	-1.0%
Online library resources	2.83	2.88	-1.7%
Creating Web pages (Dreamweaver, FrontPage)	2.11	2.16	-2.3%
Graphics (Photoshop, Flash)	2.38	2.45	-2.9%
Creating and editing video/audio (Director, iMovie)	2.00	2.07	-3.4%
CMS	2.72	2.85	-4.6%

Scale: 1 = very unskilled, 2 = unskilled, 3 = skilled, 4 = very skilled

in the 2005 survey. Note, too, that there is very little difference reported by gender and major. The gender gap is small, but it did not narrow in one year, nor did the gap between majors—for example, engineering and fine arts. The reported reduction in perceived skills using course management systems will be monitored over time.

Preference for IT in Courses

Students show no change in their preference for IT in courses. Most prefer a moderate amount of IT in courses (see Figure 6-1).

Perceived Impact of IT in Courses

The perceived impact of IT in courses shows some small changes from 2004 to 2005. The positive changes are mostly about communications and convenience, while the negative changes are mostly about instructors and instruction (see Table 6-4). Each item in the table is in response to one of two questions: "To what extent does each of the following describe your experiences in your courses?" and "To what extent has the use of information technology in courses helped

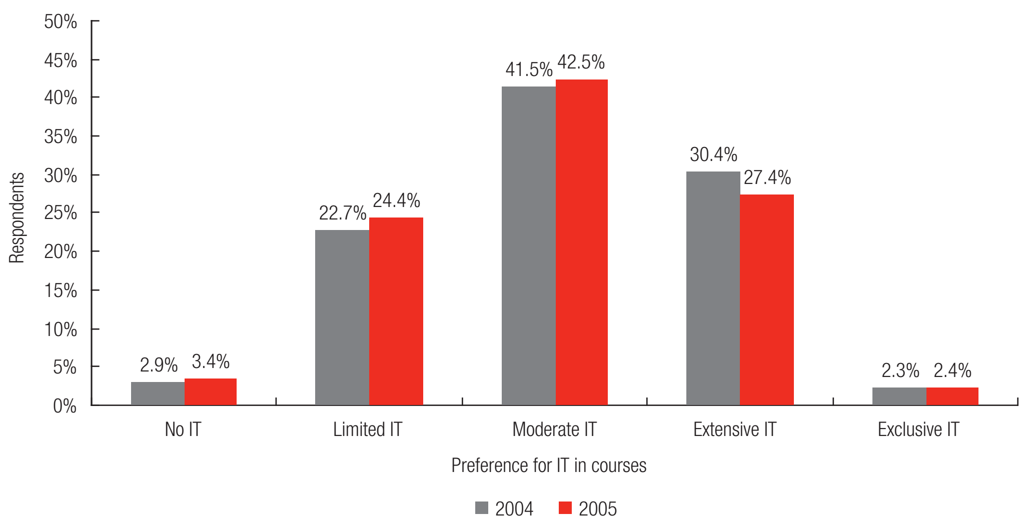


Figure 6-1. Change in Preference for IT in Courses, by Survey Year

Table 6-4. Perceived Relative Impacts of IT in Courses

Impact of IT in Courses	Mean 2005	Mean 2004	Change
Better communication and collaboration with classmates	3.73	3.65	2.1%
Greater control of my course activities	3.51	3.46	1.4%
Better communications with my instructors	3.91	3.86	1.3%
More engaged in courses that require IT	3.22	3.22	0.0%
Facilitates prompt feedback from my instructors	3.79	3.84	-1.3%
Improves the presentation of my work	3.57	3.62	-1.4%
Increases my interest in the subject matter	3.17	3.25	-2.5%
Improves my understanding of complex or abstract concepts	3.28	3.37	-2.7%

Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree you?" Fewer respondents in 2005 agreed that their institution needs to provide them with more IT training beyond that required for use in courses.

Course Management Systems

Students remain very positive about the use of course management systems in courses. There was virtually no change of opinion to the question "How would you describe your own overall experience using a course management system?" with a mean of 3.82 in 2005 and a mean of 3.86 in 2004, based on a scale where 1 = very negative, 2 = negative, 3 = neutral, 4 = positive, and 5 = very positive.

In summary, the student responses to the Web-based survey in 2005 indicate

- a slight increase in laptop ownership;
- a shift toward commercial broadband service;
- a possible broadening of student use of specialized software for presentation, Web page production, and creation of audio/video content;
- a decrease in reported use of course management systems and instant messaging software;
- a possible decrease in the percentage of computer game users among respondents, but no decrease in the mean time spent playing computer games;
- a slight decrease in reported skill levels across most applications; and
- little change in preference for IT in courses or experience with course management systems.

These changes require more study. Insufficient data exist to account for year-over-year differences, but such differences sharpen our attention for future investigations and accent the need to continually assess student behavior to predict future student needs and expectations. Next year's ECAR student study will continue this analysis.

The Net Generation Student and the ECAR Student Framework

As we examine student behavior and expectations, it is important to consider their life experience with IT. The youngest students in our study, often referred to as Net Generation students, are defined in part by exposure to and use of technology throughout their entire life span. IT is an integral part of their lives to the point that they don't think of technology as technology per se but rather as an activity. According to Oblinger and Oblinger (2005), "Instant messaging isn't considered a technology; IM'ing is treated as a verb—it is an action, not a technology. A technology is something that is new, novel, and customizable." One example of a new technology being used by our student respondents is social software, which we will discuss later in this chapter.

IT's ubiquitous presence and use produces a set of attributes that further define the Net Generation. There are many such attributes, and we include only a few that this study is able to address—those relating to the study's themes of IT's contribution to convenience, connection, control, and learning (see Figure 6-2). Needless to say, there is overlap among these four categories of activity.

Higher education has spent millions of dollars on technology aimed, in part, at satisfying student preferences and expectations for convenience, connection, control, and learning. Enterprise resource planning (ERP) systems, portals, campus wireless networks and broadband access, and course management systems represent a revolution in the delivery of online administrative services, improved communications, and student opportunities to plan and manage their academic experience and affairs. And we believe instructors are steadily responding to students' expectations and preferences in the learning sphere.

Perhaps one reason we see few differences between age groups in our student respon-

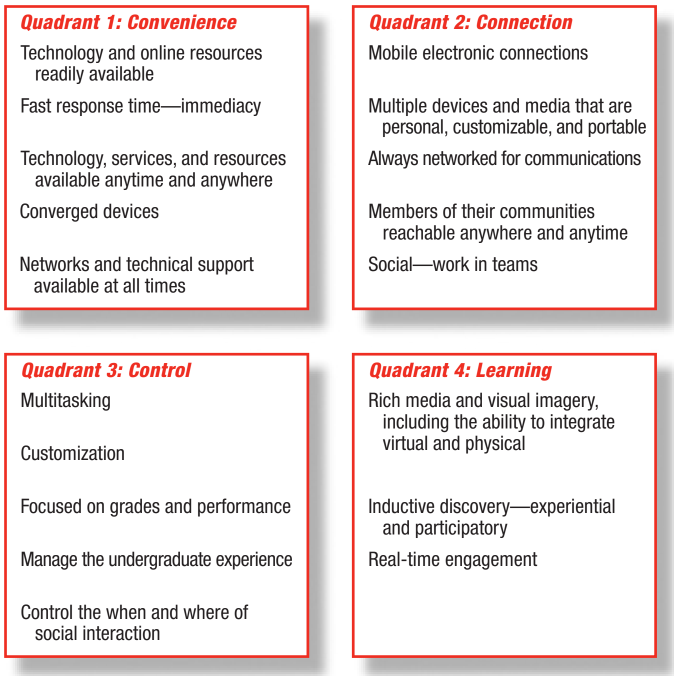


Figure 6-2. Net Generation Student Expectations and Preferences

dents' reported IT use and skills is that multiple generations are responding in a similar manner to IT improvements in the three "C" boxes (see Figure 6-2). Oblinger and Oblinger (2005) point out that technology use causes different generations to take on the characteristics of and share the expectations of the Net Generation. The operating factor may be experience. Older students may have firsthand experience with the educational practices of less than a decade ago and can appreciate the changes IT has enabled. For the younger student, much of this is probably "ho hum, why would you do it differently?"

How Do Students Describe Themselves in Our Survey?

The vast majority of the student respondents own at least one computer and a cell phone. They use these technologies daily for studying, social interaction, and entertainment. Students are increasingly mobile, using a combination of cell phone, laptop, and PDA, and about 25 percent have wireless adapters. Virtually all have Internet access, and the majority have broadband access. The students are comfortable using these technologies and rate themselves as skilled in their use. The majority of students perceive that they need no additional training to use these technologies.

Students expect a moderate use of IT in their courses, and they expect faculty to use it well. They give good grades to their instructors' skill in using IT in courses. They see technology's primary benefit in courses as convenience, followed by communications. It is also clear, as established in other studies, that social interactions are important to students.

Traditional students see IT in courses not as transformational but rather as supplemental. Students—for the present—prefer face-to-face interaction with their instructors and with other students. One respondent tells us, "Overall, I feel that using information technology could increase opportunities for classroom engagement and teacher-student accessibility. At the same time, though, it could become overwhelming and even distract from truly understanding a certain discipline or subject. Basically, as long as we stay in control of technology and use it with balance and thought, it will definitely be reliable and useful."

Overall, students' self-described IT skill levels in core activities like e-mail and word processing appear to change little throughout their college careers. Skills with applications such as spreadsheets, PowerPoint, and online library searches that are needed to satisfy course requirements, on the other hand, are subject to improvement.

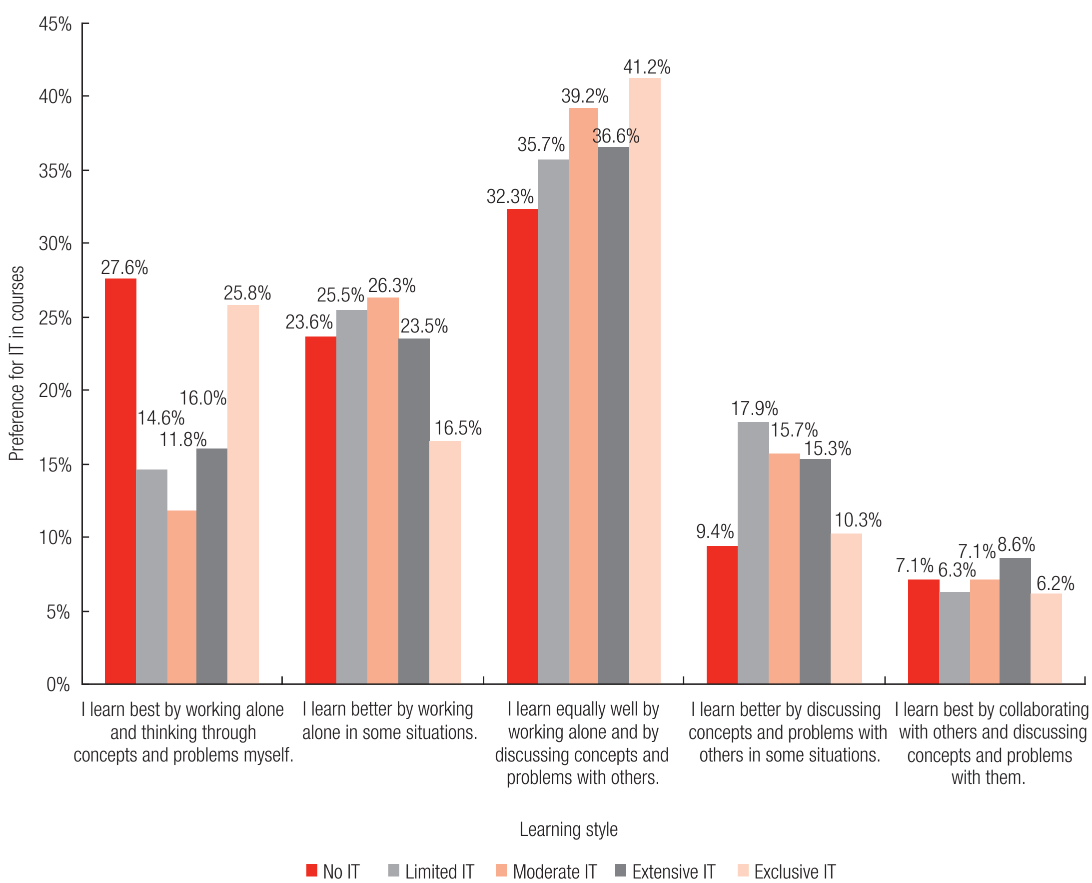
Students' preference for working in groups is only partially demonstrated. Asked in 2004 whether they preferred to study alone or in groups, they gave answers that were quite distributed (see Figure 6-3). And in general, the preference for solitary or team-based work did not correspond with a preference for use of technology in classes.

All students use IT for recreation, and this is especially true for younger students. The largest behavioral gap seems to be between those students below age 20 and those 20 and older who settle into their majors, have jobs, are increasingly concerned about getting good grades, and generally have less discretionary time than younger students.

Gender differences are small and declining, as are differences between engineering and business students and students in nonscience disciplines. The exceptions concern specialized applications such as spreadsheets and PowerPoint and computer maintenance, where engineering and science majors rate their skills much higher.

We observe Net Generation attributes more readily in nonacademic contexts

Figure 6-3. Impact of Learning Style on Preference for IT in Courses (2004)



than in the academic setting, even with enabling technologies readily accessible in both spheres. Technology use in classes is controlled and depends greatly on instructor preferences and skills. Course management systems, for example, which support new patterns of interaction, are faculty centric. The instructor determines the features that will be used.

Outside courses, students can use the Internet and devices to create social networks and do all kinds of things that they dream up. Most faculty don't understand or use social networking, blogging, and instant messaging. Transferring these activities into the academic setting does not yet appear to be widespread, as evidenced in the much lower student preference for online discussion groups in courses. New and potentially exciting patterns of IT-mediated social interaction likely occur, for the most part, outside of the formal academic setting. In his plenary address at the CUMREC conference on May 17, 2005, Maynard Webb, eBay's chief operating officer, urged the attendees to "Harness the energy that students are using for thefacebook.com for academic learning."

In the survey's open-ended comments and in the qualitative interviews, students provided us with additional insight.

Summary of Student Perspectives from Open-Ended Comments

Student responses to two open-ended survey questions provided us with 384 pag-

Table 6-5. Topics in Student Commentary on IT

Topic	Number of Coded Passages (rounded)
Learning experience	550
Online courses	450
Faculty comfort with or use of IT	410
CMS	380
Access	350
Like IT	260*
Dislike IT	80*
Problems (mixed)	320
Appropriate use of IT	300
Convenience	270
Inadequate technology	250
Laptops	230
Student comfort with or use of IT	220
Support services	200
Reliability problems	170
Survey suggestions	170

** Student likes or dislikes about IT account for a total of 340 coded passages.*

es of commentary about their experiences with IT at their institutions. Using a content analysis tool, we first identified the topics students discussed and then measured the extent of those discussions. The results indicate that students comment most often on their learning experience, online courses, and their perceptions of faculty comfort with or use of IT (see Table 6-5). The number in the table represents the approximate number of passages coded with the concept. Technical reliability problems are discussed less frequently. Some students also offer suggestions on how to improve the survey.

Often the topic discussed is placed in a broader context. For example:

- faculty comfort with or use of IT and a CMS (110 passages)
- faculty comfort with or use of IT and appropriate use of IT (100 passages)
- online courses and learning experience (130 passages)
- online courses and students' like or dislike of IT (80 passages)
- problems and support services (80 passages)
- problems and laptop (60 passages)
- online courses and appropriate use of IT (100 passages)
- online courses and access (80 passages)
- online courses and CMS (70 passages)
- learning experience and appropriate use of IT (100 passages)
- learning experience and convenience (60 passages)
- learning experience and faculty comfort with and use of IT (100 passages)
- learning experience and students' like or dislike of IT (100 passages)
- convenience and CMS (60 passages)

The comments are invaluable, as they provide extraordinary advice on how to most effectively use IT in support of the campus and learning experience.

Student Words of Wisdom and Recommendations

Between AD 700 and AD 900, the Vikings began to memorize, and later write for posterity, a collection of short poems of wisdom called Hávamál. The literal translation of Hávamál is "words of the high one" (Holm-Olsen, 1995).

What follows is the Net Generation's IT Hávamál—"the words of our students"—which gives us valuable insight into another foreign world. They can guide us on how to use technology in courses and how to clarify the support higher education needs to offer today's students. When they speak, higher education needs to listen.

Reviewing student commentary in response to open-ended questions and in the qualitative interviews gives us valuable insights into their experiences with IT. Many of these thoughts fit neatly into the categories of convenience, connection, control, and learning depicted in Figure 6-2. If student comments are acted upon, we believe that institutions will not only satisfy students' expectations but also come closer to providing a world-class undergraduate experience using IT.

Below, we summarize student comments and recommendations, placing them in the context of convenience, connection, control, and learning. We then list other items of interest that students brought to our attention. We urge readers to understand that while the factors of convenience, connection, control, and learning appear to be analytically meaningful, their definitional boundaries overlap. Facilitating access to grade or other faculty evaluation information, for example, both facilitates control and is a convenience.

Convenience

1. Convenience is highly valued, and institutions should continue to innovate and improve online services.

- "Information technology makes everything easier. I can submit my homework online, take quizzes and tests, download lecture PowerPoint slides, and get my grades and class information all online."

2. Students should have online access to all courses to determine whether they are interested in the course.

- "I like being able to view material from classes that I'm not taking so that I can decide if I'm interested in them."

3. Students want more access to wireless and faster technologies.

- "The network in the dorms is so slow it might as well be 28.8k dial-up."
- "There should be more wireless networks around the campus, and in-house wireless would be nice, too. The Internet connection should also be faster for a university."
- "Faster Internet, faster Internet, faster Internet!"

4. IT is expected to be reliable.

- "Server outage is a major problem on campus. The student service page is going down nightly and is especially bad."
- "A course management system is very useful, but there are frequent outages. This causes a real inconvenience when I need to complete an online quiz or submit assignments."
- "I like using technology for convenience purposes, but it is really inconvenient when it is down, which seems to come at important times when I need to read something for class or send a file to a teacher."
- "The most worries I have are when the network crashes and the system that the school wants us to depend on is completely useless for a day."

5. Reliability of IT in courses is important. Without it, IT becomes a distraction.

- "Technology is helpful to have as an option, but it would be foolish to base the bulk of the class on it. It seems that something always goes wrong when big projects are assigned on the computer. When I was assigned online homework problems for a chemistry course, half of my time was spent figuring out how I was supposed to type in my answer. This took time away from actually learning the material."

Connection

Today's students value electronic communication very highly. They use IM, e-mail, and cell phone communications extensively. Although it's perhaps a short-term fad, students are also beginning to use social networking software, which we'll discuss later in this chapter. Students appear to be reachable anytime and anywhere. They accomplish this with multiple devices and media that are personal (customizable) and portable. A challenge for institutions is to incorporate student communication skills, preferences, and habits more aggressively in the formal learning environment.

6. Communication, mobility, and ready access are valued.

- "In the classroom, it is nice to have a PowerPoint presentation of the day's lecture, so students are able to see the notes and are able to copy them. It is much easier to read, and it is nice to have when I have to give presentations in class. I have used IT a fair amount, using e-mail to communicate to other students in class, PowerPoint for presentations, and the library resources to do research for papers. The library Web site is great to find journals for research, and the electronic format is useful for transferring the information from school to home, where it can be printed at the person's convenience. The distance-learning class that I had was very useful for me, being able to e-mail my instructor my assignments when I had them done … at 2 p.m. in the afternoon or at 3 a.m. in the morning, whenever it was convenient for me. I didn't have to conform to someone else's schedule, which was convenient, since I had to take a lot of other classes and work as well throughout the year."

- "E-mailing with professors is a great piece of technology. Before, some people may have been afraid to talk to a professor one on one, but this feature allows for anyone to ask anything without feeling shy or afraid."

Control

Students value flexibility and the ability to manage their own course experience. Many comments focused on how IT in courses lets them manage their time, plan, and assess their performance and make corrections as needed. Related to control is the ability to customize hardware and applications.

7. Access to grades is very important.

- "I like having grades posted online so that I don't have to keep track of them myself. It is very convenient."
- "More classes should use the course management system as a way to show grades."

8. Faculty should keep grades and materials up-to-date online.

- "Oftentimes, instructors will begin to use the course management system, but will forget to post items or give up over the course of the semester. Also, instructors will require students to post items to the site but also require hard copies, not checking to see if the items were posted on time and not providing timely feedback. This makes use of the system for the purpose of handing in work frustrating and unsatisfactory."
- "It's frustrating when teachers say that students are able to track their grades on the course management system, but the teachers rarely update the course management system. It would be a lot easier if all teachers used the course management system and kept it updated."
- "Course management systems are very useful programs, but most of my professors have no idea how to use them properly and more importantly do not update them with current information, grades."

Learning

While students list learning as fourth among the primary benefits of IT in courses, they recognize that learning is an important contribution of IT. Note that convenience, connectedness, and control also support learning. In student commentary, the largest number of student observations and opinions concerned the learning experience. The learning benefits of IT are often attributed to faculty who take advantage of the students' ability to read visual images and to use multiple media. Students value instructors who pay particular attention to students' visual and spatial skills. Students also prefer inductive discovery and course exercises that are experiential and participatory and that foster real-time engagement with data and events.

9. Learning should be experiential, involving multiple senses.

- "I foresee the need to totally reengineer the classroom environment of the twenty-first century to maximize the benefits of the capabilities of IT to enhance the delivery of course content and ancillary materials like the syllabus and assignments. No longer is education merely the transfer of knowledge from a professor to a student, but it is about the total transfer experience using all of the senses to receive and to process information."

10. Learning should be interactive with the instructor, with immediate feedback.

- "I am taking a course right now that sometimes holds virtual classes where we are divided into small groups and within our groups use chat rooms to complete group assignments and interact with the professor with anonymous user names. This is one of the coolest things I have done in any class the entire time I have been in college. The best uses of technology, I believe, are either as a means to extend the classroom beyond brick-and-mortar or to make that classroom less boring."
- "I have also had a class that used a portable-type computer thing that a teacher could use in class. He would display mock tests, and the class would push in which multiple-choice answer they believed it was. The teacher would see a display stating what percent[age] guessed each answer so he could explain things the class didn't understand and see what material he needed to 'better' his teaching of."

11. Learning should be supported with visual tools.

- "My instructors overlook many advantages of computers. They can better convey concepts with animation, pictures, and diagrams using Flash or PowerPoint."

12. IT supports learning when online resources in support of research are available and can be used both in courses and for personal interests.

- "Part of what I see as the benefit of going to an information-technology-rich university is access to technologies that I can use outside of my coursework. I use the resources available to do a lot of personal research into subjects that I have interest in though not necessarily part of my coursework. This makes me a more informed student who can use this access to make abstract connections in varying concepts and thereby better improve my learning. However, I do not believe this is the norm."

13. Students value using real-time data.

- "Having computers incorporated into our classes makes the learning environment more interesting. It helps greatly when we need up-to-date information instantly for class discussions."

14. Social interaction is important. Used poorly, IT can erode social interaction.

- "Sometimes the convenience of the computer makes students' work more individualized. In other words, classmates and other people become less socialized because of easiness of working online or through a Web site."
- "IT limits social interaction. For instance, I completed a whole group project without ever seeing my group members (we communicated solely through e-mail). I think that was great for my technological skills, but it hurts my developing certain personal social skills. I think sometimes the 'technological push' is taken too far. I'm sure I could learn just as well without certain devices."
- "I think we're at a point where we've all come to depend on IT in order to get a large portion of our work done. While I think it's important that students are given at least minimal instruction to make sure they can navigate technological resources when necessary, I also believe that such skills are being acquired at the loss of others. Making phone calls is uncomfort-

able for many people because we rely on e-mails for almost everything, which, in turn, can impact negatively social skills. I think it's just as important to make sure each generation isn't losing these basic skills at the same time that they are mastering machines."

15. For online discussions to work, a clear purpose that is understood by both students and faculty must be articulated.

- "I have been in classes that made excellent use of the online discussion tool, in which this was perhaps the most fruitful part of the class. However, I have also been in classes where this tool was not well integrated, or explained, and the online discussions were inane. Like any pedagogic tool, I believe that students and professors need to understand and agree upon the purpose of online discussion boards for them to be effective."

16. Online testing needs improvement.

- "Online tests suck, especially when you cannot go back and fix something!"
- "I don't think it [the online exam] can take the place of certain hard-copy tests in physics or chemistry, which require extensive calculations for an answer. The multiple-choice format is inappropriate for this venue. But for many classes it's fine and can really help with graphic presentations."
- "The class had a lot of math to do and it was hard to display the correct symbols, not to mention the fact that you can't show your work so there is no partial credit or any way to see what you did was wrong."

Other Student Insights and Recommendations

17. Many students believe that faculty members need to use IT better than they currently do. If true, more training is needed. More research is needed to establish the accuracy of these perceptions and whether these perceptions reflect faculty IT skills, IT support and technology quality, faculty teaching skills, or even classroom demeanor.

- "The use of information technology always sounds great in theory, but it is oftentimes difficult to put into effect. Instructors are poorly trained and usually have no idea what they are doing. There have been cases where the use of a DVD player is beyond the skills of the people who are supposed to be teaching me. In reality, there is nothing wrong with this. Instructors don't need to be forced to use information technology. There is nothing wrong with lectures and notes. Information technology is not 'magic.' Using it and talking about it won't make students smarter through some miraculous fashion."
- "Teachers need to be better trained in the technology because many are having trouble in class using it and it takes away class time."
- "I think adequate technology is provided in classrooms. However, I think the teachers are unprepared to operate equipment, including computers, projectors, DVD equipment, and document displayers. We spend more time in class trying to turn the equipment on and getting it to 'cooperate' with the teacher than we do in lecture time. Professors should have classes available to them on how to prepare PowerPoint presentations, how to use classroom equipment, and how to access and navigate the course management system."
- "Train the trainers how to use the system first, standardize its use in the classroom and on campus, and then deliver it to the students. If the instructors don't believe in it and won't use it, how can one expect the students to embrace the technology?"

18. The faculty's use of PowerPoint needs to improve. Students like it when it is used well.

- "The effective use of PowerPoint slide presentations is the most useful IT innovation in education in the past 10 years, as long as the students are encouraged to download and print out the slides beforehand so that they can follow along and take notes in conjunction with each slide, rather than furiously trying to copy verbatim what instructors are writing on the black/whiteboard and then trying to sort out afterwards what is important and what's not, without the benefit of the associated commentary (since all they managed to get written down was the stuff on the board, which more often than not is an outline rather than real substance)."
- "Some instructors that use PowerPoint are just reading off of pre-made slides, and it doesn't appear that the instructor made them himself."
- "PowerPoint is the single greatest tragedy in the world of information technology. Nothing can turn a room full of students into a cow pasture at a greater rate of speed."

19. Students need more training.

- "Many people assume that in the age of computers and technology we are currently in, everyone understands computers. This includes maintaining computers as well as computer jargon. The fact is, many students occupy their lives with other things, and computers are used only for limited research, e-mail, and entertainment. As communication, sales, and other aspects of life become even more dependent, it's very important that schools begin to educate students about computer maintenance and terminology. This common knowledge will most definitely benefit everyone, and it will keep people from using computer failures as an excuse for not turning in assignments."
- "Knowledge of technology was always assumed in any classes I took. Never was I informed of the need to know a technology before I signed up for a class. I usually learned quickly, but perhaps more education on what technologies are available and how to use them would be appropriate."
- "It can never be assumed that someone knows how to use technology, because a lot of people do not."

20. Older students need special accommodation and training.

- "My age is a big factor that differentiates me (and my IT skills) from my classmates. More resources for 'reentry' students would be great."
- "It would have been helpful if there had been some explanation on how to use technology. A lot of the older students absolutely hate it because they have had to figure it out on their own through trial and error."
- "Information technology is the wave of the future. Since I am 48 years old and had no prior knowledge of computers until coming back to school, I feel that I have increased my knowledge a hundredfold in trying to keep up with the younger students in my classes."

21. Support services are important and need improvement.

- "One of the primary concerns on campus surrounding technology is the inadequate ability of the technical support office to provide prompt and effective service. Frequently students go without their laptops for days and are unable to fulfill course requirements. The removal of computer labs on campus has made overcoming such issues much more difficult."

- "I wish we had more people on campus that knew a lot about computers and could help diagnose problems with the computers and offer assistance. It would also be nice to have people available who can help with specific programs such as Excel or Photoshop if students are required to use them for class but have no previous experience, instead of a class setting to briefly teach the programs."
- "I find the people exceptionally hard to work with at the IT help desk. They have never helped me with a problem and have always given me the runaround. I do not feel as if I am getting my money's worth out of that department."
- "I believe that the IT support on my campus needs more people skills, because I have contacted them several times about a problem and they had different answers to the same problem while talking to three different people. They are very disorganized, and I have had several problems with their attitudes."

22. Courses that require technology improve computer skills.

- "My print and electronic media design class was an online course that required us to self-teach and hand in projects using Photoshop, Dreamweaver, and Quark. The extent of what we learned was ultimately up to us, but posting critiques with blogs was helpful, and we learned a lot."

23. IT should be supplemental to the course.

- "From my experience, classroom IT works best as a supplement but generally doesn't work as a replacement for existing learning systems. For example, being able to check grades online is very convenient, but taking quizzes online is frustrating and more stressful than regular quizzes. Much of this depends on the instructor's use of these resources, though. I have had both positive and negative experiences."
- "I think technology is important and can provide graphical illustrations of concepts, which improve learning. However, courses that are entirely computer based suck at the soul. Use technology to provide the framework for a class, not as the mandatory core of a class, unless it is a computer class."
- "I enjoy using information technologies to enhance my education experience, but I do not think that instructors use the technologies to their potential. I think there is an over reliance on PowerPoint presentations that replaces the classroom interactions I expect from university instructors. It is wonderful to have in-class presentations available online, but I think overuse of technology becomes a crutch and overshadows the quality of face-to-face interaction. I prefer that the information technology complement class activities and lectures rather than supplement them."

24. Computers brought to class can distract students from participating in the course.

- "What I find disturbing is watching students' eyes glued to computer screens instead of interacting with the professor and the other students. I have read of professors' complaints at other schools that students bringing computers to class end up spending half their time IM'ing friends or playing games instead of paying attention in class."

25. Faculty should evaluate the potential of technologies such as IM, blogs, and social software in teaching and learning. And they should involve students in the design process.

Social Software

As outlined earlier, "'Net Gen' students are digital, always connected, experiential, want immediacy, and are social," explains Diana Oblinger. "Technology by itself does not dazzle this generation. They are interested in function and activity. They also love customizable learning experiences" (Oblinger & Oblinger, 2005). It is not surprising, then, that IT-enabled social networking has caught on with many students. One Web site, thefacebook.com, for example, offers students fully connected and immediate social gratification. They can customize the experience by how they set up their personal profile, the groups they set up, and the groups they join.

In the very first qualitative interview for this study, a University of Wisconsin–Madison engineering student told us, "You have to check out thefacebook.com! It is really great." Two weeks later, undergraduate students at Colgate University echoed the enthusiasm of University of Wisconsin–Madison students: "We use it a lot. Lots of our friends use it too. We spend hours interacting with our friends. It's great!" One student, in the open-ended comments, notes, "Although there was no mention of it in the survey and it is a relatively new tool, thefacebook.com has recently become a tool used for communicating with fellow students, faculty/staff, and administrators, and its value should not be overlooked."

The site's common appeal is social. It is a social networking site specifically targeted for college students. When we asked students what the attraction to thefacebook.com site was, one University of Wisconsin–Madison mechanical engineering student said, "Of course, I'm on it [thefacebook.com]. It's a great way to search and find people in my class." One University of Wisconsin–Milwaukee senior said, "It's like 'crack'—it's that addictive!" Some referred to it humorously as "stalker.com," since it was so easy to find people and learn all about them. One University of Wisconsin–Milwaukee male undergraduate thought it was great. "It's wonderful," he reported. "I got a date because of it!"

Despite student enthusiasm for the Web site, one university has had serious second thoughts about its use. Dominican University recently blocked access to thefacebook.com via any computer connected to its network. Reasons given were that some students felt they were allegedly stalked by other members of the university community, and the university feared that it could somehow be liable if a criminal situation arose and the university had done nothing to prevent such easy access to information about the students involved.

When we interviewed students about social software use, some University of Wisconsin–Madison students called our attention to blogs. One French major who spent a semester abroad in France used a blog as a means to communicate with his family and friends about his daily experiences. While he does not use the blog anymore, he's pleased that it is available as an online history of his trip. Another junior states, "One of my friends encouraged me to create a blog as a mechanism to express myself. I blog every day. I blog more on a 'bad' day, telling the world that I'm depressed and sharing my moods with everyone. In fact, on a bad day I may be online all day! I use it to express my internal conflicts. It is a way to connect with other people without having to look them in the eye." Many of these students indicate that they started blogging in high school.

Most blogging Web sites allow bloggers to select who can see their blog. Often the blog can be limited to certain individuals, and locks can be placed on the blog entries. Most often, however, the students interviewed indicate that their blogs are open to the world. When asked about protecting their privacy, they indicate that if they have the blog open to everyone, they use a special online name and not their given name.

One of the interesting findings from the conversation about blogging is that all the students indicate that writing entries into their blog improves their writing skills. They admit that they write without appropriate punctuation and spelling, but the key advantage is that writing for the blog encourages the development of their own writing styles.

Students also report use of blogs in their courses. They have mixed experiences with it. One student reports using a blog in an English class. He notes, "I liked having the blogging forum for literary analysis. It led to a robust online discussion." Another student says, "There was blogging in my literature class. But it was poorly set up. We were supposed to respond to a question each week. Our messages got a time stamp. It wasn't useful because we were all doing it at the last minute and not having a discussion at all."

In addition to blogs, other social software has potential value in courses. Ann Marie Johnson, instructional developer at the University of Wisconsin–Oshkosh, comments on the potential of bookmarking, or tags, for searching: "Students know how to do general searches but not effective searching. If their first search doesn't work, they don't know what to do next. For instance, they don't know about advanced searching." Although these tags are not indexed into a formal taxonomy, placing Web search results into social public bookmarks or other shared tags offers the potential for organization-by-the-masses to create a robust reference for online materials. So, perhaps students don't need advanced Web search skills; teaching them how to use social software, which they are already attracted to, will provide the facilities they need to obtain required academic materials.

Summary

We believe many of the student comments can prove useful for developing a profile of an exemplary undergraduate IT experience. An exemplary experience is responsive to student expectations in promoting convenience, connection, control, and learning and in other areas identified in this chapter. To a large degree, the 2005 ECAR data suggest that higher education continues to make progress with convenience and connection and, to a lesser extent, with control. IT in direct support of learning shows promise but remains a work in progress and needs more research in various forms.

Listening to our students and paying attention to this study's findings, we see six areas that institutions must concentrate on:

- integrating IT into the curriculum,
- defining of IT skills,
- training for students and faculty,
- fostering a common environment and approach (consistent implementation),
- providing reliable IT service and support, and
- monitoring and benchmarking these activities.

Importance of the Curriculum

A major finding of the 2004 and 2005 ECAR studies on student technology use is that students with the highest IT skill levels acquired many of these skills as a result of curricular requirements. In the absence of curricular requirements, students are more likely to graduate without some of the IT skills they may need for employment. Many curricula are becoming increasingly IT intensive as professional societies and government redefine competencies required of some professions. For example, in medicine, the Institute of Medicine recently defined competencies in five areas:

- provision of patient-centered care,
- ability to work in interdisciplinary teams,
- employment of evidence-based practice,
- application of quality improvement, and
- utilization of informatics.

Several of these expected competencies will be technology intensive. Such mandates will likely lead to pressures and even requirements to develop clear and explicit policies on the role of IT in courses and in the curriculum. Student and faculty information literacy will increase, and academic standards of research and evidence in Web-dominated (and successor) information environments will emerge.

Of particular interest is the increasing emphasis on informatics, which is defined as the systematic application of information and computer science and technology to practice, research, and learning. Informatics, where required, and the use of appropriate technologies will likely become firmly embedded in the future curricula of the colleges and departments. Concomitantly, we will likely witness the growing need for ever more rigorous and comprehensive IT literacy, training, and support programs, which will ensure the effective use of these technologies.

Definition of IT Skills Needed for Learning

The 2005 ECAR student data suggest to us that student skill levels with various computer applications vary widely. Educators will find it desirable and likely necessary to define and establish a set of IT competency requirements. To make this possible, we need to have a widely shared understanding of

- what information technologies we want to use in courses and in the curriculum,
- at what level of sophistication these technologies should be used, and
- for what purposes these technologies should be employed.

Academic leaders across a broad spectrum of disciplines should discuss what competencies are required in the areas of informatics, simulation, and visualization. What level of digital literacy or fluency is required to find, retrieve, assess, and manage digital information? What is the nature of evidence in the digital context? And how skilled with IT and mobile devices must students be, especially as they enter the workforce?

Recognizing this need, we believe it is essential to reinforce the instrumental nature of IT in the learning process. Progress in socializing (and improving) the instruments of learning will surely make a difference, but the limits of this contribution will likely lie less in the instruments than in the pedagogy into which they have been situated.

Comprehensive Training

Once we have agreed upon the required level of skills, we can design training programs for faculty and students. Students expect their faculty to be skilled in the use of PowerPoint and course management systems. Even more, students want faculty who know how to teach! We believe many students are looking for more innovative uses of information technologies that provide them with real-time data in experiential learning exercises, more compelling visual materials, and the capacity to develop, test, and run models or to perform simulation. Digerati, of course, anticipate a time when the video game genre will add a new dimension to the educational landscape.

We cannot assume that the students are prepared to take advantage of these technologies in the absence of planned, systematic, and just-in-time training that is based on a recognized level of required skills. Students need to learn how to learn with the new technologies. Training must be deliberate and continuous. Just as books supplanted oral learning traditions and our textual practices have evolved over the course of 550 years, digital arts, communications, and practices—including digital learning—will take years and care to socialize.

Institutions should require all of their colleges to articulate concrete IT competencies for students in their programs. Once these competencies are articulated and compiled, a work plan can be developed to achieve the proposed competency levels through courses, curriculum changes, help centers, and so forth.

It would be useful to articulate desired faculty competency as well, although we recognize that this may be more difficult to do and harder to implement. Articulating student competencies will probably guide the articulation of faculty members' required competencies, as the one will likely have to complement the other in a sensible work plan.

Common Environment and Approach (Consistent Implementation)

Students are looking for more consistency of both the information technologies in use and how they are used and supported. We found in the qualitative and quantitative data an abundance of issues related to uneven CMS availability, faculty's inconsistent CMS use, technical reliability, and variable levels and quality of support. Students clearly want more of their classes to use course management systems and for faculty to use them in a consistent (and effective) manner so that courses across the institution have a common appearance. We suspect that students' concern for commonality and consistency extends into departmental and collegiate Web sites, and IT use in general, which often vary considerably.

IT Services and Support

In their survey responses and in interviews, students directly state that they need IT services that are fast, easy to use, and reliable. Without basic reliability, the students feel they can't count on the technologies when they need them the most—for submitting papers to their instructors, for taking online exams, and for communicating with instructors and classmates. They express frustration when networks or servers are down, technical support is unavailable, or the technology gets in the way of completing their required coursework. Without a core set of dependable IT systems and services, students and instructors alike will not fully adopt technologies to enhance the learning environment.

Monitoring, Measuring, and the Importance of Data

Most ECAR studies confirm that higher education does not benchmark widely or well. As a metaobservation, the 2004 and 2005 ECAR student technology studies confirm that we need to establish norms and measure student and faculty competencies, preferences, attitudes toward IT use in courses, and how students and faculty actually use IT. We need such measures as part of a toolkit to assess technology use and the performance of training programs. This prescription is extraordinarily complex, as it intersects directly with the many issues surrounding the assessment of learning outcomes. Data of this kind are clearly necessary, though not sufficient.

Next Steps

ECAR plans to repeat this study in 2006, providing a third snapshot in time and making possible an assessment of trends and rates of change in IT use, satisfaction with IT, and IT's impact, especially on learning. We will also collect institutional data on IT use in the curriculum, whether IT skills have been identified and defined, the quality and breadth of training programs, standardization, and benchmarking. It will be interesting to see whether students at institutions that have adopted policies and practices in these areas show increased use of and self-reported skill with information technologies in courses, and whether they perceive that they learn more as a result.

Appendix A

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Appendix B

Acknowledgments

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Sacher, Dick – University of Delaware
Sargeant, Donald – University of Minnesota, Crookston
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Schaeffer, James – University of North Dakota
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Unger, Beth – Kansas State University
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Wilhelm, Thomas – Wayne State University
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Appendix C

Student Information Technology Use and Skills in Higher Education: 2005 Survey Questionnaire

Thank you for your willingness to answer this survey, which focuses on your experiences with and opinions about information technology. The information you and other undergraduate students provide will be reported in a national study that will be available to higher education institutions. We will also make available to your school's leaders data that you and your classmates give us about your school. The primary goal of the study is to better understand student experiences with information technology, which, in turn, can help your school's leadership to respond to your IT needs.

Your answers are confidential, and neither your school nor the EDUCAUSE Center for Applied Research will be able to identify you.

For the purposes of this survey, information technology refers to "personal electronic devices such as laptops and handheld computers, cell phones, and your institution's computers and associated devices."

Please submit your survey responses as soon as possible within the next two weeks. It should take you approximately 15 minutes to complete the survey. If permitted by your state law, each participant who provides an e-mail address may be entered in a drawing for one of a hundred $50 gift certificates.

We appreciate your time and participation. If you have any questions or concerns, please contact the campus representative specified in the e-mail you were sent.

Click the Next button to begin the survey. Once again, thank you for your assistance!

Section 1. About You

We may only survey students age 18 or older.

1.1 I am 18 years old or older. [Required] <If no, go to end of questionnaire. If yes, go to 1.2>

○ No
○ Yes

I give my consent to the following.

For this survey you were selected at random from a list of freshmen and seniors at your institution. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

Sponsored by the EDUCAUSE Center for Applied Research, this study is being conducted by Dr. Robert Kvavik of the University of Minnesota and Judy Caruso of the University of Wisconsin–Madison.

Background Information

If you agree to be in this study, please complete and submit the following survey. The survey asks for basic background information and questions you about:

- What kinds of information technologies you use and how often.
- What your level of skill is at using different information technologies.
- How these technologies contribute to your undergraduate experience.
- What value information technologies provide in teaching and learning in higher education.

It will take about 15 minutes to complete the survey. Please answer the questions to the best of your ability. There is no right or wrong answer. You only need to fill out the survey once.

Risks and Benefits of Being in the Study

There are no physical, psychological, social, or medical risks associated with your participation in this study. The benefit of your participation is to inform school officials of the benefits of their technology investments for students.

Compensation

We will hold a raffle for gift certificates of $50 from Amazon.com for participating in this survey. If you choose to participate in the raffle, you must include an e-mail address in the space provided at the beginning of the survey. Once the survey has closed, we will conduct a random drawing from the e-mail addresses of all those who participated within two weeks of the closing of the survey, where permitted by state law. Based upon last year's response rate, your chance of winning is estimated to be approximately 1 in 168.

Your e-mail address will be kept separately from the data collected in the survey. It will not be used to connect your survey responses with your name, nor will it be used for any purpose other than to contact you should you win the prize.

Confidentiality

The records of this study will be kept private. In any report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only researchers will have access to the records.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with your institution, with any of the institutions participating in this survey, or with EDUCAUSE. If you decide to participate, you are free not to answer any non-required question or withdraw at any time without affecting those relationships.

Contacts and Questions

You may direct any questions to the researchers conducting this study:
Robert Kvavik, 612-625-2400, kvavik@umn.edu
and Judy Caruso, 608-263-7318, judy.caruso@doit.wisc.edu

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), contact the Research Subjects' Advocate line, D528 Mayo, 420 Delaware St. SE, Minneapolis, MN 55455, (612) 625-1650.

If you wish to print a copy of the survey before completing it online, a PDF version is available from the link in the header. Once you complete and submit the survey by clicking the Finish button, a summary of your responses will be displayed with the option to print and/or save them.

Statement of Consent

1.2 I have read the above information and have had the opportunity to ask questions and receive answers. I consent to participate in the study. [Required] <If no, go to end of questionnaire. If yes, go to 1.3>

○ No
○ Yes

1.3 If you are interested in entering the drawing for a $50 gift certificate, please enter your e-mail address. [paragraph memo field]

Section 2. Your Use of Electronic Devices

2.1_2.7 Which of the following electronic devices do you own? Check all that apply.

☐ 2.1 Personal desktop computer
☐ 2.2 Personal laptop computer
☐ 2.3 Personal digital assistant (PDA), e.g., Palm device
☐ 2.4 Smart phone (combination cell phone and PDA device)
☐ 2.5 Cell or digital phone
☐ 2.6 Electronic music device, e.g., iPod
☐ 2.7 Wireless adapter

2.8 Excluding your use of cell phones, how many hours each week do you normally spend using an electronic device (computer, Palm device, etc.)?

○ Do not use
○ Less than an hour
○ 1–2 hours
○ 3–5 hours
○ 6–10 hours
○ 11–15 hours
○ 16–20 hours
○ More than 20 hours

2.9_2.19 How many hours each week do you normally spend on each of the following activities using an electronic device (computer, Palm device, etc.)? (Do not use, Less than an hour, 1–2 hours, 3–5 hours, 6–10 hours, 11–15 hours, 16–20 hours, More than 20 hours)

2.9 Classroom activities and studying using an electronic device
2.10 Using a library resource to complete a course assignment (e.g., a library resource on your official school library Web site)
2.11 Surfing the Internet for information to support your coursework
2.12 Writing documents for your coursework
2.13 Creating, reading, sending e-mail
2.14 Creating, reading, sending instant messages
2.15 Writing documents for pleasure
2.16 Playing computer games
2.17 Downloading or listening to music or videos/DVDs
2.18 Surfing the Internet for pleasure
2.19 Online shopping

2.20_2.25 How many hours each week do you normally spend on each of the following activities using an electronic device (computer, Palm device, etc.)? (Do not use, Less than an hour, 1–2 hours, 3–5 hours, 6–10 hours, 11–15 hours, 16–20 hours, More than 20 hours)

2.20 Creating spreadsheets or charts (Excel, etc.)
2.21 Creating presentations (PowerPoint, etc.)
2.22 Creating graphics (Photoshop, Flash, etc.)
2.23 Creating and editing video/audio (Director, iMovie, etc.)
2.24 Creating Web pages (Dreamweaver, FrontPage, etc.)

2.25 Completing a learning activity or accessing information for a course using course management systems (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, etc.)

2.26_2.36 What is your skill level using the following computer technologies and applications? (Do not use, Very unskilled, Unskilled, Skilled, Very skilled) *(Very unskilled=have not used the software; Unskilled=have used the software but not regularly; Skilled=full use of basic features but not advanced features; Very skilled=ability to use advanced features, link the software with other software, troubleshoot problems, and upgrade/patch the software).*

2.26 Word processing (Word, etc.)
2.27 Spreadsheets (Excel, etc.)
2.28 Presentation software (PowerPoint, etc.)
2.29 Graphics (Photoshop, Flash, etc.)
2.30 Creating and editing video/audio (Director, iMovie, etc.)
2.31 Creating Web pages (Dreamweaver, FrontPage, etc.)
2.32 Course management systems (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass etc.)
2.33 Online library resources

2.34 Computer operating systems (Windows, OSX, etc.)
2.35 Computer maintenance
2.36 Securing your electronic device (firewalls, antivirus software, etc.)

2.37 **How would you rate your information technology skills compared to other students' skills on your campus?**
- ○ Much less skilled
- ○ Less skilled
- ○ About the same skill level
- ○ More skilled
- ○ Much more skilled

2.38_2.42 Why did you learn the following computer technologies and applications? (Do not use, To improve my course performance, Class or major requirement, Campus requirement, Required for student organization activities, Personal interest, Employment, Other)
2.38 Spreadsheets (Excel, etc.)
2.39 Presentation software (PowerPoint, etc.)
2.40 Graphics (Photoshop, Flash, etc.)
2.41 Creating and editing video/audio (Director, iMovie, etc.)
2.42 Creating Web pages (Dreamweaver, FrontPage, etc.)

2.43 **During the academic year, what is your most frequently used method for access to the Internet?**
- ○ Commercial dial-up modem service (e.g., AOL, EarthLink, etc.)
- ○ School-operated dial-up modem service
- ○ Commercial broadband service (e.g., DSL modem, cable modem, etc.)
- ○ School-operated wired broadband service
- ○ Commercial wireless network
- ○ School-operated wireless network

2.44_2.50 Which of the following concern you regarding information technology? (Not a concern, Small concern, Significant concern, Major concern)
2.44 Inadequate access to printing
2.45 The age of my computer hardware and software
2.46 Slow or inadequate network access
2.47 My technical skill level in troubleshooting my computer
2.48 Computer viruses, worms, or Trojan horses
2.49 Spam
2.50 Inadequate technical assistance and help available to me on my campus

Section 3. Your Use of Technology in Courses

3.1 Which of the following best describes your preference with regard to the use of technology in your courses?

- ○ I prefer taking courses that use *no* information technology.
- ○ I prefer taking courses that use *limited* technology features (e.g., e-mail to instructors and limited use of PowerPoint in class).
- ○ I prefer taking courses that use a *moderate* level of technology (e.g., e-mail, several PowerPoint presentations, some online activities or content).
- ○ I prefer taking courses that use technology *extensively* (e.g., class lecture notes online, computer simulations, PowerPoint presentations, streaming video or audio, etc.).
- ○ I prefer taking courses that use technology *exclusively* (i.e., are entirely online with no required face-to-face interactions).

3.2_3.6 To what extent does each of the following describe your experiences in your courses? (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)

3.2 I am more engaged in courses that require me to use technology.

3.3 Overall, my instructors use information technology well in my courses.

3.4 The instructors' use of technology in my courses has increased my interest in the subject matter.

3.5 I primarily use information technology in courses to improve the presentation of my work.

3.6 My school needs to give me more training on the information technology that I am required to use in my courses.

3.7_3.11 To what extent has the use of information technology in courses helped you? (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)

3.7 The use of information technology in courses has helped me better understand complex or abstract concepts.

3.8 The use of information technology in courses has helped me better communicate with my instructors.

3.9 The use of information technology in courses has helped me better communicate and collaborate with my classmates.

3.10 The use of information technology in courses has resulted in prompt feedback from my instructors.

3.11 Courses that use information technology allow me to take greater control of my course activities (e.g., planning, apportioning time, noting success and failure).

3.12 Have you taken a class that used a course management system (e.g., ANGEL, WebCT, Blackboard, Desire2Learn, or FirstClass)? [Required] <If no, go to 3.23. If yes, go to 3.13>

- ○ No
- ○ Yes

3.13 How would you describe your own overall experience using a course management system?

○ Very negative
○ Negative
○ Neutral
○ Positive
○ Very positive

3.14_3.22 How valuable did you find the following course management system features? (Did not use, Not valuable, Valuable, Very valuable)

3.14 Syllabus
3.15 Online readings and links to other text-based course materials
3.16 Online discussion board (posting comments, questions, and responses)
3.17 Access to sample exams and quizzes for learning purposes
3.18 Taking exams and quizzes online for grading purposes
3.19 Turning in assignments online
3.20 Getting assignments back from instructors with comments and grades
3.21 Sharing materials among students
3.22 Keeping track of grades on assignments and tests

3.23_3.24 Which of the following benefits from using information technology in your courses was the most valuable to you?

○ Improved my learning
○ Convenience
○ Helped me manage my course activities (e.g., planning, apportioning time, noting success and failure)
○ Helped me communicate with my classmates and instructors
○ No benefits
○ Other
☐ 3.24 Please describe (optional)

3.25 The use of information technology in my courses has improved my learning.

○ Strongly disagree
○ Disagree
○ Neutral
○ Agree
○ Strongly agree

3.26 Do you normally bring your laptop to class?

○ No
○ Yes

Section 4. Information About You

4.1 What is your gender?

- ○ Male
- ○ Female

4.2 What is your age?

○ 18	○ 24	○ 30–39
○ 19	○ 25	○ 40–49
○ 20	○ 26	○ 50–59
○ 21	○ 27	○ 60–69
○ 22	○ 28	○ 70 or over
○ 23	○ 29	○ Decline to answer

4.3 What is your cumulative grade point average (GPA)?

○ Under 2.00	○ 3.25–3.49
○ 2.0–2.24	○ 3.50–3.74
○ 2.25–2.49	○ 3.75–4.00
○ 2.5–2.99	○ Don't know
○ 3.00–3.24	

4.4 Are you a senior or freshman? [Required]

- ○ Senior
- ○ Freshman

4.5 Are you a full-time or part-time student? [Part time is fewer than 12 credit hours per semester/quarter]

- ○ Full time
- ○ Part time

4.6 Do you reside on campus or off campus?

- ○ On campus
- ○ Off campus

4.7 _4.16 What disciplines are you majoring in? Check all that apply.

- ☐ 4.7 Social sciences
- ☐ 4.8 Humanities
- ☐ 4.9 Fine arts
- ☐ 4.10 Life sciences, including agriculture and health sciences
- ☐ 4.11 Physical sciences
- ☐ 4.12 Education, including physical education
- ☐ 4.13 Engineering
- ☐ 4.14 Business
- ☐ 4.15 Other
- ☐ 4.16 Undecided

4.17 Which institution are you attending? [Required]
Before proceeding, please confirm that the name of your institution appears in box 4.17.

4.18 If you have any other comments or insights about your information technology use and skills, please feel free to share them with us below. [Paragraph field]

Section 5. Thank You

You have reached the end of the survey. Thank you! Please submit the survey by clicking the Finish button. After clicking Finish, a summary of your responses will be displayed with the option to print and/or save them. Please click the Finish button now.

– END SURVEY –

Appendix D

Qualitative Interview Questions

Questions for Student Focus Groups

1. Background

1.1 Student information: age, gender, senior/freshman, full/part-time, on/off campus, discipline, ethnic

1.2 How many computers do you own? What kinds? How long have you owned them?

2. Skill and use

2.1 How skilled are you at using computer technology to do work required for your classes?

2.2 There is a lot being said and written about the current generation of students being good at using technology and as being tech savvy. Do you think this statement is true of yourself? Of your friends?

2.3 What kinds of technology skills are you good at? (Last year's students reported being good at communications and Web surfing but less skilled at things like creating Web pages, graphics, video.)

2.4 What kinds of technology skills are you bad at?

2.5 What kinds of technology skills do they think students in general are bad at?

2.6 How good do you think students are at dealing with changes in technology (e.g., when you get a new course management system such as WebCT or Learn@UW) or a new set of programs or when what you are used to using isn't available?

2.7 Do you use computers and the Internet for entertainment? If so, what kinds of activities do you do for entertainment?

2.8 What impact do you think a student's major has on their use and skills with technology?

3. Your use of technology in courses

3.1 Do you think that the skills you may acquire in using the Internet for entertainment transfer to your school work? If so, what are the components of those skills? If not, why not?

3.2 What kinds of uses of technology have instructors made in the courses you have taken thus far?

3.3 What are the major advantages that you see in the use of technology in your courses?

3.4 What is the major disadvantage that you see in the use of technology in your courses?

3.5 Do you think that the use of technology in your courses helped you in your learning?

3.5.1 If so, how?

3.5.2 If not, why not?

3.6 Do you think that in general your instructors are skilled in the use of technology in teaching?

3.7 What are the major obstacles that you see to more effective use of computer and information technology in your courses?

3.8 One of the findings of last year's study was that students indicated that technology in their classes was about convenience and communication and control of the learning experience. While improved learning was also mentioned, it seemed to play a lesser role. Can you please comment on this?

3.9 If there was one thing your professors could do and not do with respect to technology in your course, what would it be?

4. Future

4.1 What advice would you give university administrators who are keen to encourage the effective use of technology in college courses? What sorts of things should they be doing?

5. Other

Questions for Administrator Interviews

1. Background

Names/e-mail addresses

1.1 What is your role in supporting/training students?

1.2 What kinds of contact do you have with students helping them with technology issues?

2. Student Technology Skills and Use

2.1 What do you think of the current state of student technology skills? Do you think students tend to be skilled in using technology or not?

2.2 What do you think is the breakdown from Highly Skilled, Average, and Poor to Very Poor skills among undergraduates?

2.3 What kinds of technology skills do you think students are good at?

2.4 What kinds of technology skills do you think students are bad at?

2.5 What impact do you think a student's major has on their use and skills?

3. Student Technology Use in Courses

3.1 Do you think their entertainment skills transfer over to the academic realm?

3.1.1 If so how?

3.1.2 If not, why not?

3.2 Do you think that most students find the use of technology helpful in their courses?

3.2.1 If so how?

a. Presenting complex information in visual/graphic format
b. Helping organize or manage information
c. Encouraging or requiring them to spend more time engaging with the course materials
d. Communicating with the instructor
e. Communicating or collaborating with their classmates
f. Because it makes learning more active (through use of simulations or animations)
g. Because it encourages prompt feedback from the instructor and provides a way for the instructor to provide them with more feedback
h. Because it allows the student to participate more fully in class activities
i. Because it enables them to take practice exams and quizzes and get feedback on their progress
j. Other (please describe)

(In last year's study, students indicated that they primarily used technology in classes for convenience, control of their activities, and communication. Increased learning was also reported at a lower level. What do you think of this finding? Does it fit with your experience?)

3.2.2 If not, why not?

3.3 Do you have any specific examples/experiences with student use of information technology that you thought were particularly useful or creative?
3.4 In last year's study, students indicated that they preferred a moderate amount of technology in the classroom. Does this surprise you? Why or why not?
3.5 Do you think most instructors make good use of instructional technology?

4. Future/Miscellaneous

4.1 Do you have an institutional overall strategy regarding student use and skills with information technology? How do the student's technology skills help or hinder achievement of this goal?
4.2 If you had to design a program to improve students' use of technology, what would it look like?
4.3 How do you measure the success of what you're doing in supporting/training?
4.4 What is different today than what you were doing 3 years ago?
4.5 What is changing in what you are doing in the next 12 months? 24 months?

5. Other

Appendix E

Participating Institutions and Respondent Characteristics

Respondents by Institution

Presented here are the sizes of the samples generated and executed for the 63 schools in the study and the response rate by institution. Note: there are some minor errors due to students' having selected the wrong institution in a pull-down menu in the survey.

Senior Sample

Institution	Senior FTE	Senior Sample	Percentage of Sample	Senior Response	Percentage Response
Auburn University	5,427	1,310	24.1%	195	14.9%
Baylor University	3,456	917	26.5%	174	19.0%
Brandeis University	664	375	56.5%	101	26.9%
Brazosport College	0	0	0.0%	4	0.0%
Bridgewater State College	1,616	550	34.0%	70	12.7%
California Polytechnic State University, San Luis Obispo	6,615	600	9.1%	131	21.8%
California State University, Bakersfield	1,466	600	40.9%	88	14.7%
Colgate University	661	330	49.9%	128	38.8%
Cornell University	3,500	400	11.4%	65	16.3%
DePauw University	496	496	100.0%	210	42.3%
Drexel University	1,024	1,024	100.0%	149	14.6%
Eastern Michigan University	3,972	3,977	100.1%	538	13.5%
Emory University	1,700	2,276	133.9%	25	1.1%
Foothill-DeAnza Community College District	0	0	0.0%	80	0.0%
Franklin W. Olin College of Engineering	0	0	0.0%	1	0.0%
George Mason University	4,041	1,600	39.6%	161	10.1%

(Continued)

Senior Sample *(continued)*

Institution	Senior FTE	Senior Sample	Percentage of Sample	Senior Response	Percentage Response
Gettysburg College	542	542	100.0%	12	2.2%
Grand View College	692	692	100.0%	36	5.2%
Hamilton College	433	433	100.0%	93	21.5%
Indiana University	5,374	700	13.0%	113	16.1%
Kansas State University	5,155	600	11.6%	88	14.7%
Middle Tennessee State University	10,527	6,466	61.4%	769	11.9%
Monmouth College	221	221	100.0%	89	40.3%
Montclair State University	2,978	3,776	126.8%	351	9.3%
Oakland University	2,611	600	23.0%	137	22.8%
Pace University	771	1,467	190.3%	157	10.7%
Pomona College	385	385	100.0%	103	26.8%
Purdue University	7,555	825	10.9%	89	10.8%
SUNY College at Geneseo	986	822	83.4%	265	32.2%
Saint John's University/College of Saint Benedict	226	226	100.0%	156	69.0%
Saint Leo University	327	327	100.0%	32	9.8%
Saint Mary's University of Minnesota	772	448	58.0%	103	23.0%
Seton Hall University	1,826	350	19.2%	27	7.7%
South Dakota State University	3,332	940	28.2%	109	11.6%
Southern Illinois University Edwardsville	1,433	985	68.7%	124	12.6%
The College of New Jersey	1,466	1,843	125.7%	143	7.8%
The Pennsylvania State University	11,647	500	4.3%	0	0.0%
The University of Tennessee	5,805	5,805	100.0%	872	15.0%
University of Delaware	5,180	5,180	100.0%	563	10.9%
University of Kansas	4,723	700	14.8%	52	7.4%
University of Memphis	4,279	4,279	100.0%	129	3.0%
University of Michigan	8,750	1,000	11.4%	110	11.0%
University of Minnesota, Crookston	354	358	101.1%	72	20.1%
University of Minnesota Duluth	2,291	550	24.0%	93	16.9%
University of Minnesota, Morris	520	325	62.5%	79	24.3%
University of Minnesota, Twin Cities	8,530	650	7.6%	107	16.5%
University of New Hampshire	3,093	3,093	100.0%	185	6.0%
University of North Carolina at Charlotte	3,976	3,976	100.0%	144	3.6%
University of North Dakota	2,615	600	22.9%	87	14.5%
University of Oklahoma	7,158	600	8.4%	27	4.5%

(Continued)

Senior Sample *(continued)*

Institution	Senior FTE	Senior Sample	Percentage of Sample	Senior Response	Percentage Response
University of St. Thomas	1,542	243	15.8%	66	27.2%
University of Wisconsin–Eau Claire	2,654	800	30.1%	249	31.1%
University of Wisconsin–La Crosse	2,204	2,204	100.0%	597	27.1%
University of Wisconsin–Madison	8,758	1,000	11.4%	134	13.4%
University of Wisconsin–Milwaukee	5,059	800	15.8%	117	14.6%
University of Wisconsin–Oshkosh	2,612	3,140	120.2%	507	16.1%
University of Wisconsin–Stout	1,986	800	40.3%	232	29.0%
University of Wisconsin–Whitewater	2,490	500	20.1%	88	17.6%
Ursinus College	301	301	100.0%	49	16.3%
Virginia Polytechnic Institute and State University	5,709	500	8.8%	54	10.8%
Wayne State University	3,626	1,062	29.3%	104	9.8%
Wellesley College	554	277	50.0%	89	32.1%
Western Carolina University	1,893	1,893	100.0%	120	6.3%
Total Seniors	**190,559**	**78,239**	**41.1%**	**10,042**	**12.8%**

Freshman Sample

Institution	Freshman FTE	Freshman Sample	Percentage of Sample	Freshman Response	Percentage Response
Auburn University	5,142	1,090	21.2%	128	11.7%
Baylor University	2,399	633	26.4%	109	17.2%
Brandeis University	795	375	47.2%	88	23.5%
Brazosport College	438	831	189.7%	21	2.5%
Bridgewater State College	1,618	520	32.1%	89	17.1%
California Polytechnic State University, San Luis Obispo	3,459	500	14.5%	75	15.0%
California State University, Bakersfield	1,571	500	31.8%	53	10.6%
Colgate University	723	361	49.9%	150	41.6%
Cornell University	3,300	400	12.1%	48	12.0%
DePauw University	647	647	100.0%	146	22.6%
Drexel University	1,111	1,111	100.0%	202	18.2%
Eastern Michigan University	2,253	2,259	100.3%	240	10.6%
Emory University	1,300	1,135	87.3%	1	0.1%
Foothill-DeAnza Community College District	7,880	2,553	32.4%	118	4.6%
Franklin W. Olin College of Engineering	71	71	100.0%	23	32.4%

(Continued)

Freshman Sample *(continued)*

Institution	Freshman FTE	Freshman Sample	Percentage of Sample	Freshman Response`	Percentage Response
George Mason University	3,325	1,500	45.1%	198	13.2%
Gettysburg College	686	686	100.0%	3	0.4%
Grand View College	224	224	100.0%	40	17.9%
Hamilton College	481	481	100.0%	123	25.6%
Indiana University	9,130	600	6.6%	92	15.3%
Kansas State University	4,199	500	11.9%	64	12.8%
Middle Tennessee State University	4,061	4,061	100.0%	409	10.1%
Monmouth College	452	452	100.0%	154	34.1%
Montclair State University	1,900	1,987	104.6%	206	10.4%
Oakland University	3,026	600	19.8%	91	15.2%
Pace University	2,193	2,442	111.4%	208	8.5%
Pomona College	394	394	100.0%	145	36.8%
Purdue University	7,949	675	8.5%	95	14.1%
SUNY College at Geneseo	1,055	1,038	98.4%	178	17.1%
Saint John's University/College of Saint Benedict	354	354	100.0%	182	51.4%
Saint Leo University	288	288	100.0%	71	24.7%
Saint Mary's University of Minnesota	1,235	573	46.4%	76	13.3%
Seton Hall University	3,410	350	10.3%	63	18.0%
South Dakota State University	2,821	940	33.3%	107	11.4%
Southern Illinois University Edwardsville	1,026	840	81.9%	130	15.5%
The College of New Jersey	1,571	1,228	78.2%	104	8.5%
The Pennsylvania State University	16,654	500	3.0%	70	14.0%
The University of Tennessee	4,367	4,367	100.0%	479	11.0%
University of Delaware	3,247	3,247	100.0%	320	9.9%
University of Kansas	3,671	600	16.3%	33	5.5%
University of Memphis	3,158	3,158	100.0%	41	1.3%
University of Michigan	5,700	1,000	17.5%	157	15.7%
University of Minnesota, Crookston	209	213	101.9%	32	15.0%
University of Minnesota Duluth	1,958	525	26.8%	65	12.4%
University of Minnesota, Morris	312	313	100.3%	76	24.3%
University of Minnesota, Twin Cities	4,260	600	14.1%	58	9.7%
University of New Hampshire	2,408	2,408	100.0%	255	10.6%
University of North Carolina at Charlotte	2,883	2,883	100.0%	123	4.3%
University of North Dakota	2,420	500	20.7%	53	10.6%

(Continued)

Freshman Sample *(continued)*

Institution	Freshman FTE	Freshman Sample	Percentage of Sample	Freshman Response`	Percentage Response
University of Oklahoma	3,255	500	15.4%	45	9.0%
University of St. Thomas	987	156	15.8%	47	30.1%
University of Wisconsin–Eau Claire	1,953	800	41.0%	196	24.5%
University of Wisconsin–La Crosse	1,499	1,499	100.0%	402	26.8%
University of Wisconsin–Madison	5,031	1,000	19.9%	180	18.0%
University of Wisconsin–Milwaukee	3,776	800	21.2%	100	12.5%
University of Wisconsin–Oshkosh	2,569	1,789	69.6%	345	19.3%
University of Wisconsin–Stout	1,776	800	45.0%	143	17.9%
University of Wisconsin–Whitewater	2,086	500	24.0%	59	11.8%
Ursinus College	397	397	100.0%	42	10.6%
Virginia Polytechnic Institute and State University	5,982	500	8.4%	92	18.4%
Wayne State University	3,402	1,384	40.7%	87	6.3%
Wellesley College	612	306	50.0%	144	47.1%
Western Carolina University	1,547	1,547	100.0%	123	8.0%
Total Freshmen	**168,606**	**65,491**	**38.8%**	**7,997**	**12.2%**

Respondents by State

State	Number of Institutions	Number of Students Responding
Alabama	1	323
California	4	793
Delaware	1	883
Florida	1	103
Georgia	1	26
Iowa	2	281
Illinois	2	497
Indiana	2	540
Kansas	2	237
Massachusetts	4	605
Michigan	4	1,464
Minnesota	7	1,212
North Carolina	2	510
North Dakota	1	140
New Hampshire	1	440
New Jersey	3	894
New York	5	1,415
Oklahoma	1	72
Pennsylvania	4	527
South Dakota	1	216
Tennessee	3	2,699
Texas	2	308
Virginia	2	505
Wisconsin	7	3,349
Total	**63**	**18,039**

Respondents by Carnegie Class

Doctoral	MA	BA	AA	Other
Institutions = 30 *Students = 8,788*	*Institutions = 18* *Students = 6,651*	*Institutions = 12* *Students = 2,353*	*Institutions = 2* *Students = 223*	*Institutions = 1* *Students = 24*
Auburn University	Bridgewater State College	Colgate University	Brazosport College	Franklin W. Olin College of Engineering
Baylor University	California Polytechnic State University, San Luis Obispo	DePauw University	Foothill-DeAnza Community College District	
Brandeis University	California State University, Bakersfield	Gettysburg College		
Cornell University	Eastern Michigan University	Grand View College		
Drexel University	Montclair State University	Hamilton College		
Emory University	Pace University	Monmouth College		
George Mason University	SUNY College at Geneseo	Pomona College		
Indiana University	Saint Leo University	Saint John's University/College of Saint Benedict		
Kansas State University	Saint Mary's University of Minnesota	University of Minnesota, Crookston		
Middle Tennessee State University	Southern Illinois University Edwardsville	University of Minnesota, Morris		
Oakland University	The College of New Jersey	Ursinus College		
Purdue University	University of Minnesota Duluth	Wellesley College		
Seton Hall University	University of Wisconsin–Eau Claire			
South Dakota State University	University of Wisconsin–La Crosse			
The Pennsylvania State University	University of Wisconsin–Oshkosh			

(Continued)

Respondents by Carnegie Class *(continued)*

Doctoral	MA	BA	AA	Other
The University of Tennessee	University of Wisconsin–Stout			
University of Delaware	University of Wisconsin–Whitewater			
University of Kansas	Western Carolina University			
University of Memphis				
University of Michigan				
University of Minnesota, Twin Cities				
University of New Hampshire				
University of North Carolina at Charlotte				
University of North Dakota				
University of Oklahoma				
University of St Thomas				
University of Wisconsin–Madison				
University of Wisconsin–Milwaukee				
Virginia Polytechnic Institute and State University				
Wayne State University				

Respondents by Gender

Institution	Male	Female	Percentage Male	Percentage Female	Total
Auburn University	144	178	44.7%	55.3%	322
Baylor University	79	201	28.2%	71.8%	280
Brandeis University	79	109	42.0%	58.0%	188
Brazosport College	7	18	28.0%	72.0%	25
Bridgewater State College	53	104	33.8%	66.2%	157
California Polytechnic State University, San Luis Obispo	88	118	42.7%	57.3%	206
California State University, Bakersfield	59	82	41.8%	58.2%	141
Colgate University	95	180	34.5%	65.5%	275
Cornell University	50	62	44.6%	55.4%	112
DePauw University	132	224	37.1%	62.9%	356
Drexel University	168	182	48.0%	52.0%	350
Eastern Michigan University	229	545	29.6%	70.4%	774
Emory University	10	16	38.5%	61.5%	26
Foothill-DeAnza Community College District	80	118	40.4%	59.6%	198
Franklin W. Olin College of Engineering	15	8	65.2%	34.8%	23
George Mason University	168	189	47.1%	52.9%	357
Gettysburg College	5	10	33.3%	66.7%	15
Grand View College	10	66	13.2%	86.8%	76
Hamilton College	79	135	36.9%	63.1%	214
Indiana University	83	121	40.7%	59.3%	204
Kansas State University	72	79	47.7%	52.3%	151
Middle Tennessee State University	358	816	30.5%	69.5%	1,174
Monmouth College	92	148	38.3%	61.7%	240
Montclair State University	140	414	25.3%	74.7%	554
Oakland University	68	160	29.8%	70.2%	228
Pace University	101	260	28.0%	72.0%	361
Pomona College	90	155	36.7%	63.3%	245
Purdue University	84	100	45.7%	54.3%	184
SUNY College at Geneseo	130	309	29.6%	70.4%	439
Saint John's University/College of Saint Benedict	118	220	34.9%	65.1%	338
Saint Leo University	30	72	29.4%	70.6%	102
Saint Mary's University of Minnesota	39	139	21.9%	78.1%	178
Seton Hall University	26	64	28.9%	71.1%	90

(Continued)

Respondents by Gender *(continued)*

Institution	Male	Female	Percentage Male	Percentage Female	Total
South Dakota State University	86	128	40.2%	59.8%	214
Southern Illinois University Edwardsville	75	179	29.5%	70.5%	254
The College of New Jersey	92	153	37.6%	62.4%	245
The Pennsylvania State University	34	36	48.6%	51.4%	70
The University of Tennessee	530	818	39.3%	60.7%	1,348
University of Delaware	299	580	34.0%	66.0%	879
University of Kansas	45	40	52.9%	47.1%	85
University of Memphis	53	117	31.2%	68.8%	170
University of Michigan	102	165	38.2%	61.8%	267
University of Minnesota, Crookston	52	52	50.0%	50.0%	104
University of Minnesota Duluth	66	91	42.0%	58.0%	157
University of Minnesota, Morris	56	99	36.1%	63.9%	155
University of Minnesota, Twin Cities	62	102	37.8%	62.2%	164
University of New Hampshire	133	304	30.4%	69.6%	437
University of North Carolina at Charlotte	87	178	32.8%	67.2%	265
University of North Dakota	66	73	47.5%	52.5%	139
University of Oklahoma	28	43	39.4%	60.6%	71
University of St Thomas	40	73	35.4%	64.6%	113
University of Wisconsin–Eau Claire	133	312	29.9%	70.1%	445
University of Wisconsin–La Crosse	276	720	27.7%	72.3%	996
University of Wisconsin–Madison	93	220	29.7%	70.3%	313
University of Wisconsin–Milwaukee	76	138	35.5%	64.5%	214
University of Wisconsin–Oshkosh	238	610	28.1%	71.9%	848
University of Wisconsin–Stout	133	240	35.7%	64.3%	373
University of Wisconsin–Whitewater	47	99	32.2%	67.8%	146
Ursinus College	37	54	40.7%	59.3%	91
Virginia Polytechnic Institute and State University	59	87	40.4%	59.6%	146
Wayne State University	59	132	30.9%	69.1%	191
Wellesley College	2	231	0.9%	99.1%	233
Western Carolina University	83	159	34.3%	65.7%	242
Total	**6,123**	**11,835**	**34.1%**	**65.9%**	**17,958**