ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control

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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

The EDUCAUSE Center for Applied Research (ECAR) was launched on January 1, 2002, to create a body of research and analysis on important issues at the intersection of higher education and information technology. ECAR is fulfilling its mission through a program of symposia and through the publication of

- biweekly research bulletins oriented to senior campus functional executives;
- detailed studies designed to identify trends, directions, and practices in an analytically robust fashion;
- case studies designed to showcase campus activities and highlight effective practices, lessons learned, and other insights from campus leaders’ practical experience; and
- roadmaps designed to help senior executives quickly grasp the core of important technology issues.

Since ECAR’s inception, five symposia have been held and more than 100 research publications have been issued.

ECAR’s Stretch Goal

In 2001, when ECAR was being planned, I had the pleasure of working with Senior Fellows Robert Albrecht, Diana Oblinger, and Mary Beth Baker. Early plans for ECAR ranged from the practical and mundane—we envisioned a steady stream of high-quality products—to the ambitious and even unprecedented. Our favorite audacious idea was to collect, analyze, and report on data about how real college and university students use and relate to information technologies in their roles as students, learners, community members, and so forth. We knew that the study of education outcomes and IT’s contributions to them was both an analytically and an ideologically slippery slope, but we also knew that we must at least begin to chip away at questions about the complex relationship between IT and learning.

A Complex, Politically Charged Arena of Inquiry

Few subjects are as important, politically charged, and poorly understood as that of students’ IT uses, perceptions, expectations, and experiences. We understand even less about how these influence academic progress, persistence, retention, grade performance, and more. This ECAR study doesn’t presume to cover this intellectual waterfront, but we see it as an important and perhaps even a significant step toward that end.

EDUCAUSE and ECAR benefit from an engaged and committed membership. In this case, 13 of our most committed institutional members and subscribers agreed to run the gauntlet of their institution’s institutional research board approval process so that we could gain access to a representative sample of their freshman and senior students. As a result, nearly 4,500 students participated in this study. Importantly, those universities participating reflect U.S. higher education’s great diversity. Some represent public land-grant institutions, some are elite private institutions, and others were selected because they focus dominantly on undergraduate instruction and have incorporated technology into instruction...
in noteworthy ways. We hope over time to expand participation in this study so that the effects of institutions and institutional types may be examined.

**Findings**

The results of this first ECAR student study are gratifying, satisfying, and occasionally surprising. We relearn that students are not a monolithic population across any dimension of behavior, including IT usage. We are reminded that among the many so-called digital natives—university students born in the Internet era—we also find many reluctant and even skeptical IT users. More importantly, students in this study reveal themselves to be discriminating users of IT. While many can wear out more than a pair of thumbs in hours of video gaming, most state a clear preference for moderate doses of IT in the classroom.

This study confirms findings suggested in ECAR’s earlier study of faculty use of course management systems that new course-oriented software is making the business of learning more convenient but isn’t yet yielding visible breakthroughs in learning itself. This finding too is not surprising and is hardly conclusive, given the limitations of self-reported data. We must note, though, that convenience is important. Many studies of students, such as Levine and Cureton’s *When Hope and Fear Collide: A Portrait of Today’s College Student*, describe student lifestyles that author Jeanette Cureton later describes as “wired and tired.” Today’s students are enormously busy. They carry unprecedented academic course loads, unprecedented financial responsibilities and debts, unusual family obligations, and often demanding occupational obligations. If IT’s impacts were limited to convenience, those of us in the business of crafting such technologies could justifiably wave a victory flag. Of course, we all continue to struggle and work for the bigger prize of a learning revolution.

**Important Contributions**

ECAR research studies result from a team effort. Robert B. Kvavik, ECAR senior fellow and associate vice president at the University of Minnesota, Twin Cities; Glenda Morgan, director of academic technology initiatives at the California State University Chancellor’s Office; and Judith B. Caruso, ECAR fellow and director of policy, security, and planning at the University of Wisconsin–Madison, authored this report. Their intellectual leadership manifests in the work itself. Bob Albrecht, Bob Bender, and Robert Kvavik coauthored the case study of Emory University’s Collaborative Learning Center to supplement the core study. Bob Albrecht, Bob Bender, and I had the pleasure of providing commentary on drafts and research design throughout the life of this project. Dr. Darwin Hendel, Ronald Huesman Jr., John Kellogg, and Cynthia Murdoch of the University of Minnesota, Twin Cities, provided outstanding advice on technical survey design issues and on the sampling strategy that would yield confident statistical representations. We are enormously grateful to them.

Of course, the real team in any ECAR study is the EDUCAUSE community. Our ability to develop a good understanding of practices, policies, and directions in higher education depends on the goodwill of our associates in the community. In this case we have made exceptional demands of our good friends. Jan Biros and John Bialec of Drexel University opened the right doors for us at their institution. Gabriele Wienhausen and Steve Relyea of UC San Diego shepherded the approvals and technical issues there. Carol Carrier, Craig Swan, Billie Wahlstrom, and Linda Clemens at the University of Minnesota, Twin Cities, and Donald Sargeant at the University of Minnesota, Crookston, enthusiastically gave us the necessary approvals to include their campuses in the study. Judy Doherty of Colgate University was instrumental in obtaining approvals and access to students for interviews at Colgate.
At the University of Wisconsin System institutions, John Berens at UW–Oshkosh, Richard Cleek of UW–Colleges, Jane Henderson and Margy Ingram at UW–Stout, Bob Kaleta at UW–Milwaukee, Jim Lowe at UW–Eau Claire, John Tillman at UW–LaCrosse, and Lorna Wong of UW–Whitewater led the efforts at their respective institutions, ensuring approvals and student and administrator participation. We also wish to thank Donald E. Harris, vice provost and CIO of Emory University, for his support in making Emory’s fine Collaborative Learning Center available to us for study. Thanks to all of you for your assistance. We could not have done this study without you.

The EDUCAUSE staff is also an essential part of our community, and our ability to conduct this research depends on their provision of myriad services big and small. The EDUCAUSE team is always there when you need them, and their commitment to excellence is evident in all that they do. Thank you.

Finally, ECAR, while now enjoying the support of nearly 300 college and university subscribers, continues to depend on the generous support of a small and dedicated cadre of corporate sponsors. Datatel, HP, Microsoft, Oracle, PeopleSoft, SunGard Collegis, and SunGard SCT not only provide direct financial support of ECAR but are also generous with their advice and skilled resources.

We are aware that many and possibly most universities and colleges survey their own student bodies to understand their preferences, inclinations, and levels of satisfaction. We hope the data and analysis from this study shed new light on their own data and studies. We also hope most sincerely that this work will inspire excitement and redouble commitment, for the results are indeed exciting and encouraging, and that many institutions will choose to continue and elevate this work by participating in future studies of this essential topic.

Richard N. Katz
Boulder, Colorado

Endnotes
Executive Summary

Many people see today’s undergraduate students as technology savvy, with IT skills and usage that far exceed those of previous student populations. They are characterized as preferring teamwork, experiential activities, and the use of technology. Prensky calls them “digital natives,” referring to the fact that they have grown up with technology, as compared with “digital immigrants,” who didn’t. Prensky’s digital immigrants include previous generations of students and most of today’s faculty and administrators. Ninety-five percent of the students in this study are members of this “millennial” generation.

We undertook this study to test these observations using both quantitative and qualitative data. We did so by focusing on four issues:

- What kinds of information technologies do students use?
- With what levels of skill are they using these technologies?
- How does this use contribute to their undergraduate experience?
- What value does the use of IT add in terms of learning gains?

This study also identifies some effective practices in supporting student technology use and speculates on the future of student IT use and skills in higher education.

Methodology and Study Participants

The study consisted of four data collection and analytical initiatives:

- A literature review identified and clarified the study’s major elements and created a working set of hypotheses to be tested. We also examined other higher education IT student surveys.
- A review of and comparison with last year’s ECAR study on faculty use of course management systems, undertaken at the University of Wisconsin System under Glenda Morgan’s direction, provided important context.
- A survey provided quantitative data from a sample of 9,350 freshmen and 9,050 seniors, with 4,374 respondents at 13 higher education institutions: Colgate University; Drexel University; University of California, San Diego; University of Minnesota, Crookston; University of Minnesota, Twin Cities; University of Wisconsin–Colleges; University of Wisconsin–Eau Claire; University of Wisconsin–La Crosse; University of Wisconsin–Madison; University of Wisconsin–Milwaukee; University of Wisconsin–Oshkosh; University of Wisconsin–Stout; and University of Wisconsin–Whitewater.
- Interviews with 132 students in focus group settings at six institutions and with 23 administrators who support student IT on their campuses provided qualitative data. All information collected is confidential, and no personally identifiable data is available from the quantitative survey. We obtained institutional review board approval at all institutions except Drexel University, where the project was deemed exempt.

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We advise some caution in interpreting these data because the study was limited to 13 higher education institutions and also because of context differences and different interpretations of survey question wording among students. Overall, we achieved a 95 percent confidence rate with a ±5 percent margin of error. The institutions chosen represent a mix of the different types of higher education institutions in North America.

**Key Findings**

This study of student experiences with information technology at 13 universities finds that, while information technology is indeed making important inroads into classroom and study processes, the effects to date of this penetration seem to signal important enhancements in the convenience of postsecondary teaching and learning and not yet a learning revolution.

**Technology Ownership**

There is an inexorable trend among college students toward universal ownership, mobility, and access to technology. Although the “digital divide” may exist, the study found no significant differences by ethnic group on ownership at the 13 institutions included in this study.

We found that 70.7 percent of the senior respondents and 57.1 percent of the freshman respondents reported ownership of a personal desktop computer; 38.5 percent of the senior respondents and 52.7 percent of the freshman respondents owned laptop computers. Only 11.9 percent overall owned personal digital assistants (PDAs), with male students more likely than female students to own a PDA. Eighty-two percent of students surveyed owned cell phones, with females (84.7 percent) more likely to own one than males (77.7 percent).

**Internet Access**

Freshman students, who often reside on campus, access the Internet most often using university networks (82.2 percent). Seniors used commercial access most often (56.4 percent). More than 81 percent of students had access to broadband service, either through commercial or university sources, while 18.5 percent used slower modems. Students reported in the qualitative interviews that their satisfaction with access is partially shaped by the institution’s IT environment. Students were often frustrated with overcrowded computer labs.

**Technology Use Patterns**

Asked about the applications they used on their electronic devices, students reported that they use technology primarily for educational purposes, followed by communication, and lastly for presentation of materials. Students reported using computers for writing documents (99.5 percent) and e-mail (99.5 percent), followed by surfing the Internet for pleasure (97.2 percent) and for classroom activities (96.4 percent). And they do many of these things simultaneously. Students reported using technology for creating or editing video and audio and for creating Web pages the least.

**Hours of Technology Use**

By a wide margin, students indicated that they used a computer first for doing classroom activities and studying (mean of 4.01 on a scale where 1 represents “do not use,” 2 represents less than one hour weekly, 3 represents one to two hours, 4 represents three to five hours, 5 represents six to 10 hours, and 6 represents 11 or more hours per week). Students also used a computer approximately two to five hours a week for writing documents, surfing the Internet for pleasure, e-mailing, using instant messaging, using an electronic device at work, or downloading
and listening to music or videos. Other activities such as completing a learning activity, playing games, creating spreadsheets, and creating presentations (including Web sites) occupied an average student’s time less than two hours per week.

The qualitative data support these findings. When interviewed, students reported making heavy use of a computer for communication, but that was secondary to schoolwork.

The factors contributing to hours of use of various technology applications fall into three categories: academic requirements, communications, and entertainment. Academic usage relates strongly to the student’s academic major and class status (senior or freshman). Communications and entertainment relate strongly to gender and age but are statistically low-level significant factors.

The qualitative interviews supported the significance of student major: a picture emerged of student technology use being instrumental in nature and driven by the demands of the major and the classes that students take. Seniors reported spending more time overall on a computer than did freshmen, and they reported greater computer use at a place of employment. Seniors spent more hours on the computer each week in support of their educational activities and also more time on more-advanced applications such as spreadsheets, presentations, and graphics.

Skill Level

Undergraduate students must develop two skill types: information literacy or fluency, and the technical skills needed to use IT tools. Defining technology skills is difficult because rapid changes in software demand new and different skills. Recognizing this dynamic, the National Research Council in 1999 defined technology skills as technology fluency. Our research is premised on this definition.

When asked about the level of skill they felt they had attained for each application, students rated themselves highly skilled in the use of communications, word processing, and the Internet. On a scale where 4 = very skilled, 3 = skilled, 2 = unskilled, and 1 = very unskilled, the means for e-mail, instant messenger, word processing, and Web surfing were all greater than 3.0. Students rated themselves lower on graphics (mean = 2.45), creating Web pages (mean = 2.17), and creating and editing audio and video (mean = 2.07). Confirming earlier findings, seniors tended to rank themselves higher than freshmen with tools such as PowerPoint and spreadsheets. The student’s major proved significant, with business, engineering, and life sciences students reporting the highest skills.

Although the quantitative data indicate that students believe they have the skills they need, the qualitative interviews suggest student skills are more problematic. The interviews indicate that students are skilled with basic Microsoft Office applications but tend to know just enough technology functionality to accomplish their work and don’t have in-depth application knowledge or problem-solving skills.

IT in the Classroom

When analyzing student IT use in the classroom, the study team reviewed factors that make good practice in teaching and learning, using Chickering and Gamson’s seven principles that contribute to good practice in teaching and learning. Using this focus, we asked students about their use and preference for IT in the classroom in the areas of communication, active learning, feedback, time-on-task, and student control of class progress.

In the quantitative survey, students noted their preferences for classroom technology use, with the highest number (41.2 percent) preferring to take classes that use a moderate amount of technology. Approximately
23 percent preferred classes that use limited technology, and 30.8 percent preferred classes that use technology extensively.

We considered the following factors in evaluating students’ preferences: previous experience with classroom technology use, faculty technology skills, hours students use technology, and respondents’ perceived skill levels using computers. We also considered institution, major, grade point average (GPA), and demographics. Previous positive classroom experiences had a beneficial impact on a student’s preference for classroom technology. Not surprisingly, if the instructor uses technology well, students will come to appreciate its benefits. This might explain why seniors had a higher preference for classroom technology use than did freshmen.

A student’s major was also an important predictor, with engineering students having the highest preference for technology in the classroom (67.8 percent), followed by business students (64.3 percent). When analyzing students’ preferences for classes using technology, we found that a student’s GPA was not a significant factor. Students with lower GPAs preferred classes using technology equally with those students having higher GPAs. An exception was students with the highest GPAs (3.51 to 4.00), who modestly preferred less technology in the classroom.

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Technology’s Impact in the Classroom

We asked students about technology’s impact on various classroom activities. The activity receiving the highest impact was “helped me to better communicate with the instructor,” with a mean of 3.85. Other activities with a mean above 3.60 included “resulted in prompt feedback from the instructor,” “helped me communicate and collaborate with my classmates,” and “I primarily use IT in courses to improve the presentation of my work.” The highest scores were given to improved communications, followed by factors related to classroom activities management. Less affected were those activities having to do with comprehension of classroom materials (complex concepts). Time-on-task and grading outcomes appeared to be neutral from the respondents’ perspective, with means as low as 3.04.

Interestingly, students don’t feel that classroom IT use greatly increases the amount of time engaged with course activities (3.22 mean). This directly contrasts with faculty perceptions reported in the ECAR study on faculty course management system (CMS) use, where 65 percent of faculty reported perceiving that students spent more time engaged with course materials.

Engineering and business majors indicated that classroom technology bettered their understanding of complex concepts and provided more opportunities for practice and reinforcement. Seniors provided overall higher scores than freshmen.

Benefits of Classroom IT Use

Students recognize a number of benefits of classroom IT. Included are convenience, management of classroom activities, time savings, improved learning, better and more effective communications, and better presentation of their class assignments. Of these, convenience and communication predominate. We would note that gender, class standing (senior or freshman), grade point average, and major had little impact on what students perceived to be the primary benefits of classroom IT.

Convenience

Students cited convenience (48.5 percent) as the greatest benefit of IT classroom use. When combined with saving time, the percentage increases to 64.6 percent. Only 12.7 percent said the most valuable benefit was improved learning, and only 3.7 percent per-
ceived no benefit whatsoever. In the survey’s open-ended comments, 134 students voluntarily identified convenience as one of the primary benefits of classroom IT use.

**Management of Class Activities**

Students indicated a noticeable improvement in their ability to manage their classroom activities. Classroom management includes more time for practice and reinforcement of ideas and concepts and greater control of classroom activities (planning, apportionment of time, and self-assessment). Students noted also that faculty’s PowerPoint use was very helpful, especially when faculty made their notes available for download. The students described PowerPoint as a way to organize information and really appreciated that they no longer had to decipher faculty handwriting. Students did recognize, however, that PowerPoint handouts might encourage them to be lazy or skip class.

**Saved Time**

Sixteen percent of students reported that classroom technology use saved them time.

**Improved Learning**

Even though students strongly emphasized the convenience of classroom IT use, they also consistently stated that good use of technology helps them learn. The students’ perception of IT’s learning benefits in the classroom agrees with faculty views reported in the ECAR study on faculty CMS use.

**Communications and Presentation**

In the qualitative interviews, students said they felt technology improved communication with the faculty. Technology enabled out-of-classroom contact—for example, students could set up meetings with faculty via e-mail, or e-mail a question and get a quick response.

**Presentation of Work**

The qualitative interviews didn’t find that students assigned an especially high priority to using technology to improve the presentation of their work. The students interviewed placed far more emphasis on faculty use of technology to improve course presentation.

**Barriers to Classroom IT Use**

Overall, 54.3 percent of the students reported some barriers to classroom IT use. Of the barriers listed in the survey, the most problematic was “feels like extra work” (16.7 percent), followed by “applications not running on their computer” (14.1 percent), “lack of access to printers” (13.4 percent), and “lack of technical support” (9.7 percent). These findings were reinforced by the number of times students mentioned them in an open-ended survey question.

**Course Management Systems**

When students comment on technology in the classroom, they are most likely referring to the use of course management systems. Today, a CMS is often the first technology undergraduate students experience in the university classroom. The percentage of students who have used a CMS has increased dramatically since the systems were first introduced seven years ago.

Eighty-three percent of the students in our survey had taken a class that used a CMS, and 16.7 percent had not. Seniors (90.1 percent) were more likely to have taken a class that used a CMS than freshmen (78.5 percent). Of students who had used a CMS, 76.1 percent were positive or very positive about the experience, 17.3 percent were neutral, and only 6.6 percent were negative or very negative. Females (mean of 3.93) liked the systems slightly better than males (mean of 3.74).6

Course management systems offer numerous features to support learning and course administration. Ninety-five percent of the stu-
Students reported using a syllabus feature. Other features they reported using included online readings (94.8 percent), tracking grades (89.4 percent), sample exams online (88.8 percent), turning in assignments (78.5 percent), online discussion (74.2 percent), sharing materials with students (73.4 percent), obtaining faculty feedback (71.8 percent), and online quizzes (70.0 percent).

CMS Benefits to Students

We asked students whether they perceived that a particular CMS tool improved learning, class management, or both. We also provided the option of reporting whether a tool had no effect or a negative effect on either learning or class management. Classroom management (convenience) scored highest, followed by improved learning. Negative perceptions were minimal.

The interactive features that faculty use least were those that students indicated as contributing the most to their learning. The students were especially positive about sharing materials with students (38.5 percent), faculty feedback on assignments (32 percent), and online readings (24.9 percent). Not surprisingly, and consistent with the rating of benefits of classroom IT, students rated the administrative and convenience features most highly.

Features used that improved class management included tracking grades (45.7 percent), online quizzes (38.5 percent), online readings (29.1 percent), and sample exams online (21.2 percent). All other features received less than a 20 percent response.

Many students we interviewed indicated a need for a more consistent approach to CMS use. Also, students and faculty commented on the need for training: 12 percent of faculty surveyed indicated that they would increase their CMS use if more training were made available. A University of Minnesota, Twin Cities, student recommended, “With so many courses now using a CMS, there is a need to have an introductory class on using a CMS at the freshman or sophomore level.” Some students noted in interviews, however, that such training was unnecessary.

Future Trends

Although the new generation of technology-savvy students currently attending or entering colleges and universities possesses unprecedented levels of IT skills, this study found that these students have only a moderate preference for technology in the classroom. Respondents reported learning just enough IT skills to manage the tasks at hand; they did not explore the technologies in depth. Also, these skills need to be obtained in the classroom setting, as there seems to be little or no other source for training in instructional IT. Both faculty and students reported using course management systems most often to communicate information and conduct administrative activities, and much less to support learning.

Given the present state of students’ IT use and skills and the currently limited use of CMS features, higher education institutions need to evaluate their student IT services. Students and faculty members alike need good technology education and training. Today’s instructional IT use primarily advances convenience rather than the higher goal of improving learning. Just as the first wave of student, financial, and human resources information systems provided primarily convenience and improved transaction benefits, this first wave of instructional technology also provides these benefits. Six trends will likely lead the way in truly revolutionizing students’ IT use and skills and institutions’ instructional use of IT.

Improved Understanding of Student IT Use

Institutional learning and cognitive scientists will mine and analyze student course
activity data and translate their findings into programs and effective practices for policymakers and practitioners to carry out.

**Improved IT Literacy**

Student and faculty IT literacy will increase, and academic standards for research and evidence in Web-dominated information environments will emerge. Students will need to discern what good information is and isn’t. We believe curricula will need to be redesigned to guide this effort and to provide necessary incentives for students to learn how to learn with technology. And we will see more-rigorous training programs emerge. Concomitantly, we expect to see greater engagement of the K–12 sector in these activities because colleges and universities will inevitably impose student admission requirements relating to technology skills and use.

One of this study’s key findings is the need to improve faculty’s classroom technology use. The qualitative data reveals students’ perception that faculty use of technology is not uniform and often wanting. Faculty members, like their students, use the convenience and management features of course management systems more than the interactive features that students said contributed most to their learning. Institutional leadership needs to establish a funded priority for faculty technology development using effective practices as guidelines. Leaders need to establish appropriate rewards and incentives.

Student training also needs attention. Some students are highly skilled in IT use, but many need training in specific applications, computer maintenance, and IT problem solving.

**Improved CMS Quality**

Ongoing improvement is needed in the quality and usability of course delivery systems. The software will become increasingly transparent and easier to use. It will become more student-centric, giving students more tools to take greater control of and shape learning.

Course management systems and other learning technologies such as e-portfolios promise to radically increase higher education IT offices’ workload in the near future, not to mention that of students and faculty. We suspect that the effort and resources needed to support student and faculty use of these evolving technologies will over time surpass that currently invested in traditional administrative enterprise systems. Moreover, institutions will face enormous pressure to integrate the enterprise systems’ information and functions with those of course management systems and e-portfolios. The drivers for greater integration include rising student and faculty expectations for access, expected cost reduction, a demand for simplicity in an increasingly complex environment, and process simplification.

Students and faculty must also receive CMS training. Even as instructional technology becomes easier to use, both faculty and students report the need for better training. Also, course management tools need to expand to be free from course and time constraints. Students should be able to manage all their courses from a single site, and faculty should be able to manage courses from inception through their entire life cycle.

**Improved Information Availability**

Networked scholarly information will continue to proliferate, and both digital rights management and mechanisms for recovering economic returns on these rights (such as micropayments and licensing) will improve. We expect to see a standardization of learning objects and their use.

**Improved System Capabilities**

Exploration and integration of new capabilities and practices as they emerge from the video-gaming, virtual reality, simulation, and
modeling arenas should lead to greater and improved information exchange and interaction between students and faculty.

For freshman male students, gaming is the pastime of choice. These students are spending much of their free time (five hours or more per week) playing games with their peers. If higher education could capitalize on improvements inherent in the virtual reality of these games, students could greatly benefit. Some universities are already experimenting in this area.

**Improved Planning**

Institutions will place greater emphasis on planning and creating comprehensive and integrated work plans to implement technology in support of learning. At many institutions, much of the implementation is currently piecemeal and in the hands of a few innovators and early adopters.

Although some institutions have done institution-wide planning for instructional technology deployment, instructional technology has more often been a local issue, limited to college and departmental boundaries. Instead, instructional IT planning should be

- centralized, including all academic departments of the institution;
- in sync with institution-wide strategic planning;
- in sync with other institutional IT plans;
- participatory, sensitive to the norms and cultures of the colleges and departments;
- accommodating of diverse needs, such as recognizing the difference between art and design course needs and those of the social sciences;
- future-oriented, with goals set in the context of an expected future discipline;
- based on empirical data and continual analysis of student course activity data; and
- the responsibility of the institution’s academic and technology officers.

**Conclusion**

While this study of student IT use and skills provides just a snapshot in time, the findings can help guide higher education institutions in planning and improving IT services. Institutions can use the data reported here, along with their own data, to create instructional IT plans.

The freshmen and seniors in this study tended to overstate their own skill levels. But they also noted that they do not know applications in depth and only learn what they need to get their work done. Instructional technology support staff agreed with this perception and expressed concern that students understand the applications superficially and lack needed problem-solving skills. Clearly, additional IT training would be useful to students.

While most students reported having adequate access to technology, they expressed only a moderate preference for IT use in the classroom. Currently, students and faculty primarily use course management systems for convenience and communication. We found limited use of the CMS features that students reported as most improving their learning, such as sharing materials with students and faculty feedback on assignments and quizzes. The initial phase of CMS adoption focused on system use for communication and administrative functions. Additional faculty and student training and institutional incentives will increase use of features that can transform instruction and learning. Technology has the potential to revolutionize instruction.

Six trends will likely lead to the revolution of instruction with IT:

- analyzing student course activity data to help create effective programs and practices, and establishing accreditation criteria in technology use in learning activities;
- improving student and faculty IT literacy, including increasing training for students and faculty;
ongoing improvement in course delivery systems’ quality and usability;
continued proliferation of networked scholarly information;
exploration and integration of new capabilities from the video-gaming, virtual reality, simulation, and modeling arenas; and
institutions’ greater emphasis on planning and creating comprehensive and integrated work plans to implement technology in support of learning.

Endnotes
4. The scale for this question was 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.
5. The scale for this question was 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.
6. The scale for this question was 1 = very negative, 2 = negative, 3 = neutral, 4 = positive, and 5 = very positive.
Project Design and Methodology

Thank you for providing me with a survey that I could take at 2:30 a.m. and put off doing my homework.
—ECAR survey respondent

Much has been made about the new generation of technology-savvy students currently in and entering college. These students possess an unprecedented level of IT skills, and they think about and use technology radically differently from earlier student generations. In the context of higher education, these assumptions have a number of 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 gained their IT skills largely outside the classroom.
- Little further training or education of students in the use of IT is necessary.

We must validate with quantitative and qualitative data this assumption of a technology-literate undergraduate student population. As part of the course management study at the University of Wisconsin System, we learned that faculty and those involved in supporting students in their IT use questioned this assumption. They noted that students have a range of problems in effectively using IT and a reluctance to use these tools in an instructional setting.

If such problems exist and institutions do not address them, a number of consequences could result:

- Student and faculty use of instructional technology will be more limited than desired and expected.
- Students will be slower to develop adequate problem-solving skills using IT.
- Higher education won’t realize its investment in learning technology because students won’t have the appropriate skills to use it effectively.
- Students will leave their colleges and universities with inadequate technology skills for the challenges they might find in the workplace or in graduate school.
- Colleges and universities won’t be able to provide necessary student technology education and training.

We designed this study to provide a factual description of the state of student technology skills in higher education. It will do so by focusing on four issues: what kinds of information technologies do students use, with what levels of skill are they using these technologies, how does this use contribute to their undergraduate experience, and what value does IT use add in terms of learning gains? Additionally, this study will identify some effective practices in the support of student use of technology.
Research Team

The principal investigators include Robert B. Kvavik, ECAR senior fellow and professor of political science at the University of Minnesota; Judith Borreson Caruso, ECAR research fellow and director of policy, security, and planning at the University of Wisconsin–Madison; and Glenda Morgan, director of academic technology initiatives at the California State University.

Robert B. Kvavik

Robert B. Kvavik earned his Ph.D. from Stanford University in 1971. He is currently associate vice president at the University of Minnesota, where he directed the implementation of PeopleSoft student and human resources modules. He has published extensively in his academic discipline and increasingly on IT’s impact on and organization for 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 and Richard Katz were the principal authors of ECAR’s enterprise resource planning (ERP) study, published in the fourth quarter of 2002, and Kvavik and John Voloudakis were the principal authors of ECAR’s IT security study, published in the fourth quarter of 2003. Kvavik was one of several authors of ECAR’s study of IT leadership, published in the first quarter of 2004.

Judith Borreson Caruso

Judith Borreson Caruso has been an ECAR research fellow since July 2002. Before becoming director of policy, security, and planning at the University of Wisconsin–Madison, she served as that institution’s director of applications technology for many years. Caruso is active in IT professional organizations, including CUMREC and EDUCAUSE. She has served on the EDUCAUSE Current Issues and EDUCAUSE Quarterly editorial committees and is currently CUMREC vice chair for business affairs and a board member. During her ECAR tenure, she has participated in the ERP and IT security studies.

Glenda Morgan

Glenda Morgan earned her Ph.D. in political science from the University of Minnesota, Twin Cities, in 2002. She is currently director of academic technology initiatives at the Office of the Chancellor of the California State University System. Prior to assuming this position, she was the learning technology analyst at the University of Wisconsin System. Her research interests include copyright and privacy policy as they relate to emerging technologies as well as to the use of technology in a teaching and learning environment. Morgan was the principal author of ECAR’s 2003 study on faculty use of course management systems.

Methodology

We used a multifaceted research methodology to gather and analyze quantitative and qualitative data from approximately 4,500 students and administrators at 13 higher education institutions in five states (California, Minnesota, New York, Pennsylvania, and Wisconsin).

We began with a literature review, undertaken to define the study’s major elements and create a working set of hypotheses to be tested. The bibliography appears in Appendix D. 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. We also used the ECAR Faculty Use of Course Management Systems study, undertaken at the University of Wisconsin System under Glenda Morgan’s direction, as a foundation for this study.

ECAR designed a quantitative Web-based survey (see Appendix A) to assess student IT
skills and learning. ECAR then sent an e-mail invitation with the survey’s Web address and access code information to a sample of 9,350 freshman and 9,050 senior students at 13 institutions. Fully 4,374 students responded to the survey. Note that we received only 61 responses from the University of Wisconsin—Colleges. We include these students in our aggregate figures but exclude them from analysis where the institution is used as a basis for comparison, because the overall response rate was too low for meaningful analysis. Our institutional comparisons involve 12 institutions.

To encourage a larger response from the students, we offered a $50 gift certificate to 100 students, which we awarded by lottery. We had learned from other institutions’ experiences that the absence of an incentive would greatly reduce the response rate. A good number of students commented on the possibility of winning a prize in the open-ended question—for example, “I hope I win the 50 bucks.”

The information collected is confidential. No data from the quantitative survey are presented that would make it possible to identify a particular respondent. The data files we used for analysis have been purged of any information that would have similar consequences. We also sought and received institutional review board approval from every participating institution with the exception of Drexel University, where the project was determined to be exempt. The applications, application dates, and approval dates are available from ECAR.

We use means and standard deviations in this study. Means are arithmetic averages and measures of central tendency, and standard deviations measure 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 do not present the figures for reasons of simplicity. Note also that percentages in some of the tables don’t add up to 100 percent because of rounding.

We urge caution in interpreting these data because of our selection of schools, but also because of context differences and students’ different interpretations of survey wording. Also, it may well be that the technophobes in our sample didn’t answer the survey, and there is no way to account for them, given the sampling model we used. Nevertheless, we achieved a 95 percent confidence rate with a ±5 percent margin of error. This means that every mean and distribution we show must be read as if there is a possible 10 percent variation in the number and that we are 95 percent sure this is the case. But there is a 5 percent chance that the 10 percent variance is wrong; it could be higher or lower.

We selected a nonrepresentative mix of the different higher education institution types in the United State in terms of Carnegie class, location, source of funding, and levels of technology emphasis. See Table 2-1 for a list of the institutions included in the survey. However, we consider our findings to be instructive rather than conclusive of student experiences at different institution types. We used none of the above factors in our analysis.

When we look at respondents by Carnegie class institution, 4.4 percent were enrolled at BA institutions, 52.3 percent at MA institutions, and 43.3 percent in doctoral institutions. Our data show that 11.9 percent of our respondents were from institutions with enrollments of 4,000 and under, 11.8 percent from institutions with 4,001–8,000, 44.7 percent from institutions with 8,001–15,000, 20.9 percent from institutions with 15,001–25,000, and 10.6 percent from institutions with more than 25,000.

We found that 80.8 percent of our respondents were enrolled in 10 public institutions,
and 19.2 percent were enrolled in two private institutions (see Table 2-2).

Lastly, 34.9 percent of the students were enrolled in institutions that have an articulated institutional IT focus, while 65.1 percent were in institutions that have invested significantly in IT but have not necessarily used it as a major theme or recruiting tool for the institution (see Table 2-3).

### Table 2-1. Institutions Included in the Survey, by Carnegie Class
<table>
<thead>
<tr>
<th>Doctoral</th>
<th>MA</th>
<th>BA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drexel University</td>
<td>Colgate University</td>
<td>University of Minnesota, Crookston</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>University of Wisconsin–Eau Claire</td>
<td></td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>University of Wisconsin–La Crosse</td>
<td></td>
</tr>
<tr>
<td>University of Wisconsin–Madison</td>
<td>University of Wisconsin–Oshkosh</td>
<td></td>
</tr>
<tr>
<td>University of Wisconsin–Milwaukee</td>
<td>University of Wisconsin–Stout</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>University of Wisconsin–Whitewater</td>
</tr>
</tbody>
</table>

### Table 2-2. Public and Private Institutions
<table>
<thead>
<tr>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Wisconsin (7)</td>
<td>Colgate University</td>
</tr>
<tr>
<td>University of Minnesota (2)</td>
<td>Drexel University</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2-3. Technology Focus

<table>
<thead>
<tr>
<th>Institutional Technology Focus</th>
<th>No Declared Technology Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drexel University</td>
<td>Colgate University</td>
</tr>
<tr>
<td>University of California, San Diego (Sixth College)</td>
<td>University of Minnesota, Twin Cities</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>University of Wisconsin–Eau Claire</td>
</tr>
<tr>
<td>University of Wisconsin–Stout</td>
<td>University of Wisconsin–La Crosse</td>
</tr>
<tr>
<td>University of Wisconsin–Madison</td>
<td>University of Wisconsin–Madison</td>
</tr>
<tr>
<td>University of Wisconsin–Milwaukee</td>
<td>University of Wisconsin–Milwaukee</td>
</tr>
<tr>
<td>University of Wisconsin–Oshkosh</td>
<td>University of Wisconsin–Oshkosh</td>
</tr>
<tr>
<td>University of Wisconsin–Whitewater</td>
<td>University of Wisconsin–Whitewater</td>
</tr>
</tbody>
</table>

### Sample and Response Size

Tables 2-4 and 2-5 show the number of surveys sent out to randomly selected students by class (freshmen and seniors), the number of students who responded, and the percentage of responses received from each institution. As expected, freshmen were
more likely to respond than seniors, and the numbers and percentages for freshmen are higher even though we oversampled seniors. Each university used a slightly different sampling plan. Drexel University sent the survey to all freshmen and seniors. We achieved a 95 percent confidence interval and a ±5 percent random error rate.

We caution the reader about generalizing beyond these 12 institutions. We believe our

Table 2-4. Senior Sample

<table>
<thead>
<tr>
<th>Institution</th>
<th>Senior Headcount</th>
<th>Senior Sample</th>
<th>Percentage of Sample</th>
<th>Senior Response</th>
<th>Percentage Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colgate University</td>
<td>631</td>
<td>400</td>
<td>63.4%</td>
<td>141</td>
<td>35.3%</td>
</tr>
<tr>
<td>Drexel University</td>
<td>1,800</td>
<td>1,800</td>
<td>100.0%</td>
<td>81</td>
<td>4.5%</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>7,471</td>
<td>600</td>
<td>8.0%</td>
<td>90</td>
<td>15.0%</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>326</td>
<td>250</td>
<td>76.7%</td>
<td>98</td>
<td>39.2%</td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>8,318</td>
<td>500</td>
<td>6.0%</td>
<td>148</td>
<td>29.6%</td>
</tr>
<tr>
<td>University of Wisconsin—Eau Claire</td>
<td>2,989</td>
<td>800</td>
<td>26.8%</td>
<td>332</td>
<td>41.5%</td>
</tr>
<tr>
<td>University of Wisconsin—La Crosse</td>
<td>2,270</td>
<td>700</td>
<td>30.8%</td>
<td>156</td>
<td>22.3%</td>
</tr>
<tr>
<td>University of Wisconsin—Madison</td>
<td>8,744</td>
<td>1,000</td>
<td>11.4%</td>
<td>244</td>
<td>24.4%</td>
</tr>
<tr>
<td>University of Wisconsin—Milwaukee</td>
<td>5,203</td>
<td>800</td>
<td>15.4%</td>
<td>124</td>
<td>15.5%</td>
</tr>
<tr>
<td>University of Wisconsin—Oshkosh</td>
<td>2,910</td>
<td>800</td>
<td>27.5%</td>
<td>174</td>
<td>21.8%</td>
</tr>
<tr>
<td>University of Wisconsin—Stout</td>
<td>2,229</td>
<td>700</td>
<td>31.4%</td>
<td>128</td>
<td>18.3%</td>
</tr>
<tr>
<td>University of Wisconsin—Whitewater</td>
<td>2,238</td>
<td>700</td>
<td>31.3%</td>
<td>102</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

Table 2-5. Freshman Sample

<table>
<thead>
<tr>
<th>Institution</th>
<th>Freshman Headcount</th>
<th>Freshman Sample</th>
<th>Percentage of Sample</th>
<th>Freshman Response</th>
<th>Percentage Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colgate University</td>
<td>724</td>
<td>400</td>
<td>55.2%</td>
<td>187</td>
<td>46.8%</td>
</tr>
<tr>
<td>Drexel University</td>
<td>1,500</td>
<td>1,500</td>
<td>100.0%</td>
<td>431</td>
<td>28.7%</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>2,851</td>
<td>600</td>
<td>21.0%</td>
<td>152</td>
<td>25.3%</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>271</td>
<td>225</td>
<td>92.3%</td>
<td>92</td>
<td>36.8%</td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>4,238</td>
<td>525</td>
<td>11.8%</td>
<td>181</td>
<td>36.2%</td>
</tr>
<tr>
<td>University of Wisconsin—Eau Claire</td>
<td>2,898</td>
<td>800</td>
<td>27.7%</td>
<td>301</td>
<td>37.6%</td>
</tr>
<tr>
<td>University of Wisconsin—La Crosse</td>
<td>2,090</td>
<td>700</td>
<td>33.5%</td>
<td>232</td>
<td>33.1%</td>
</tr>
<tr>
<td>University of Wisconsin—Madison</td>
<td>5,479</td>
<td>900</td>
<td>16.4%</td>
<td>214</td>
<td>23.8%</td>
</tr>
<tr>
<td>University of Wisconsin—Milwaukee</td>
<td>4,933</td>
<td>800</td>
<td>16.2%</td>
<td>207</td>
<td>25.9%</td>
</tr>
<tr>
<td>University of Wisconsin—Oshkosh</td>
<td>2,774</td>
<td>800</td>
<td>28.8%</td>
<td>201</td>
<td>25.1%</td>
</tr>
<tr>
<td>University of Wisconsin—Stout</td>
<td>2,012</td>
<td>700</td>
<td>34.8%</td>
<td>175</td>
<td>25.0%</td>
</tr>
<tr>
<td>University of Wisconsin—Whitewater</td>
<td>2,386</td>
<td>700</td>
<td>29.3%</td>
<td>132</td>
<td>18.9%</td>
</tr>
</tbody>
</table>
findings are indicative but not conclusive about student behavior at many similar institutions. We distributed the survey in February and March 2004. Our freshmen would have completed one semester or quarter at the time they answered our survey.

We also expected females to respond in higher numbers, which they did, despite our oversampling of male students (see Table 2-6).

Our respondents’ GPAs have a fairly normal distribution (see Table 2-7). More than two-thirds of the students had a B or better GPA (67.4 percent). The group’s mean GPA was between 3.0 and 3.24.

We emphasize that our student sample is heavily weighted with traditional students:

Table 2-6. Respondents, by Gender

<table>
<thead>
<tr>
<th>Institution</th>
<th>Number Male</th>
<th>Number Female</th>
<th>Percentage Male</th>
<th>Percentage Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colgate University</td>
<td>133</td>
<td>178</td>
<td>42.8%</td>
<td>57.2%</td>
<td>311</td>
</tr>
<tr>
<td>Drexel University</td>
<td>249</td>
<td>231</td>
<td>51.9%</td>
<td>48.1%</td>
<td>480</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>113</td>
<td>120</td>
<td>48.5%</td>
<td>51.5%</td>
<td>233</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>88</td>
<td>91</td>
<td>49.2%</td>
<td>50.8%</td>
<td>179</td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>119</td>
<td>199</td>
<td>37.4%</td>
<td>62.6%</td>
<td>318</td>
</tr>
<tr>
<td>University of Wisconsin—Eau Claire</td>
<td>182</td>
<td>425</td>
<td>30.0%</td>
<td>70.0%</td>
<td>607</td>
</tr>
<tr>
<td>University of Wisconsin—La Crosse</td>
<td>102</td>
<td>273</td>
<td>27.2%</td>
<td>72.8%</td>
<td>375</td>
</tr>
<tr>
<td>University of Wisconsin—Madison</td>
<td>173</td>
<td>273</td>
<td>38.8%</td>
<td>61.2%</td>
<td>446</td>
</tr>
<tr>
<td>University of Wisconsin—Milwaukee</td>
<td>173</td>
<td>135</td>
<td>56.2%</td>
<td>43.8%</td>
<td>308</td>
</tr>
<tr>
<td>University of Wisconsin—Oshkosh</td>
<td>93</td>
<td>257</td>
<td>26.6%</td>
<td>73.4%</td>
<td>350</td>
</tr>
<tr>
<td>University of Wisconsin—Stout</td>
<td>106</td>
<td>182</td>
<td>36.8%</td>
<td>63.2%</td>
<td>288</td>
</tr>
<tr>
<td>University of Wisconsin—Whitewater</td>
<td>70</td>
<td>158</td>
<td>30.7%</td>
<td>69.3%</td>
<td>228</td>
</tr>
<tr>
<td>Total</td>
<td>1,601</td>
<td>2,522</td>
<td>38.8%</td>
<td>61.2%</td>
<td>4,123</td>
</tr>
</tbody>
</table>

Table 2-7. Respondents’ Cumulative Grade Point Average (GPA)

<table>
<thead>
<tr>
<th>GPA</th>
<th>Number</th>
<th>Percentage</th>
<th>Cumulative Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.76–4.00</td>
<td>647</td>
<td>14.9%</td>
<td>14.9%</td>
</tr>
<tr>
<td>3.50–3.75</td>
<td>754</td>
<td>17.3%</td>
<td>32.2%</td>
</tr>
<tr>
<td>3.25–3.49</td>
<td>725</td>
<td>16.7%</td>
<td>48.9%</td>
</tr>
<tr>
<td>3.00–3.24</td>
<td>805</td>
<td>18.5%</td>
<td>67.4%</td>
</tr>
<tr>
<td>2.50–2.99</td>
<td>912</td>
<td>20.9%</td>
<td>88.3%</td>
</tr>
<tr>
<td>2.25–2.49</td>
<td>170</td>
<td>3.9%</td>
<td>92.2%</td>
</tr>
<tr>
<td>2.00–2.24</td>
<td>135</td>
<td>3.1%</td>
<td>95.3%</td>
</tr>
<tr>
<td>Under 2.00</td>
<td>85</td>
<td>2.0%</td>
<td>97.3%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>121</td>
<td>2.7%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Total</td>
<td>4,354</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>
94.6 percent are full-time students (see Figure 2-1), and 92.0 percent are 25 years old or younger. Because more freshmen responded to the survey than seniors, 56.6 percent of respondents are under the age of 21.

Concomitantly, as freshmen tend to live on campus and seniors don't, our data reflect the freshman/senior distribution with on-campus/off-campus residency. We found that 55.1 percent of respondents lived on campus and 44.9 percent didn’t (Figure 2-2).

We asked students to indicate their ethnic group. Eighty-one percent were white, not of Hispanic origin (see Table 2-8). More than 6 percent of respondents (6.46 percent) declined to provide this information.

Lastly, we asked the students to identify their major (see Figure 2-3). Because so many students are freshmen, we weren’t surprised to find that 19.2 percent were undecided. Business (15.9 percent), social sciences (13.5 percent), and life sciences (12.7 percent) were the most frequently cited majors, probably an indicator that many of these students are weighing careers in business, law, and medicine. The larger number (5,295 answers
versus 4,374 respondents) occurs because we allowed students with double majors to so indicate.

**Qualitative Data**

We collected qualitative data through focus groups and individual interviews. We interviewed undergraduate students, administrators, and individuals identified as experts on student technology use in the classroom. We conducted student focus groups and interviewed administrators at six of the schools participating in the study.

We held student focus groups at Colgate University; the University of Minnesota, Twin Cities; the University of Wisconsin–Milwaukee; the University of Wisconsin–Stout; and the University of Wisconsin–Whitewater. We strove to interview as diverse a group of students as possible. We selected students from the different categories of institutions described above (Carnegie class, public and private, and those with a technology focus versus those without). Appendix B contains the focus group questions.

To recruit students, we posted advertisements in various campus locations, made announcements in large-enrollment classes, and e-mailed students using lists the institutions provided. In some cases we provided refresh-

Table 2-8. Respondents’ Ethnicity

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American or Black, not of Hispanic origin</td>
<td>64</td>
<td>1.5%</td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>18</td>
<td>0.4%</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>314</td>
<td>7.2%</td>
</tr>
<tr>
<td>Hispanic, Chicano, Mexican American, Latino</td>
<td>74</td>
<td>1.7%</td>
</tr>
<tr>
<td>White, not of Hispanic origin</td>
<td>3,532</td>
<td>81.0%</td>
</tr>
<tr>
<td>Other</td>
<td>76</td>
<td>1.7%</td>
</tr>
<tr>
<td>I do not wish to provide this information</td>
<td>282</td>
<td>6.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,360</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

**Figure 2-3. Students’ Majors**
ments or small gifts as incentives to attend. We also included in the focus groups students who work in general-access undergraduate student computing laboratories or for student technology help desks. Each group meeting lasted between an hour and an hour and a half. Notes were taken or recordings made and transcripts produced. A total of 132 students participated in the focus groups. None of the student comments cited in this study identify any individual student. In some instances, we corrected their English but made no change in meaning.

We interviewed 23 technology administrators and faculty at five of the participating institutions: Colgate University; the University of Minnesota, Twin Cities; the University of Wisconsin–Madison; the University of Wisconsin–Stout; and the University of Wisconsin–Whitewater. We selected administrators and faculty who supported undergraduate students in their use of technology for academic purposes. We chose, for example, managers of a student computer laboratory or employees of computer help desks. We also interviewed administrators who had valuable insights concerning student technology use. Appendix C includes the interview questions.

Endnote

3

Student Use and Skill with Information Technology

*Students are good with e-mail and online fantasy football leagues.*
*They do both of these while in class.*
—University of Wisconsin–Whitewater senior

The University of Wisconsin–Whitewater senior quoted above draws our attention to digital multitasking in the classroom, a characteristic of the millennial generation. Born after 1980, students of this generation are said to be distinguished by their learning styles and preferences, which include teamwork, experiential activities, and technology use. Prensky calls them “digital natives,” referring to the fact that they’ve grown up with technology, as opposed to “digital immigrants,” who didn’t. Digital immigrants include previous generations of students and most of today’s faculty and administrators, including this study’s authors.¹ Ninety-five percent of the students in our study are members of the millennial generation.²

One adult student in our study elaborated on the frustration felt as a digital immigrant in the new e-environment. “I returned to college after a 20-year hiatus, was admitted as a senior, and immediately found myself in dire straits. You cannot submit an assignment or even get assignments or grades without electronic skills. I did not even know if Web-mail was the same as e-mail. Excel was just a word that I knew had something to do with computers. In the past year I found myself overwhelmed with learning how to use Web-mail, MS Word, MS Excel, MS PowerPoint, Adobe Illustrator, Adobe Photoshop, computer scanners, digital camera downloads, and probably more. The e-threshold of successful participation in college is rising fast.” In contrast, the digital native is fully at ease in this new and rapidly expanding technological environment. Computers and cell phones are a fact of life.

Digital natives
♦ like to receive information quickly and have little tolerance for delays;
♦ parallel process and multitask;
♦ prefer graphics to text;
♦ prefer random access rather than a linear progression of information;
♦ function best when connected to a network;
♦ like to receive instant gratification and frequent rewards; and
♦ prefer games to serious work.³

Similarly, John Seely Brown portrays this generation of students as preferring discovery-based learning, where they find things out for themselves by trial and error rather than by accepting information from an “authoritative” source. They emphasize action and experimentation by trying things themselves rather than being told what to do.
or learning directions in a traditional way, for example, by reading manuals.\(^4\)

Jason Frand notes that these students take technology for granted and that staying connected is a central part of their lives. Doing is more important than knowing, and learning is accomplished through trial and error as opposed to a logical and rule-based approach.\(^5\)

According to Paul Hagner, these “students not only possess the skills necessary to utilize these new communication forms, but also there is an ever-increasing expectation on their part that these new communication paths be used.”\(^6\)

Not everyone is so enamored with the consequences of these learning skills and styles, however. Quoted in the Minneapolis--St. Paul \textit{Star-Tribune}, Professor Larry Rudnick of the University of Minnesota, Twin Cities, noted that one danger of the computer, especially for students who expect the computer to give them an instant answer, is that it always comes up with one, even if that answer is wrong. Newspaper writer Mary Jane Smetanka reported that some students are so conditioned by punch-a-button problem-solving on computers that they approach problems with a scattershot impulsiveness instead of methodologically working them through. This, in turn, leads to problem-solving difficulties.\(^7\)

Higher education’s challenge is to recognize these skill sets and preferences and provide a learning environment and opportunities that take advantage of and adjust for these traits.

An essential question for us is whether the above portraits of today’s student find support in our data. These portraits assume much about student access to technology, comfort and skill levels with technology, the transferability of these skills to multiple software applications, and a distinct learning style using hardware and software. Implicit is an assumption that younger students, even within the millennial group, have distinguishable skill sets and expectations based on the technology experience they brought with them to college. The answer to this question has enormous policy, implementation, and investment implications for higher education institutions, which we will return to in the concluding chapter.

In this chapter we present data and analysis from our surveys and from similar higher education institution surveys that describe technology usage and skill sets. We focus on the following areas: first, what kinds of information technologies do students own and use? More specifically,

- What kinds of information technologies do students own and have access to and at what levels of access and ownership?
- What kinds of information technologies do students use in the classroom, for academic work, and for entertainment?
- What amount of time do students spend engaging with different types of information technologies during the school year?
- Second, at what skill levels are students using information technologies? Specifically,
  - How skilled are students using IT in general?
  - How skilled are students using IT for academic purposes?
  - Do students have good problem-solving skills when it comes to using technology?
  - Do skills transfer from IT use for entertainment to more academic applications?
  - Are there age and generational differences?
  - Do freshmen have better or worse levels of comfort and technology skill than do seniors?

On the basis of the literature just cited about this student generation, we should expect to find that students use many and different types of IT in their academic work as well as for entertainment. We should find high levels of IT skill and skill transferability. We should especially find a great emphasis
on technologies that support communications and convenience. And we should find distinct learning styles and preferences. To the degree that our findings diverged from the portraits elaborated on by the authors cited above, we attempt to explain these differences.

**Access, Mobility, and Ownership**

Numerous national and institution-specific studies have tracked student access, mobility, and ownership of information technologies. We find an inexorable trend among college students to universal ownership, mobility, and access, recognizing that a digital divide exists at this moment and is of public concern.\(^9\) We found, however, no significant differences by ethnic group on ownership at the 13 institutions included in this study.

Steve Jones of the Pew Internet & American Life Project reported in his 2002 study that 85 percent of college students owned computers.\(^9\) The study involved 2,054 students at 27 colleges and universities. A 2003 survey at The University of Texas at Austin reported a 90 percent ownership rate for undergraduates; of these, 65 percent owned desktops and 35 percent owned laptops.\(^10\)

For all California State University System institutions, the ownership rate reported was 95.4 percent.\(^11\) Pennsylvania State University reported an ownership level of 95.0 percent for 2002.\(^12\)

Figure 3-1 uses data from surveys conducted by the University of Wisconsin–Madison beginning in 1998 and going through 2004. Note the steady growth in the percentage of ownership, which is now in the middle 90 percent range. Note also the greater growth rate among freshmen, who own slightly more machines percentage-wise than do seniors.\(^13\)
Our study found an equally high percentage of ownership (see Table 3-1).

**Laptops Versus Desktops**

We asked students whether they owned a computer, and if so, was it a laptop or a desktop computer. We found that 93.4 percent (4,084) owned a computer, and of these, 62.8 percent (2,747) owned a desktop, and 46.8 percent (2,047) owned a laptop. Just over 16 percent (710) owned both a desktop and laptop computer. And only 6.6 percent (290) of our study group didn’t own a computer. Since we conducted this survey entirely via the Web, we conclude that 100 percent of respondents have access to a computer and the Internet.

Looking for differing computer ownership patterns, we found desktop computer ownership to be the same for both on-campus and off-campus students, with little variation between freshmen and seniors or by gender, institution, and major. A higher percentage of off-campus students (72.2 percent) than on-campus students (54.8 percent) owned desktop computers. On-campus students (53.4 percent) were more likely than off-campus students (39.4 percent) to own laptops, suggesting a preference or need for greater mobility by on-campus students. As one student noted, “I just recently got a laptop computer, and I find it very useful to bring to the university library and to other study areas to work on papers and assignments.”

We noted similar patterns in the University of Wisconsin–Madison, University of Michigan, and University of Texas surveys.

We also found that freshmen (65.7 percent) were twice as likely to own laptops as seniors (34.3 percent). And concomitantly, the younger the student, the more likely he or she was to own a laptop computer. We found no gender difference in laptop ownership. Provost Gabrielle Wienhausen of Sixth College of the University of California, San Diego, noted that space constraints on dormitory room desks also contributed to a preference for laptops.

Laptop ownership was highest at Colgate University (78.8 percent), Drexel University (69.1 percent), and the University of Wisconsin–Stout (68.7 percent). Note that 100 percent of students at the University of Minnesota, Crookston, and the University of Wisconsin–Stout have access to laptop computers, as these institutions require all students to use a laptop, which is paid for by means of an annual fee. Students at the University of California, San Diego, reported laptop ownership at 59.1 percent; the University of Wisconsin–Madison reported 46.3 percent; and the University of Minnesota, Twin Cities, reported 43.8 percent. Laptop ownership was lowest at the University of Wisconsin–Milwaukee (33.2 percent) and the University of Wisconsin–Oshkosh (27.2 percent). We surmise that these numbers also

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**Table 3-1. Ownership of Selected Technologies**

<table>
<thead>
<tr>
<th>Technology Owned</th>
<th>Males</th>
<th>Females</th>
<th>Seniors</th>
<th>Freshmen</th>
<th>Overall Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal desktop</td>
<td>69.5%</td>
<td>58.8%</td>
<td>70.7%</td>
<td>57.1%</td>
<td>62.8%</td>
</tr>
<tr>
<td>Laptop</td>
<td>46.8%</td>
<td>46.6%</td>
<td>38.5%</td>
<td>52.7%</td>
<td>46.8%</td>
</tr>
<tr>
<td>PDA</td>
<td>17.8%</td>
<td>8.2%</td>
<td>15.1%</td>
<td>9.6%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Smart phone</td>
<td>1.9%</td>
<td>0.6%</td>
<td>1.1%</td>
<td>1.1%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Cell phone</td>
<td>77.7%</td>
<td>84.7%</td>
<td>81.7%</td>
<td>82.3%</td>
<td>82.0%</td>
</tr>
</tbody>
</table>
reflect personal and family income. Engineering students tended to own laptop computers more than students in other majors.

Our student interviews reinforced this ownership pattern. Students at the University of Wisconsin–Milwaukee and the University of Wisconsin–Oshkosh campuses reported significant computer use while on campus, but off-campus use dropped significantly.

Other Technologies

We asked about ownership of personal digital assistants (PDAs), smart phones (combination cell phone and PDA), and cell or digital phones, all of which indicate both student mobility and interest in communications. PDAs (11.9 percent) and smart phones (1.1 percent) have not penetrated the market very deeply, but cell phone usage is at 82.0 percent. PDAs tend to be owned by older students and men in our study. Resultantly, seniors were more likely to own PDAs. Students at the research universities reported the highest PDA usage (on average about 15 percent). Students at the University of California, San Diego, had the highest reported level of PDA ownership, at 19 percent.

Women in general (84.7 percent) were more likely than men (77.7 percent) to own cell phones. The University of California, San Diego (89.3 percent), and Drexel University (88.7 percent) had the highest percentage of cell phone owners. At Drexel University, 91.8 percent of the women owned cell phones, which was the highest reported for women in our sample. The oldest students in our sample (above age 40) reported the lowest use of cell phones (75.0 percent). Again, similar patterns were reported in the 2003 surveys by the University of Wisconsin–Madison, the University of Michigan, The University of Texas at Austin, and Pennsylvania State University.

Broadband Versus Modem Access

We asked students how they primarily accessed the Internet. Not surprisingly, freshmen residing on campus accessed the Internet most often using university networks. Seniors in our sample used commercial access most often (Figure 3-2). Among all students, 81.5 percent had access to broadband service, either through commercial or university sources, while 18.5 percent used slower modems. Clearly, broadband access is growing: a 2001 survey at the University of Minnesota, Twin Cities, found that 58 percent had high-speed access.

Part-time students, as opposed to full-time students, were far more dependent on commercial vendors, and many more were
dependent on modem-based service (see Figure 3-3).

By far the most significant finding with respect to modem versus broadband access is the student’s perception of barriers to the use of technology and preference for classes using technology. Students using modems uniformly reported more problems using technology and were less likely to want to take classes that use technology.

From the qualitative interviews, we learned that each campus’s IT environment partly shapes students’ IT access and satisfaction with that access. At Colgate University, for example, the ratio of students to computers in the labs is roughly 5:1. Even with this relatively high level of access, students complained about overcrowding. Also, all but 250 of these students are in university housing, which has 10-Mbps port per resident. At the University of Wisconsin–Milwaukee, the student computing labs are crowded and have long lines. Many students noted that their personal machines do not work very well (in no small part because of viruses).

A few students commented on cost. “I think the use of information technology in classes can be beneficial to students,” one student said. “However, the poor do not have the same access to information technology as the rich, so in this sense, the use of information technology in classes is discriminatory. It is true that poor students do have access to some forms of information technology at their institutions, but this access is often limited and inconvenient. The use of information technology should not be required of students in order to complete a course and receive a good grade. In my opinion, the requirement of using information technology to complete coursework is equivalent to giving some students unlimited access to a textbook while allowing other students only half an hour a day to study the same material. This, of course, would be widely regarded as unfair and unequal, and so is the current use of information technology at universities.”

Another student noted simply, “I would like to emphasize the point that the greatest barrier to using technology is its price tag. If I could afford a laptop or PDA, I would use one.” We note that the University of Michigan survey found that only 3.0 percent of the students considered cost a barrier to
computer ownership. This may, however, reflect comparatively high family incomes at that institution.

**Usage Patterns**

We asked students about the applications they used on their electronic devices. Virtually 100 percent used computers for writing documents and e-mails, followed by surfing the Internet for pleasure and for classroom activities (see Table 3-2). We were pleased to find that 83.6 percent of the students reported using a library resource to complete a class assignment. We also learned that they did many of these things simultaneously. According to a freshman at the University of Wisconsin–Stout, “Students probably do the same four things all at the same time. They do word processing, Internet browsing, instant messenger, and e-mail.”

Many of our students commented on multi-tasking and preferences for games in both positive and negative terms. One student said, “I like the concept of the use of technology in classrooms, that is, ‘laptop students’ on a wireless campus, but there are many, many students who are ‘disruptive’ in class because they are instant messaging and surfing the Web rather than paying attention in class. They attend class so that they are considered ‘present’ even though there is very little learning going on from their end.”

The least-used activities reported were creating Web pages (21.7 percent) and editing video and audio (21.2 percent).

Seniors were more likely to have used spreadsheets, presentation software, and a computer at work. Freshmen were more likely to use instant messaging, play computer games, and download videos.

<table>
<thead>
<tr>
<th>Application</th>
<th>Seniors</th>
<th>Freshmen</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing documents (word processing)</td>
<td>99.4%</td>
<td>99.6%</td>
<td>99.5%</td>
</tr>
<tr>
<td>Creating, reading, sending e-mail</td>
<td>99.6%</td>
<td>99.5%</td>
<td>99.5%</td>
</tr>
<tr>
<td>Surfing the Internet for pleasure</td>
<td>97.2%</td>
<td>97.1%</td>
<td>97.2%</td>
</tr>
<tr>
<td>Classroom activities and studying using an electronic device</td>
<td>96.4%</td>
<td>96.3%</td>
<td>96.4%</td>
</tr>
<tr>
<td>Using a university library resource to complete a class assignment</td>
<td>86.9%</td>
<td>81.7%</td>
<td>83.6%</td>
</tr>
<tr>
<td>Chatting with friends or acquaintances using instant messaging</td>
<td>71.2%</td>
<td>91.3%</td>
<td>83.0%</td>
</tr>
<tr>
<td>Downloading or listening to music or videos/DVDs</td>
<td>72.3%</td>
<td>87.1%</td>
<td>80.9%</td>
</tr>
<tr>
<td>Completing a learning activity or accessing information for a course using course management systems</td>
<td>73.5%</td>
<td>77.4%</td>
<td>75.8%</td>
</tr>
<tr>
<td>Online shopping</td>
<td>77.4%</td>
<td>64.8%</td>
<td>70.0%</td>
</tr>
<tr>
<td>Playing computer games</td>
<td>62.3%</td>
<td>74.8%</td>
<td>69.6%</td>
</tr>
<tr>
<td>Creating spreadsheets or charts (Excel, etc.)</td>
<td>75.1%</td>
<td>57.6%</td>
<td>64.9%</td>
</tr>
<tr>
<td>Creating presentations (PowerPoint, etc.)</td>
<td>68.8%</td>
<td>48.8%</td>
<td>57.1%</td>
</tr>
<tr>
<td>Using an electronic device (computer, Palm device, etc.) at your place of employment</td>
<td>62.3%</td>
<td>36.9%</td>
<td>47.5%</td>
</tr>
<tr>
<td>Creating graphics (Photoshop, Flash, etc.)</td>
<td>47.3%</td>
<td>46.3%</td>
<td>46.7%</td>
</tr>
<tr>
<td>Creating Web pages (Dreamweaver, FrontPage, etc.)</td>
<td>23.8%</td>
<td>19.6%</td>
<td>21.7%</td>
</tr>
<tr>
<td>Creating and editing video/audio (Director, iMovie, etc.)</td>
<td>18.1%</td>
<td>22.6%</td>
<td>21.2%</td>
</tr>
</tbody>
</table>
We noted some institutional differences. At Colgate University, Drexel University, and the University of California, San Diego, a greater percentage of students had tried each listed application than at the other institutions. At the University of Minnesota, Crookston, a remarkable 83.7 percent had used PowerPoint. We also noted that women were less likely to have played computer games. The qualitative data also support this. While a vast majority of students interviewed did play computer games (especially Internet-based games), those who reported doing a lot of computer gaming were predominantly male. As Michael Crawford, manager of the University of Wisconsin–Madison residence hall computer labs, reported, “When it comes to gaming, our demographic is the white male.”

### Hours of Use

We were also interested in how many hours each week students used their computer and for what applications (see Table 3-3). The high standard deviations indicate a great deal of variation around the mean.

Students spend many hours every week using their computers. And they use them for a wide range of purposes. We saw 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. Our figures compare with those of Steve Jones, who in 2003 found that 42 percent of the students use the Internet most often to communicate socially, 38 percent to do class work, 10 percent to be entertained, and 7 percent to communicate

<table>
<thead>
<tr>
<th>Activities</th>
<th>N</th>
<th>Mean*</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom activities and studying using an electronic device</td>
<td>4,367</td>
<td>4.01</td>
<td>1.241</td>
</tr>
<tr>
<td>Writing documents (word processing)</td>
<td>4,352</td>
<td>3.76</td>
<td>0.955</td>
</tr>
<tr>
<td>Surfing the Internet for pleasure</td>
<td>4,359</td>
<td>3.47</td>
<td>1.213</td>
</tr>
<tr>
<td>Creating, reading, sending e-mail</td>
<td>4,359</td>
<td>3.47</td>
<td>0.979</td>
</tr>
<tr>
<td>Chatting with friends or acquaintances using instant messaging</td>
<td>4,347</td>
<td>3.45</td>
<td>1.620</td>
</tr>
<tr>
<td>Using an electronic device (computer, Palm device, etc.) at your place of employment</td>
<td>3,337</td>
<td>3.31</td>
<td>2.306</td>
</tr>
<tr>
<td>Downloading or listening to music or videos/DVDs</td>
<td>4,336</td>
<td>3.15</td>
<td>1.563</td>
</tr>
<tr>
<td>Completing a learning activity or accessing information for a course using course management systems</td>
<td>4,344</td>
<td>2.48</td>
<td>1.152</td>
</tr>
<tr>
<td>Using a university library resource to complete a class assignment</td>
<td>4,349</td>
<td>2.46</td>
<td>1.010</td>
</tr>
<tr>
<td>Playing computer games</td>
<td>4,337</td>
<td>2.39</td>
<td>1.312</td>
</tr>
<tr>
<td>Creating spreadsheets or charts (Excel, etc.)</td>
<td>4,342</td>
<td>2.07</td>
<td>1.060</td>
</tr>
<tr>
<td>Online shopping</td>
<td>4,353</td>
<td>2.06</td>
<td>0.960</td>
</tr>
<tr>
<td>Creating presentations (PowerPoint, etc.)</td>
<td>4,342</td>
<td>1.82</td>
<td>0.896</td>
</tr>
<tr>
<td>Creating graphics (Photoshop, Flash, etc.)</td>
<td>4,335</td>
<td>1.79</td>
<td>1.077</td>
</tr>
<tr>
<td>Creating Web pages (Dreamweaver, FrontPage, etc.)</td>
<td>4,315</td>
<td>1.39</td>
<td>0.898</td>
</tr>
<tr>
<td>Creating and editing video/audio (Director, iMovie, etc.)</td>
<td>4,338</td>
<td>1.34</td>
<td>0.793</td>
</tr>
</tbody>
</table>

*Scale = 1 (do not use), 2 (less than an hour), 3 (1–2 hours), 4 (3–5 hours), 5 (6–10 hours), 6 (11 or more hours)
professionally; 2 percent did not know.\textsuperscript{16} At the California State University System institutions, students were found to spend 55.6 percent of their time on computers in support of class work.\textsuperscript{17} Differences emerged there by major and by gender, where males used their computers for academic work 49.2 percent of the time and females 60.0 percent. The 2003 University of Wisconsin–Madison Student Computing Survey found that students spent on average 22 hours per week on the Internet.

The qualitative data support these findings. When interviewed, students reported heavily using a computer for communication, but that was secondary to using it for schoolwork. While students noted extensive computer use for entertainment such as playing games, downloading music and video, and shopping, these uses were less important and occupied less of their time than the use of technology for class-related work.

In summary, our findings both confirm and contradict findings by observers such as Frand, Oblinger, and Zemsky and Massey. Like Frand and Oblinger, Zemsky and Massey found that students “want to be connected, principally to one another. They want to be entertained, principally by games, music, and movies.”\textsuperscript{18} Zemsky and Massey contend that students “want to present themselves and their work.” We found instead that the highest computer use was in support of academic activities and that presentation software was driven primarily by the requirements of a student’s major and the curriculum. Like Zemsky and Massey, Oblinger, and Frand, we found strong use and skill levels in support of communications and entertainment. As one student commented, “I would feel very disconnected and lost if my laptop and cell phone were taken away from me. However, had I never been introduced to them, I may not rely on them as much as I do now. Still, I believe they are very useful tools, especially for communication.”

With respect to the importance of presentation software, we believe Zemsky and Massey may have jumped too quickly to a conclusion based on the data available to them. They conferred with university bookstores on each of the campuses participating in their Weatherstation Project and then turned to the \textit{Chronicle of Higher Education}’s monthly tracking of the “Best-Selling Software at College Bookstores.” Bookstores sell bread-and-butter software much less than previously because it now comes bundled with the machines. But they do sell lots of peripheral software, like Photoshop.\textsuperscript{19} We also found that presentation software was least used, and, as we will demonstrate shortly, students had the least self-reported skill in using it.

\textbf{Explaining Varying Hours of Use}

We did a regression analysis to determine what factors contributed to hours of use of various technology applications (see Table 3-4). Factors vary by application, although it is possible to group the factors by academic application, communications, and entertainment. Academic usage relates strongly to the student’s academic major and class status (senior or freshman). Communications and entertainment relate very much to gender and age. For the most part, though, these factors have a low level of significance.

Findings from the qualitative interviews support the significance of student major. From our student interviews, a picture emerged of student technology use being instrumental in nature and driven by the demands of the major and the classes students took. According to a University of Wisconsin–Whitewater student, “Students use what they need to use. They don’t try new stuff if they don’t need it for class.” Another student from the University of Wisconsin–Whitewater noted a great deal of variation in students’ application usage and skill, with the primary
determining factor being the student’s major. “Students have a very diverse skill set. Certain majors have no idea—others have a pretty good idea. Certain majors require more use.” Another commented, “I do not know how to use many of the programs mentioned. For example, Excel and PowerPoint were never taught to me in high school or college. If I was to partake in a class that had these programs required, I would need the classes to teach me how to use them before I feel I could be graded on any of those technical assignments.”

Occasionally students’ IT usage is driven by an external or extracurricular activity or interest, but it is still instrumental. One Colgate University student noted that she didn’t really have a great understanding of IT but would learn a specific thing if she needed it. For example, as an editor, she had to learn Adobe Photoshop and PageMaker. “I learned these because I need to know how to use them.”

Because the senior/freshman variable seemed to be a common factor, we looked at its impact in greater depth. The most noticeable difference was the use of a computer at a place of employment. More seniors work, and not surprisingly, that work often requires the use of computers. Seniors spent more hours on the computer each week in support of their educational activities and also more time on more advanced applications—spreadsheets, presentation applications, and graphics. The University of Wisconsin–Madison data show that seniors (30.0 percent) take more software training than freshmen (7.0 percent). And freshmen spend more time playing games, listening to music, and instant messaging. One conclusion is that usage relates in part to curriculum demands, with seniors having less discretionary time for computer entertainment. Later we’ll observe the other obvious

Table 3-4. Factors that Explain Hours Spent Using Technology

<table>
<thead>
<tr>
<th>Application</th>
<th>Strongest Factor</th>
<th>Next Strongest Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom activities and studying using an electronic device</td>
<td>Senior</td>
<td>Major (engineering)</td>
</tr>
<tr>
<td>Writing documents (word processing)</td>
<td>Institution</td>
<td>Gender (female)</td>
</tr>
<tr>
<td>Surfing the Internet for pleasure</td>
<td>Gender (male)</td>
<td>Institution</td>
</tr>
<tr>
<td>Creating, reading, sending e-mail</td>
<td>Senior</td>
<td>Gender (female)</td>
</tr>
<tr>
<td>Chatting with friends or acquaintances using instant messaging</td>
<td>Age (youngest)</td>
<td>On campus</td>
</tr>
<tr>
<td>Using an electronic device at your place of employment</td>
<td>Senior</td>
<td>Full time</td>
</tr>
<tr>
<td>Downloading or listening to music or videos/DVDs</td>
<td>Age (youngest)</td>
<td>Gender (male)</td>
</tr>
<tr>
<td>Completing a learning activity or accessing information for a course using course management systems</td>
<td>Major</td>
<td>Institution</td>
</tr>
<tr>
<td>Using a library resource to complete a class assignment</td>
<td>Senior</td>
<td>Major (social sciences)</td>
</tr>
<tr>
<td>Playing computer games</td>
<td>Gender (male)</td>
<td>On campus</td>
</tr>
<tr>
<td>Creating spreadsheets or charts</td>
<td>Age (oldest)</td>
<td>Major</td>
</tr>
<tr>
<td>Online shopping</td>
<td>No factor</td>
<td>No factor</td>
</tr>
<tr>
<td>Creating presentations (PowerPoint, etc.)</td>
<td>Age (oldest)</td>
<td>Major (business)</td>
</tr>
<tr>
<td>Creating graphics (Photoshop, Flash, etc.)</td>
<td>Major (fine arts)</td>
<td>Gender (female)</td>
</tr>
<tr>
<td>Creating Web pages (Dreamweaver, FrontPage, etc.)</td>
<td>Gender (male)</td>
<td>Major (life sciences)</td>
</tr>
<tr>
<td>Creating and editing video/audio (Director, iMovie, etc.)</td>
<td>Gender (female)</td>
<td>Major (fine arts)</td>
</tr>
</tbody>
</table>
conclusion: because seniors are required to use the applications more, their skill levels rise.

Men, and especially the youngest men in our sample, were more likely to spend more hours playing computer games, surfing the Internet, and downloading music. Women spend more time communicating. Confirming what parents suspect, students with the lowest GPAs spend significantly more time playing computer games, and students with the highest GPAs spend more hours weekly using the computer in support of classroom activities. For almost all activities, students at Drexel University and the University of California, San Diego, spent more hours on the computer, with one notable exception. The University of Minnesota, Crookston, students spent the most hours on the computer in support of classroom activities. This likely reflects the deliberate design of the curriculum—students are required to do most of their work using a laptop computer.

**Student Technology Skills**

Undergraduate students must develop two skill types: information literacy or fluency and the technical skills needed to use IT tools. The American Library Association 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, “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 states that technology skills or literacy is a necessary precursor to information literacy and that the latter cannot be achieved without the former.

Rapid software evolution that requires new and different skills makes defining technology skills difficult. 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.” This concept includes three skill sets: 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 conduct problem-solving activities using IT.

While we don’t use the phrase technology fluency in this study, our research is premised on 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.

**Skill Level**

We asked the students about the skill level they felt they had attained for each application (see Table 3-5). Note that the table includes only students who use the software; we didn’t include in the calculation students who indicated that they didn’t use the software. Note, too, that our findings are based on student self-assessment and are not a true measurement of student skills. We need better measurement tools. But the data are informative and can guide future initiatives to improve technology use and policy making.
The students rated themselves as especially highly skilled in communications, word processing, and Internet use. They rated themselves lowest on graphics and presentation software. Confirming earlier findings, seniors tended to rank themselves higher than freshmen in tools such as PowerPoint and spreadsheets. We found that a student’s major played a significant role in student skills, followed by class status (senior/freshman). A study of student skills at the California State Universities also noted differences by major.²⁷

Sharon Fass McEuen’s study of student technology skills at Southwestern University in Georgetown, Texas, noted similar patterns.²⁸ Skill levels were highest in word processing, the Internet, and communications and were significantly lower for specialized applications such as spreadsheets and presentation software. She also found much lower skill levels in computer maintenance. McEuen likens technology skills to writing skills: students come to college knowing how to write but are not developed writers. McEuen suggests that colleges and universities approach IT in the same way they approach writing.²⁹

The open-ended questions reflected the differentiation of skill sets. One student told us, “As far as information technology goes, according to your definition, I am pretty well versed in programs such as Word, PowerPoint, Excel, etc. The programs I have trouble with are programs such as LabView. I figure this is just because it is the first time I have ever been exposed to it.” A freshman noted: “I don’t feel freshmen are given enough instruction on the use of campus technology. I couldn’t access my e-mail account for one-half of the first semester until I made friends with an older student who taught me how to log in to my account.” A student at the University of Minnesota, Twin Cities, made a more telling comment: “I’d say I’m average when it comes to information technology skills. I can survive with what I need to do, but I can’t fix my computer or do much in Excel or anything like that, tables and stuff.” The survey didn’t ask about skills needed to maintain equipment, but the interviews revealed a dichotomous set of skills: students are much more capable

<table>
<thead>
<tr>
<th>Application</th>
<th>Mean*</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail</td>
<td>3.60</td>
<td>0.525</td>
</tr>
<tr>
<td>Instant messenger</td>
<td>3.54</td>
<td>0.652</td>
</tr>
<tr>
<td>Word processing</td>
<td>3.53</td>
<td>0.553</td>
</tr>
<tr>
<td>Web surfing</td>
<td>3.47</td>
<td>0.578</td>
</tr>
<tr>
<td>Presentation software (PowerPoint, etc.)</td>
<td>2.90</td>
<td>0.762</td>
</tr>
<tr>
<td>Online library resources</td>
<td>2.88</td>
<td>0.687</td>
</tr>
<tr>
<td>Spreadsheets (Excel, etc.)</td>
<td>2.86</td>
<td>0.763</td>
</tr>
<tr>
<td>Course management systems</td>
<td>2.83</td>
<td>0.744</td>
</tr>
<tr>
<td>Graphics (Photoshop, Flash, etc.)</td>
<td>2.45</td>
<td>0.846</td>
</tr>
<tr>
<td>Creating Web pages (Dreamweaver, FrontPage, etc.)</td>
<td>2.17</td>
<td>0.910</td>
</tr>
<tr>
<td>Creating and editing video/audio (Director, iMovie, etc.)</td>
<td>2.07</td>
<td>0.848</td>
</tr>
</tbody>
</table>

*Scale = 1 (very unskilled) to 4 (very skilled)
of using their computer and software than maintaining them.

**Explaining Skill Levels Attained**

The student’s major is a significant factor explaining the level of IT skill attained. The overall highest level of self-reported computer and application skills was among business students, engineering students, and life science students. But when we looked at graphics skills, having a fine arts or engineering major was more significant (see Table 3-6). So was the need for training in the major. One student told us, “Students with media arts majors need much more training with Adobe and Macromedia applications.” And in all cases, seniors in the major had higher skill levels than freshmen. 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 and spreadsheets; arts students are more likely to use graphics applications. At the University of Minnesota, Crookston, all students are required to make PowerPoint presentations to demonstrate their work. And not surprisingly, we find that Crookston students had the highest reported PowerPoint skill levels.

We saw little difference by gender, except in the use of graphics, where men reported higher skill levels. But this probably relates to the male/female distribution in majors such as engineering. Our findings differ significantly from those of McEuen, who found that male students at Southwestern University estimated their IT fluency and comfort level with technology higher than females. We believe that the student’s major should temper gender differences in self-reported skill levels.

Interestingly, we found virtually no difference in reported skills by GPA. And differences among 12 of the institutions in our study are minimal for every application when controlling for the availability of majors at the institution. One explanation may be that students rate themselves vis-à-vis their peers, and so the variation in skill levels may not appear in our study. Or it may confirm Garrison Keillor’s observation about the upper Midwest, where “everyone is above average.”

### Table 3-6. Factors Explaining Skill Levels Attained

<table>
<thead>
<tr>
<th>Application</th>
<th>Strongest Factor</th>
<th>Next Strongest Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail</td>
<td>No factor</td>
<td>No factor</td>
</tr>
<tr>
<td>Instant messenger</td>
<td>Age (youngest)</td>
<td>Institution</td>
</tr>
<tr>
<td>Word processing</td>
<td>Senior</td>
<td>Major (humanities)</td>
</tr>
<tr>
<td>Web surfing</td>
<td>Gender (male)</td>
<td>Age (youngest)</td>
</tr>
<tr>
<td>Presentation software (PowerPoint, etc.)</td>
<td>Senior</td>
<td>Major (business)</td>
</tr>
<tr>
<td>Online library resources</td>
<td>Senior</td>
<td>Major (social sciences)</td>
</tr>
<tr>
<td>Spreadsheets (Excel, etc.)</td>
<td>Senior</td>
<td>Major (business)</td>
</tr>
<tr>
<td>Course management systems</td>
<td>Institution</td>
<td>Major (business)</td>
</tr>
<tr>
<td>Graphics (Photoshop, Flash, etc.)</td>
<td>Gender (male)</td>
<td>Major (fine arts)</td>
</tr>
<tr>
<td>Creating Web pages (Dreamweaver, FrontPage, etc.)</td>
<td>Gender (male)</td>
<td>Major (life sciences)</td>
</tr>
<tr>
<td>Creating and editing video/audio (Director, iMovie, etc.)</td>
<td>Gender (female)</td>
<td>Major (fine arts)</td>
</tr>
</tbody>
</table>
Our quantitative data show that in general students say they have the skills they need. The qualitative data suggest a slightly different picture. Students have basic skills with office suites as well as with e-mail and Web surfing. But they appear to have difficulty moving beyond basic features and don’t seem to recognize the enhanced functionality of the applications they own and use. And problem-solving skills appear questionable, which may be why students have problems coping with new demands or anything out of the ordinary.

Cathy O’Bryan, manager of professional and technical education in the Division of Information Technology at the University of Wisconsin–Madison, observed, “With freshmen, you see higher technology skills, but the problem-solving skills aren’t there. They are taught a ‘corner of the pie’ rather than how to manage the whole desktop. The students are just taught one area. I see a lot of students that can use a tool only in a vacuum. When students have to create an application with the tool, for example, they don’t know how to design and apply what they’ve learned. If you sketch out the application, they could do it, but they don’t have the critical-thinking skills to take what they’ve learned and create a solution to a specific problem.”

As one student who worked on the student help desk at the University of Wisconsin–Whitewater described student skills, “Some students are tech savvy, and some hate computers and think the computers hate them back. Most people can use the basic programs, but there is not a lot of in-depth knowledge.” This common view was reiterated by a student at Colgate University: “Most students’ skills are adequate. They’re not fumbling around and are fairly well versed. But most students are not too good. Not markedly bad either. Students put in basic time to learn office applications, but not beyond what is required.”

Commenting on students’ IT skills coming out of high school, O’Bryan said, “The technology skills education in the K–12 system is inadequate. There is no systemic standard for technical training. It varies greatly school by school and state by state. Many high schools don’t have adequate technical resources and do not employ skilled, certified instructors and staff. While the overall skill level of students has risen over the years, there are still the haves and the have-nots when it comes to technology skills. With freshmen, you see that diversity. And, the bell curve is flattening out, with many students at each end of the spectrum.” Maddy Covelli, manager of the Software Training for Students (STS) program at the University of Wisconsin–Madison, concurred. “Students are generally coming in with good basic skills—much more so than when I was in school five years ago. If you’ve been out of school for as little as five years, you can find yourself behind your peers (in technical skills).”

A student technology service worker at the University of Wisconsin–Milwaukee observed that students “mystify” technology and some are “afraid to putz.” The aversion to experimentation seems driven by a fear of doing damage to their machines and applications. One Colgate student stated, “I know that I am clueless. I am so afraid. I am petrified that I am going to do something wrong.” This student described how he was trying to get rid of some of the viruses on his computer and somehow deleted the driver for his sound card. No one had been able to get it back for him. This finding contradicts some of the literature on student attitudes and use of technology. Brown, Frand, and Oblinger contend that the current student generation has a strong affinity for experimentation and learning by trial and error, especially when it comes to technology.

At the University of Wisconsin–Madison, the STS program offers free IT skills training
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for all students. The program includes one- to two-hour instructor-led classes taught by students, more than 200 self-study fully online classes, and links to Web sites offering free online classes. Attendance at the instructor-led classes has increased over the years, with more than 8,700 student registrants in the 2003 fiscal year. Currently, the most popular classes include the technologies not generally offered in high schools and those requiring greater skills. Operating since 1995, the STS has changed its class offerings each year on the basis of student demand. During its first few years, the most popular classes were basic Internet and e-mail classes. In 2003–2004, complex technology classes covering Dreamweaver, Excel, and Photoshop were the most popular. For the fall 2003 semester, 392 instructor-led classes were offered.

Covelli measures the success of the instructor-led classes by measuring attendance levels and monitoring responses to attendee satisfaction surveys. The survey data also help her plan what classes to offer the next semester and ensure that student needs are met. When talking about the barriers to improving student IT skills, Covelli noted, “The greatest barrier for students in our technology classes is time management. The students find it difficult to make the time to really learn the technology rather than just learning enough to get by for an assignment.”

The comparative literature on student IT skill self-assessment suggests that students overrate their skills, freshmen overrate their skills more, and men overrate more than women. Our data support these findings. Judy Doherty, director of the Student Technologies Resource Group at Colgate University, remarked on student skill assessment: “Students state in their job applications that they are good if not very good, but when tested their skills are average to poor, and they need a lot of training.”

Conclusion

The literature on student technology use and skills portrays today’s undergraduate student as being comfortable with IT. Our findings both support and contradict this literature.

We found student access to and ownership of technology to be high, though access to a computer off campus did seem to pose problems 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 major. And the skill is not learned prior to coming to the university. The university’s curriculum matters.

Students rated themselves highly skilled in the use of communications and word processing, and the Internet. They rated themselves less highly on graphics and presentation software. Seniors tended to rate their skills more highly than freshmen, indicating the importance of training and requirements at universities. The skills are not necessarily innate and intuitive. Our qualitative data suggest that students are possibly rating their skills higher than they ought. Students have difficulty with problem solving and dealing with new kinds or technology applications. The 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 (but this doesn’t seem to be a huge contribution) and to typing speed. Peer networks seem important here, at least at the more residential campuses. But systematic survey analysis is needed to fully support these conclusions.

In the next two chapters we explore further how student use and skill play out in their use of technology in the classroom and the use of course management system software.
Endnotes


8. There is a significant body of scholarship on access to IT, often phrased in terms of the “digital divide.” See, for example, J. Cooper and K. D. Weaver, Gender and Computers: Understanding the Digital Divide (Mahwah, N.J.: Lawrence Erlbaum Associates, 2003); P. Norris, Digital Divide? Civic Engagement, Information Poverty, and the Internet Worldwide (New York: Cambridge University Press, 2001); M. Warschauer, Technology and Social Inclusion: Rethinking the Digital Divide (Cambridge, Mass.: MIT Press, 2003); and R. L. Mack, The Digital Divide: Standing at the Intersection of Race and Technology (Durham, N.C.: Carolina Academic Press, 2001). The emphasis in this literature is on examining the factors (such as race, class, ethnicity, and geography) that shape the broader aspects of Internet use and what implications they have for public policy.


15. University of Michigan online Student IT Survey.


26. Ibid., chapter 2.

27. The CSU survey reported that 87.7 percent of their students rated their skill levels as good or excellent. They also found that seniors rated their overall skill levels higher than freshmen. And there were some different levels of skill found among the majors, with humanities being lowest and computer science/engineering highest. CSU Technology Metrics Student Survey Report, 2002, pp. 46–48, 99.


29. Ibid., p. 9.
30. The California State University student survey found that males rated their skills higher than females. *CSU Technology Metrics Student Survey Report*, op. cit., p. 100.

31. McEuen, op. cit., p. 4.


33. STS program at UW–Madison, op. cit.

As the first student quoted above so astutely observed, technology in the classroom is not a panacea. It must be properly used. Then students will perceive it to be extremely beneficial and effective. As one enthusiastic student commented, “I love information technology. It has helped me to grow tremendously academically this year, and it strengthened my relationships with teachers, classmates, and friends.” For others, Luddite or not, it is problematic, undermining face-to-face contact and having little impact on their learning. One student said, “I feel like I have lost part of the vital student-teacher connection.” Another noted that technology made faculty seem more detached. For some, it appears to be a Luddite ambivalence about machines, although this is more often a student’s perception of the faculty.

What the above contradictory comments suggest is that realizing IT’s potential contribution to student learning requires careful thought and effort among faculty and students alike.

Chickering and Gamson identify seven principles that contribute to good practice in teaching and learning:

- encourage active learning,
- encourage prompt feedback,
- emphasize time on task,
- communicate high expectations, and
- respect diverse talents and ways of learning.

Building on Chickering and Gamson’s work, Chickering and Ehrmann identify ways to use technology in the classroom as a lever to implement these seven principles in undergraduate education. For example, they propose the use of e-mail and other forms of technology to dramatically improve student-faculty contact. Publishing student work on the Internet makes it more visible and thus communicates higher expectations. And technology use can help better accommodate diverse learning styles by catering to visual learners and facilitating learning at different speeds. By using technology in such ways, they contend, technology can start realizing its potential to improve learning.

Similarly, Colleen Carmean and Jeremy Haefner identify five categories of learning principles that technology can support and thereby foster an engaging and student-centered experience:

- Social. Technology facilitates communication between students and faculty and among students, and it permits rich and timely feedback from faculty.

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Active. Students engage with real-world data and issues, faculty employ active learning techniques, and curricula emphasize exploration, practice, and reinforcement.

Contextual. Students come to class with an existing knowledge base and preexisting conceptual frameworks.

Engaging. Technology permits accommodating different learning styles, communicating high expectations, and providing a high-challenge, low-threat environment.

Student owned. Students organize materials and take control of planning for their work.

These researchers guide our analysis of how technology contributes to the undergraduate learning experience. Do students believe that technology use at their campus improves learning? Do they acknowledge faculty’s adherence to best practices and recognize technology’s impact on their learning? In this chapter we pay particular attention to student use of and preference for technology in the classroom. We focus on several aspects:

Communication. Is technology being used in the classroom to facilitate communication and collaboration between students and faculty as well as among students?

Active learning. Is technology being used to facilitate active learning by introducing real-world data or problems, with an emphasis on exploration, practice, and reinforcement?

Feedback. Are faculty using technology to provide more feedback to their students? Do students believe this feedback contributes to their learning and their undergraduate experience?

Time on task. Is technology use increasing the amount of time students spend on course-related work?

Student control. Is technology use contributing to students’ greater control of their progress in their classes?

In analyzing the students’ responses to our survey, we also contrast faculty responses to similar questions found in the ECAR study on faculty use of course management systems at the University of Wisconsin System’s institutions.

Student Preference for Classroom IT

What are student preferences with respect to technology use in the classroom? We expected that the millennial student would prefer classes that use technology and increasingly demand technology in support of learning. What we find instead is a bell curve with a preference for moderate classroom technology use (see Figure 4-1). The mean (3.07), median (3.00), and mode (3) were squarely at the moderate level of preference on a scale of 1 to 5, with 1 being “I do not prefer the use of technology” to 5 being “I prefer taking courses that are taken totally online.” We found that 30.8 percent of students preferred taking courses that use extensive levels of technology. Least preferred (2.2 percent) were courses delivered entirely online. Nevertheless, 25.6 percent of the students preferred limited or no use of technology in the classroom.

A Pennsylvania State University survey found a similar distribution of preferences: 47.0 percent of students surveyed would prefer to take a course that makes significant use of technology, and 46.0 percent preferred a traditional classroom setting.

We also used a two-box ratio to illustrate student preferences. To do this we delete the neutral group from the analysis and compare the ratio of students with the strongest and weakest preferences for classroom technology. What we find is a rather weak ratio in favor of technology: 1.4 to 1.1.

To better understand what factors influence the preference for classroom technology use, we clustered the factors as follows:
previous experience with classroom technology use; faculty skill using technology, hours students use technology, and respondents’ perceived skill levels using computers; institution; and major, GPA, and demographics.

We found that a student’s previous positive classroom experiences had a beneficial impact on the preference for classroom technology. Not surprisingly, if the instructor uses technology well, students will come to appreciate its benefits. This may explain why seniors had a higher preference level for classroom technology use than freshmen. Noteworthy, too, is the finding that a student who gets better grades in classrooms using technologies likes those classes better. But also significant was the finding that students who feel they have more control (planning, apportioning time) over their classroom experience because of technology use also strongly preferred a high level of classroom technology use.

The qualitative findings revealed students’ strong feeling that faculty use technology poorly. Many students commented on their instructors’ lack of skill. One Colgate University undergraduate said, “Faculty skills are across the board from very skilled to clueless.” Another noted, “Most faculty use of technology is fairly bad. Many want to use it but are scared because students know more [than they do], and they get embarrassed.” Other students complained about having to waste class time while faculty tried to get the technology to work. “Web sites are helpful, but faculty use of technology can be more of a pain than it’s worth if they spend the first 15 minutes of class trying to get a projector to work.” Other problems mentioned include faculty’s lack of awareness of the technology options available to them. Especially noteworthy was the unskilled use of PowerPoint and course management systems.

Faculty, though, have a different perception of their technology use. Sixteen percent of faculty who participated in ECAR’s Faculty Use of Course Management Systems study reported having decreased their CMS use because students found the system difficult.

![Figure 4-1. Student Preference for Use of IT in Classes (N = 4,363)](image)
to use. Student technology difficulties included access problems, lack of technology skills, students’ lack of motivation to use a CMS, and students’ lower preference for online materials.

A student’s major was also an important predictor of preferences for classroom technology (see Table 4-1). Engineering students, followed by business students, had the highest preference for technology in the classroom, and seniors in these two majors had a higher preference for technology than their freshman counterparts.

We noted some institutional differences (Table 4-2), but these were minor and found to be statistically insignificant. Research uni-

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Prefer No Technology</th>
<th>Prefer Limited Technology</th>
<th>Prefer Extensive Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>4.8%</td>
<td>24.4%</td>
<td>67.8%</td>
</tr>
<tr>
<td>Business</td>
<td>1.3%</td>
<td>28.2%</td>
<td>64.3%</td>
</tr>
<tr>
<td>Life sciences</td>
<td>4.8%</td>
<td>35.3%</td>
<td>56.3%</td>
</tr>
<tr>
<td>Physical sciences</td>
<td>5.7%</td>
<td>40.9%</td>
<td>51.8%</td>
</tr>
<tr>
<td>Social sciences</td>
<td>7.9%</td>
<td>44.4%</td>
<td>44.2%</td>
</tr>
<tr>
<td>Education</td>
<td>3.5%</td>
<td>47.9%</td>
<td>42.9%</td>
</tr>
<tr>
<td>Humanities</td>
<td>7.7%</td>
<td>47.9%</td>
<td>40.2%</td>
</tr>
<tr>
<td>Fine arts</td>
<td>9.0%</td>
<td>46.9%</td>
<td>39.3%</td>
</tr>
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<table>
<thead>
<tr>
<th>Institution</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Wisconsin—Madison</td>
<td>3.21</td>
<td>456</td>
<td>0.819</td>
</tr>
<tr>
<td>University of Wisconsin—Stout</td>
<td>3.20</td>
<td>302</td>
<td>0.841</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>3.16</td>
<td>242</td>
<td>0.874</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>3.16</td>
<td>190</td>
<td>0.790</td>
</tr>
<tr>
<td>Drexel University</td>
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<td>511</td>
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</tr>
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<td>University of Minnesota, Twin Cities</td>
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<td>University of Wisconsin—Milwaukee</td>
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<td>University of Wisconsin—Eau Claire</td>
<td>3.00</td>
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<td>0.779</td>
</tr>
<tr>
<td>University of Wisconsin—La Crosse</td>
<td>3.00</td>
<td>387</td>
<td>0.816</td>
</tr>
<tr>
<td>Colgate University</td>
<td>2.73</td>
<td>327</td>
<td>0.777</td>
</tr>
<tr>
<td>Mean for the total sample</td>
<td>3.07</td>
<td>4,362</td>
<td>0.859</td>
</tr>
</tbody>
</table>

*Scale = 1 (I prefer taking classes that use no information technology) to 5 (I prefer taking classes that are totally online)
iversity and laptop institution students ranked similarly in their preference for classroom technology use. The Wisconsin master’s-degree-granting universities’ students had less of a preference for technology use. What surprised us was the score at Colgate University, whose students report that they are highly skilled in the use of technology and use their computers a great deal on a weekly basis. If we compare Colgate University students’ preferences with the strongest and weakest preferences, 40.9 percent prefer little or no technology in the classroom, compared with 25.6 percent at all institutions. But this may relate to the absence of business and engineering majors, and also to the importance of seminars and small group discussions in the liberal arts collegiate environment.

We also queried whether the number of hours spent doing various activities on a computer affected preferences for classroom technology. The best predictor was the use of course management systems. We will return to the impact of course management systems in the next chapter. Looking at the perceived skill level with each software application produced a similar result. Basically, students who are more comfortable and skilled at using classroom technologies prefer having them available.

We also found minor gender differences. Males prefer slightly more classroom technology use (see Figure 4-2).

We found a similar but weaker pattern when comparing seniors and freshmen, with seniors showing a greater preference for technology use than freshmen. This finding surprised us; it contradicts what we would expect of the younger millennial students in our study. We can only surmise some level of ambivalence among the freshmen. It may also lend strength to the earlier finding that previous and positive experience with classroom technology is significant. Also, freshmen are unlikely to come to college knowing Excel and PowerPoint. They generally know e-mail, instant messaging, and video games.

When we analyzed students’ preferences for classes using technology, we found that a student’s GPA was not a significant factor. Students with lower GPAs preferred classes using technology equally with those students having

![Figure 4-2. Student Preference for Classroom IT Use, by Gender](image-url)

**Figure 4-2.** Student Preference for Classroom IT Use, by Gender
higher GPAs. An exception was that students with the highest GPAs (3.51–4.00) modestly preferred less classroom technology.

We thought that a preferred learning style would influence a student’s preference for technology (see Table 4-3). The literature we discussed in Chapter 3 on the millennial generation suggests a preference for teamwork. This expectation was not corroborated.

**Technology’s Impact in the Classroom**

We asked students to evaluate the impact of classroom technology use (see Table 4-4). They clearly gave the highest scores to improved communications—with classmates and faculty and through feedback on course work. They also highly rated the related ability to improve the presentation of their work. Ranked almost as high were classroom management activities: more time for practice and reinforcement, and greater control of classroom activities (planning, time apportionment, and self assessment). Activities related to comprehension of classroom materials (complex concepts), time on task, interest levels, and grading outcomes appear more neutral from respondents’ perspectives.

The earlier ECAR course management study also established the importance of improved communications. Improving communications was one of the top five reasons for using a CMS. Fifty-nine percent of faculty reported that using a CMS increased faculty-to-student communication.

An interesting finding is that students do not feel that classroom IT use greatly increases the amount of time engaged with course activities (3.22 mean). This directly contrasts with the earlier ECAR study’s results, where 65 percent of faculty reported that they perceived that students spend more time engaged with course materials when IT is used in the classroom.

Engineering and business students indicated that classroom technology did better their understanding of complex concepts and provided more opportunities for practice and reinforcement. This may suggest that these disciplines or their faculty are further ahead in the development of software applications for their students. Seniors, too, provided overall higher scores than freshmen.

We again saw some gender difference: women looked for more training from the faculty and spent less time than their male counterparts in classes that required technology.

We surmise from these initial findings that faculty and students alike use classroom technology heavily for administrative and com-

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learn best by working alone and thinking through concepts by myself.</td>
<td>631</td>
<td>14.5%</td>
</tr>
<tr>
<td>I learn better by working alone in some situations.</td>
<td>1,090</td>
<td>25.0%</td>
</tr>
<tr>
<td>I learn equally well by working alone and by discussing problems and concepts with others.</td>
<td>1,631</td>
<td>37.4%</td>
</tr>
<tr>
<td>I learn better by discussing concepts and problems with others in some situations.</td>
<td>689</td>
<td>15.8%</td>
</tr>
<tr>
<td>I learn best by collaborating with others and discussing problems and concepts with them.</td>
<td>321</td>
<td>7.4%</td>
</tr>
</tbody>
</table>
munication purposes, and applications that support new and innovative ways to learn aren’t nearly as visible to students.

The qualitative data corroborate this finding. Most students interviewed described classroom technology use as fairly narrow, and where it was used, these uses tended to be somewhat staid.

**IT’s Perceived Benefits**

We asked students about the perceived benefits of using technology in the classroom (see Figure 4-3). By far the most cited benefit was convenience (48.5 percent). When combined with saving time, the percentage increases to 64.6 percent. Only 12.7 percent said the most valuable benefit was improved learning, and only 3.7 percent perceived no benefit whatsoever. These findings compare favorably with those of a study done by Douglas Havelka at the University of Miami in Oxford, Ohio. He found that IT’s top five benefits were that it improves work efficiency, affects how people behave, improves communications, makes life more convenient, and can be used to save time. The sixth-ranked benefit was that it improved students’ ability to learn.¹⁰

We looked for factors that might explain differences in the perceived primary benefit of technology in the classroom. Gender, class (senior/freshman), GPA, and major had little impact, but we saw some notable differences by institution. The University of Minnesota, Crookston, stood out in terms of the number of respondents who indicated that technology had improved learning (20.6 percent), versus,

<table>
<thead>
<tr>
<th>Activity</th>
<th>N</th>
<th>Mean*</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of IT in classes has helped me to better communicate with the instructor.</td>
<td>4,358</td>
<td>3.85</td>
<td>0.845</td>
</tr>
<tr>
<td>The use of IT in courses has resulted in prompt feedback from the instructor.</td>
<td>4,351</td>
<td>3.84</td>
<td>0.813</td>
</tr>
<tr>
<td>The use of IT in courses has helped me communicate and collaborate with my classmates.</td>
<td>4,343</td>
<td>3.64</td>
<td>0.893</td>
</tr>
<tr>
<td>I primarily use IT in courses to improve the presentation of my work.</td>
<td>4,353</td>
<td>3.61</td>
<td>0.872</td>
</tr>
<tr>
<td>The use of IT in courses provides more opportunities for practice and reinforcement.</td>
<td>4,345</td>
<td>3.58</td>
<td>0.803</td>
</tr>
<tr>
<td>The use of technology in my classes met my expectations.</td>
<td>4,358</td>
<td>3.54</td>
<td>0.747</td>
</tr>
<tr>
<td>Classes that use IT allow me to take greater control of my class activities.</td>
<td>4,346</td>
<td>3.45</td>
<td>0.923</td>
</tr>
<tr>
<td>The use of IT in classes has helped me better understand complex or abstract concepts.</td>
<td>4,358</td>
<td>3.38</td>
<td>0.854</td>
</tr>
<tr>
<td>The instructors’ use of technology in my classes has increased my interest in the subject matter.</td>
<td>4,347</td>
<td>3.25</td>
<td>0.906</td>
</tr>
<tr>
<td>Classes that use IT are more likely to focus on real-world tasks and examples.</td>
<td>4,347</td>
<td>3.23</td>
<td>0.884</td>
</tr>
<tr>
<td>I spend more time engaged in course activities in those courses that require me to use technology.</td>
<td>4,362</td>
<td>3.22</td>
<td>0.928</td>
</tr>
<tr>
<td>I get better grades in courses that use IT.</td>
<td>4,356</td>
<td>3.19</td>
<td>0.925</td>
</tr>
<tr>
<td>Faculty members need to give us more in-class training for IT used in the class.</td>
<td>4,361</td>
<td>3.04</td>
<td>0.976</td>
</tr>
</tbody>
</table>

*Scale = 1 (strongly disagree) to 5 (strongly agree)
for example, Colgate University at 9.5 percent. In contrast, Colgate University students (64.2 percent), followed by the University of California, San Diego, students (56.0 percent), gave the highest scores to convenience. And all University of Minnesota and Wisconsin campuses tended to give a higher score to management of classroom activities (approximately 19 percent, on average).

The qualitative data and open-ended survey responses reinforce these findings. We group the students’ comments by category of perceived benefit.

**Convenience**

In the survey’s open-ended comments, 134 students voluntarily identified convenience as one of the primary benefits of using IT in classes. Student comments included

- “I don’t need to go to the library very often.”
- “I could work full-time while taking classes.”
- “Reading materials were posted online, so I could print out a chapter as needed for class instead of buying the entire book.”
- “My chemistry class has assignments and exam answers online—very convenient.”
- “The availability of information technologies around campus has helped me save time in an already hectic schedule. I am able to go online at any number of places and access pertinent documents, which saves me time.”
- “I feel technology is a benefit to everyone because of its increased convenience and speed.”

**Management of Class Activities**

The students also emphasized the ability to manage time and information. They found faculty’s use of PowerPoint to be very helpful, especially when faculty made their notes available for download. The students described PowerPoint as a way to organize information and really appreciated that they no longer had to decipher faculty handwriting. They also stated that it makes their notes far more accurate. A University of Wisconsin–Milwaukee student stated, “I know that I haven’t misheard something or misspelled it. If I lose
or damage my notes, there is a copy that I can get back—or if I miss a day, I can get a good copy of the notes and not have to rely on the notes of someone else in the class.”

Learning

Although students strongly emphasized the convenience factor of classroom IT use, they also consistently stated that good use of technology helps them learn. The most common comment we heard in the qualitative interviews was that technology helped faculty present information and concepts more visually, and this helped students learn better and more effectively. Examples students described included mathematical and 3D modeling in chemistry and geology. A less commonly cited factor, but one identified at several institutions, was how classroom technology gave students access to real-world data and experiences as well as to programs they might use in their professional life after graduation.

Students appreciated the different kinds of information that technology gave them access to. One student noted that while he was generally not satisfied with classes that used technology, using technology had helped him. “I can go to the Internet and find stuff out. For example, in a class on nanotechnology I went online and found pictures that portrayed nanotech, which was really helpful in understanding the concept.” Other comments illustrating how students value technology's use in support of learning included, “Technology doesn’t increase learning, though it does depend on the class and the type of learner. Some people might need to see things to learn. Also, if technology brings in different types of information, then it does increase the class experience; it can give you a more complete look. Plus you can get good background information—for example, ‘Googling’ a speaker to find out more about him, or getting survey data from South Africa. I am learning so much more on my own because of the Internet.”

Students described how PowerPoint helped their faculty to be more organized, and they said that having more accurate and easier-to-use notes definitely helped their learning. “Online notes help you follow along a little better and help you see what the professor is focused on.” Another commented, “If they put the notes up ahead of time, you can see what you don’t understand. Plus we are such a visual culture, and it gives you something to look at, a visual cue.” However, one student astutely noted that the effective use of PowerPoint depends on faculty teaching skills: “PowerPoint presentations and online lecture notes won’t replace the teaching ability of the professor.”

One downside to this use of technology is that many students recognize that it can make them lazy or passive and encourage them to skip class. The same student from the University of Wisconsin–Milwaukee quoted above said one of his professors advised students not to download the PowerPoint as a handout but to take their own notes and then compare them to the PowerPoint slides.

Although most students positively viewed faculty use of PowerPoint as an organizational tool that indirectly contributes to learning, some students were critical about the poor manner in which faculty used the tool. “Faculty use of technology is okay. But it hasn’t made leaps and bounds. With a chalkboard, at least the lights were on and you didn’t fall asleep. Some use videos and music and this is cool, but the majority are taking their lectures and just putting them on PowerPoint.” Students complained that faculty would often read their PowerPoint slides out loud (instead of teaching from them) and frequently moved too quickly through the material. “PowerPoint can be too fast. It is possible to get too much information and then you end up not paying attention to the professor and you’re not as
involved in the class. You need to think about the material.” Students also described how faculty PowerPoint use made class a little too structured and inflexible and could distance faculty from students, especially when the faculty relied on it too much. “PowerPoint takes away from interaction.”

The students’ perception of the benefits of IT use agrees with the faculty’s view as reported in the ECAR study Faculty Use of Course Management Systems. Asked about their perception of how course management systems accommodated diverse learning styles, 70 percent of faculty surveyed reported that using a CMS provided opportunities for students to work at their own pace. More than 60 percent noted that a CMS let them distribute course materials in a wide variety of formats. They perceived that this increased student learning and helped students learn at their own pace.

Communications

Students felt that technology improved communication with the faculty. Technology made it possible to have out-of-classroom contact—for example, setting up meetings with faculty by e-mail or e-mailing a question and getting a quick response, especially valuable when working on a project. “E-mail makes it easier to communicate. For example, e-mailing a question to a professor about something that you wouldn’t quite go to office hours for but you still want an answer for.” Similarly, “Hours are an issue. Faculty don’t keep the same hours as students do, and so e-mail helps you ask a question when it occurs to you, though it can lead to your being very impatient—‘Why hasn’t he e-mailed me back, it’s been 10 minutes?’” Students also reported that e-mail helped break down barriers between students and faculty, resulting in less formal, more relaxed interaction. “E-mail makes you more comfortable with the faculty. You can e-mail them before meeting with them, it can help cut down on formality, they sign with their first name or write a fairly relaxed note. It makes you feel less intimidated.” Another perceived benefit was saving class time for teaching instead of housekeeping tasks. “You can save class time by doing things outside of class. And it means faculty can get news to students.”

Others were less positive. Sometimes technology made learning impersonal and decreased personal contact with professors. “Students don’t go speak to faculty members that much. They generally shoot them an e-mail. This cuts down on personal contact—but it does increase out-of-class contact.” Similarly, “One of the disadvantages of the use of technology is a little more disconnection between faculty and students. They don’t talk or meet, but rather exchange e-mail.”

Presentation of Work

Contrary to the quantitative data, the qualitative interviews didn’t find that students assigned an especially high priority to using technology to improve the presentation of their work. The students interviewed placed far more emphasis on faculty’s using technology to improve their presentation, as described above. Students, however, are using technology such as Photoshop and graphic applications in natural and physical science classes for this purpose, though some describe struggling with them. Illustrative comments include

- “Information technology helps make my work look clear and precise.”
- “Information technology allows my work to be neat and organized, which generally results in a better grade.”
- “Information technology allows me to better demonstrate my work.”
- “Information technology has helped me to better communicate my presentations to my classmates, thereby helping them to learn from me and vice versa.”
Barriers to IT Use

We asked students whether they perceived barriers to their use of technology in the classroom and offered them a list of possible barriers (see Table 4-5). We found that more than half thought they faced barriers to technology use (54.3 percent), but they didn’t see the barriers we listed as major problems. Most problematic on our list were, feels like extra work (16.7 percent), applications not running on their computer (14.1 percent), lack of access to printers (13.4 percent), and lack of technical support (9.7 percent). These findings were reinforced by how many times students mentioned them in an open-ended survey question.

We let students identify barriers they perceived to be problems through an open-ended survey question. What surprised us was the large number of students who took the time to vent their concerns. We can cluster their concerns into several categories.

Technology Problems

Students reported problems—with hardware, software, and computer viruses—with both personally owned and university equipment. Many students complained about their personal computers, including their being too old and having battery-life problems. Students using university resources showed little patience with servers going down on occasion and disrupting their work patterns. Printers were also identified as a problem; old equipment breaks down. Some students complained of software problems and the cost of software applications. They also noted that some applications don’t work on their machines. Some students were also unhappy about the multitude of viruses and the difficulties in getting their machines working again after being compromised.

Institutional Support

Students reported that lack of institutional support for operating systems such as Macintosh OS X and Microsoft Windows made using technology in their classes difficult.

Instructor Problems

Many students complained about their instructors’ ability to use course management systems and other applications. In the open-ended comments in the quantitative survey,

<table>
<thead>
<tr>
<th>Potential Barrier</th>
<th>Not a Barrier</th>
<th>A Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have to set up and troubleshoot too many browser variations.</td>
<td>95.5%</td>
<td>4.5%</td>
</tr>
<tr>
<td>I don’t have sufficient access to a computer.</td>
<td>95.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>I don’t have the necessary skills.</td>
<td>91.3%</td>
<td>8.7%</td>
</tr>
<tr>
<td>It is too expensive.</td>
<td>91.2%</td>
<td>8.8%</td>
</tr>
<tr>
<td>I have trouble connecting to the Internet from my place of residence (I don’t</td>
<td>90.7%</td>
<td>9.3%</td>
</tr>
<tr>
<td>have reliable access to the Internet).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don’t have the technical support I need.</td>
<td>90.3%</td>
<td>9.7%</td>
</tr>
<tr>
<td>I don’t have sufficient access to a printer.</td>
<td>86.6%</td>
<td>13.4%</td>
</tr>
<tr>
<td>The applications don’t run on my computer.</td>
<td>85.9%</td>
<td>14.1%</td>
</tr>
<tr>
<td>It feels like extra work with little connection to the course.</td>
<td>83.3%</td>
<td>16.7%</td>
</tr>
<tr>
<td>There are no barriers.</td>
<td>54.3%</td>
<td>45.7%</td>
</tr>
</tbody>
</table>
more than 30 students noted that instructors don’t understand how to use technology. One student commented, “A lot of the frustrations I encounter with information technology are caused by the fact that while we students are quick at picking up on these techniques, the teachers are often confused and make mistakes or errors that confuse the students. It’s mostly the lack of technological education on the professor’s part that is the trouble.”

Students resent technology being used to create “busy work,” which doesn’t contribute to learning. One Colgate University student stated, “Faculty sometimes see technology as a medium for delivery and not so much a way of broadening what (or improving how) you learn.” Further, they “just throw stuff in and don’t really use it.” Students also complained about spending too much time learning to use software rather than engaging with the course’s subject matter. A German major described how many of her classmates complained that they spend too much time doing computer-related tasks and not enough time doing German.

In ECAR’s Faculty Use of Course Management Systems study, faculty members were asked what caused them to decrease their use of a CMS. Twenty-five percent reported that it was too time-consuming. They focused on two different aspects: the time it takes to get their course ready for a CMS and the time it takes to load the materials into the CMS. Only 10 percent reported that they decreased CMS use because they found it difficult to use. Hanson found that 53.1 percent of the faculty had little difficulty with the system, 27.8 percent thought some features were obvious but others were difficult to figure out and use, and only 5.7 percent said they needed considerable help to use the system.

Course Management Systems

Students reported that discussion sections do not work well with a CMS. Online quizzes caused some concern among the students because the tests are timed and students can’t skip a question and go back. Also, computers can freeze, making it impossible for them to complete the quiz within the allocated time.

Personal Technology Skills

Some students were candid about their lack of computer skills. “I do not understand many of the applications on my computer. Also, I sometimes don’t even realize what I can do with my computer or online unless someone else shows me how.” Some students reported that they had Web-site navigation difficulties.

Faculty also view students’ technology skills as a barrier to classroom IT use. In ECAR’s Faculty Use of Course Management Systems study, faculty and staff noted that students had poor technology skills and that this slowed down or discouraged faculty from using a CMS. Some faculty reported that primarily older, nontraditional students lacked the technology skills to comfortably use a CMS, though numerous other respondents said that all students, regardless of age or standing, ran into similar problems.

Access Problems

While access didn’t pose a significant barrier to classroom technology use for most students, off-campus students more often identified this as a barrier. Many students who use the Internet at home via modem report that service is slow and downloading large files is annoying and time-consuming. One student noted that since he had no broadband at home, he had to come to school to do online work. Students also complained about trouble getting access because of password and logon problems.

In the Faculty Use of Course Management Systems study, 16 percent of the faculty who reduced their CMS use did so because students had difficulty getting access to the
needed technology. Faculty reported that many students didn’t have reliable computer or Internet access at home.15

What we find, then, is a wide array of problems, none of which are significant for a majority of students. Combined, however, these difficulties cause problems for many students. Fortunately, much of what they’ve identified can be fixed or ameliorated.

Conclusion

Universities have invested enormous sums of money in technology. Students 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 revolution has occurred both culturally and in service delivery. The jury is out on IT’s impact on learning and the learning experience.

Clearly, some students acknowledge that technology has improved learning, and we suspect this occurs where there is a deliberate institutional or faculty strategy to change and improve the learning experience. Software applications such as PowerPoint and Excel are tools, as is a CMS, but by themselves they do not contribute to an improved learning experience. It is incumbent on the faculty member to understand the promise and performance of these tools in support of improved learning and to use them accordingly. Our data suggest that we are, at best, at the cusp of employing technologies to improve learning.

Endnotes

7. Ibid., p. 64.
8. Ibid., p. 64.
9. The scale for this question was 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.
12. Ibid., p. 48.
15. Ibid., p. 49.
Course Management Systems

"I love our course management system. The more it is used, the better. I love being able to access all of my course information online and communicate with my instructor electronically. It helps me to learn."

—Undergraduate respondent, ECAR survey

"Course management systems are a convenience for professors. But they leave me cold. It's as if the professor distances himself or herself from the classroom by hiding in cyberspace and pulling the course management system over our eyes."

—Undergraduate respondent, ECAR survey

It is increasingly fair to say that when students comment on technology in the classroom, they are most likely referring to the use of a course management system (CMS). Today, a CMS is often the first technology undergraduate students experience in the university classroom, just as a Web-enabled enterprise resource planning (ERP) is the first technology students use in support of college admission and related administrative student services.

The percentage of students who have used a CMS has risen dramatically since they were first introduced seven years ago. It’s common to find that 90 percent of an institution’s students have had some CMS experience. But we must balance this percentage with the number of faculty who use a CMS and the percentage of the institution’s courses that are set up to use a CMS. These latter percentages are low at many institutions, suggesting that students still take the vast majority of their courses without using this tool.

Course management systems are software suites designed and marketed to faculty and students for use in teaching and learning. Common course management systems in the higher education environment include, but are not limited to, WebCT, Blackboard, ANGEL, and Desire2Learn. Most course management systems today include tools for course content organization and presentation, communication and student assessment tools, gradebooks, and classroom material and activities management. Most promising are new features that let faculty and administrators track and analyze student use of the application to enable better understanding of how students use the system and thereby make improvements.

Other technologies that assist in teaching and learning, such as PowerPoint, can be used in conjunction with a CMS. Using course management systems, faculty can post lecture notes as PowerPoint slides to a course site.

Course management systems and their implementation are a work in progress. They promise to significantly reduce time and space restrictions on learning for students and faculty, much as their predecessor ERP did for student administrative services. Used properly, they have the potential to greatly improve student access to information and communication with their instructors, enhance the quality of learning, and increase learning productivity.
Course management systems can enhance learning quality by enabling instructors to convey information more effectively and engagingly, helping instructors meet the needs of students with varied learning styles, and enriching the interactions students have with each other and their instructors. That’s the promise. The students quoted above call our attention to CMS use by noting an uneven diffusion of innovation using this technology. We can attribute this in part to limitations in faculty or student skill and also partly to a lack of institutional recognition of innovation, especially as successful CMS use affects or doesn’t affect faculty tenure, promotion, and merit decisions.

Course management systems also promise to increase learning productivity. A CMS can allow students to learn more and faster. In turn, the institution sees a return on its investment through higher retention and graduation rates, higher levels of student satisfaction, and, in many cases, higher tuition revenue. We ask whether we can demonstrate measurable returns on an institution’s investment in student learning tools.

Despite rising CMS use in higher education, we know too little about how students use the technology and how it affects learning. Much of the work done to date consists of student satisfaction surveys by single higher education institutions seeking to understand and improve system use on their campus. We cite some of them throughout this study and list them in the bibliography. However, they offer little comparative analysis by institution and student demographics. This chapter seeks to develop a broader overview of how students perceive and use CMS features and to what advantage.

Our study is informed by faculty observations of course management systems at the University of Wisconsin System institutions and elaborated on in the ECAR study Faculty Use of Course Management Systems. Using these data in addition to our own, we can contrast faculty and student perceptions of course management systems and gain some insight into best practices. Unless otherwise indicated, all faculty data in this chapter are extracted from that ECAR study. We expect to find that both faculty and students agree that course management systems offer useful and convenient tools for distributing and managing information and for communication. We expect that they differ in their perception of how effectively faculty use course management systems and their impact on learning.

Specifically, this chapter addresses the following questions:

- What value do course management systems provide in teaching and learning in higher education?
- What percentage of students surveyed have used a CMS, and do students prefer courses that use course management systems?
- What do students perceive as the primary benefits of a CMS? And, conversely, do students perceive that CMS use has negative consequences? If so, for what reasons?
- 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?

In short, to what degree do students confirm that faculty use of course management systems satisfies Chickering and Gamson’s best-practice criteria elaborated on in Chapter 4?
Student CMS Use

Eighty-three percent of students in our survey had taken a class that used a CMS, and 16.7 percent had not (see Figure 5-1). Not surprisingly, seniors (90.1 percent) were more likely than freshmen (78.5 percent) to have taken a class that used a CMS. Clearly, this tool’s deployment has grown exponentially in the last several years. At the University of Minnesota, for example, the total number of seats available in courses using course management systems grew from 5,050 in the first semester it was deployed to 59,256 three years later. Most of the growth occurred in the second year, and the deployment has since leveled off.

We looked for usage patterns by institution (see Figure 5-2). All institutions in the study have purchased and deployed course management systems, but the percentage of students taking a class using a CMS varied from a high of 96.6 percent at the University of Wisconsin–Whitewater to a low of 59.5 percent at the University of California, San Diego. We also asked whether students who preferred to take courses with little or no technology in the classroom tried to avoid courses that used course management systems. The data suggest that the answer is yes at each institution, but only weakly so.

We found little difference in CMS use by gender, age, or ethnic group.

Students’ CMS Experience

We asked the students who had taken a course using a CMS to describe their overall experience (see Figure 5-3). Of students who had used a CMS, 76.1 percent were positive or very positive, 17.3 percent were neutral, and only 6.6 percent were negative or very negative. One student commented, “Course management systems make it possible for a student to be very successful in class because of access to lecture notes and outlines, contacts with other students, online quizzes, and displaying of grades. Courses that use a CMS help me to learn, and it improved my grades.” Another noted, “I got more satisfaction and learned more from the class.” But a few negative voices emerged also. “I hate the classroom management system because it is so complex, and it was not properly explained to me by the instructor. This led me to almost fail the class.” Some students noted that it made the instructor more distant by reducing face-to-face interaction.
Figure 5-2. Percentage of Students Enrolled in a Class Using a CMS, by Institution

- University of California, San Diego: 59.5%
- Drexel University: 60.7%
- University of Wisconsin–Eau Claire: 79.8%
- University of Minnesota, Twin Cities: 84.8%
- University of Wisconsin–Madison: 87.6%
- University of Wisconsin–Milwaukee: 87.6%
- University of Wisconsin–Oshkosh: 88.3%
- University of Wisconsin–La Crosse: 90.5%
- University of Minnesota, Crookston: 92.1%
- Colgate University: 93.3%
- University of Wisconsin–Stout: 93.7%
- University of Wisconsin–Whitewater: 96.6%

Figure 5-3. Students’ Overall CMS Experience

- Very Negative: 1.2%
- Negative: 5.4%
- Neutral: 17.3%
- Positive: 59.1%
- Very Positive: 17.0%
The mean for the group was 3.85, the median was 4.01, and the mode was 4.¹

We looked for factors that might explain the different opinions about CMS experience (see Figure 5-4). Females (mean of 3.93) liked course management systems slightly better than males did (mean of 3.74).

We also looked at opinion differences by participating institution (see Table 5-1). Although the differences are small, University of Wisconsin System students ranked their CMS experience highest in our sample.

Students at the research universities liked course management systems less (below the norm—a mean of 3.85).

We compared by institution students’ CMS experience and their preference for technology in the classroom (see Table 5-2). We found

![Figure 5-4. Students’ Overall CMS Experience, by Gender](image)

<table>
<thead>
<tr>
<th>Institution</th>
<th>Mean*</th>
<th>Number</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Wisconsin—Whitewater</td>
<td>4.08</td>
<td>226</td>
<td>0.748</td>
</tr>
<tr>
<td>University of Wisconsin—La Crosse</td>
<td>4.06</td>
<td>351</td>
<td>0.656</td>
</tr>
<tr>
<td>University of Wisconsin—Oshkosh</td>
<td>3.94</td>
<td>330</td>
<td>0.760</td>
</tr>
<tr>
<td>University of Wisconsin—Milwaukee</td>
<td>3.93</td>
<td>290</td>
<td>0.839</td>
</tr>
<tr>
<td>Colgate University</td>
<td>3.90</td>
<td>305</td>
<td>0.624</td>
</tr>
<tr>
<td>University of Wisconsin—Stout</td>
<td>3.90</td>
<td>282</td>
<td>0.743</td>
</tr>
<tr>
<td>University of Wisconsin—Eau Claire</td>
<td>3.86</td>
<td>504</td>
<td>0.744</td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>3.82</td>
<td>278</td>
<td>0.853</td>
</tr>
<tr>
<td>University of Wisconsin—Madison</td>
<td>3.76</td>
<td>401</td>
<td>0.792</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>3.70</td>
<td>144</td>
<td>0.917</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>3.59</td>
<td>175</td>
<td>0.947</td>
</tr>
<tr>
<td>Drexel University</td>
<td>3.56</td>
<td>308</td>
<td>0.924</td>
</tr>
<tr>
<td><strong>Mean for the total sample</strong></td>
<td><strong>3.85</strong></td>
<td><strong>3,638</strong></td>
<td><strong>0.802</strong></td>
</tr>
</tbody>
</table>

*Scale = 1 (very negative) to 5 (very positive)
that despite an overall positive experience with course management systems, the preference for technology was more balanced. It would be interesting to see in a longitudinal study if the preference for technology mean rises as more classes and instructors use course management systems.

**CMS Features**

Course management systems offer numerous features that support learning and course administration. We asked students which features they had used (see Figure 5-5) and found that they used class administrative features most, with Syllabus (95 percent) and online reading (94.8 percent) receiving the highest percentages. Less used are the interactive features (70 to 75 percent). The “yes” responses in Figure 5-5 are cumulative figures that reflect the percentage of students who have used the specified CMS feature once or more than once. Exposure to a CMS feature depends on 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 will likely have been exposed to most CMS features. The *Faculty Use of Course Management Systems* study confirmed our findings, showing that more faculty used the content presentation tools such as Syllabus and fewer used the interactive tools such as the gradebook and quizzing (see Figure 5-6 for the University of Wisconsin–Whitewater). Hanson found similar use patterns, with faculty most often using Syllabus (72.0 percent), class announcements (70.0 percent), and supplemental online readings (62.2 percent). The discussion board was used by 32.8 percent of the faculty, and student discussion was used at 5.0 percent.

### Table 5-2. Comparison of Means for CMS Experience and Preference for Classroom Technology Use, by Institution

<table>
<thead>
<tr>
<th>Institution</th>
<th>Mean: CMS Experience</th>
<th>Mean: Prefers Classroom Technology Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Wisconsin–Whitewater</td>
<td>4.08</td>
<td>3.05</td>
</tr>
<tr>
<td>University of Wisconsin–La Crosse</td>
<td>4.06</td>
<td>3.00</td>
</tr>
<tr>
<td>University of Wisconsin–Oshkosh</td>
<td>3.94</td>
<td>3.03</td>
</tr>
<tr>
<td>University of Wisconsin–Milwaukee</td>
<td>3.93</td>
<td>3.06</td>
</tr>
<tr>
<td>Colgate University</td>
<td>3.90</td>
<td>2.73</td>
</tr>
<tr>
<td>University of Wisconsin–Stout</td>
<td>3.90</td>
<td>3.20</td>
</tr>
<tr>
<td>University of Wisconsin–Eau Claire</td>
<td>3.86</td>
<td>3.00</td>
</tr>
<tr>
<td>University of Minnesota, Twin Cities</td>
<td>3.82</td>
<td>3.14</td>
</tr>
<tr>
<td>University of Wisconsin–Madison</td>
<td>3.76</td>
<td>3.21</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>3.70</td>
<td>3.16</td>
</tr>
<tr>
<td>University of Minnesota, Crookston</td>
<td>3.59</td>
<td>3.16</td>
</tr>
<tr>
<td>Drexel University</td>
<td>3.56</td>
<td>3.15</td>
</tr>
<tr>
<td><strong>Mean for the total sample</strong></td>
<td><strong>3.85</strong></td>
<td><strong>3.07</strong></td>
</tr>
</tbody>
</table>
Figure 5-5. CMS Features Used by Students

Figure 5-6. CMS Tool Use by Category: University of Wisconsin–Whitewater, Fall 2000 to Spring 2002*

Figure 5-7 helps explain faculty members’ pattern of feature usage by showing how they rank the importance of each CMS feature. Not surprisingly, faculty rank the content presentation tools as most important.

**Students’ Perceived Benefits Using a CMS**

We asked students whether they perceived that a particular CMS feature improved learning, whether it improved class management, or whether it improved both learning and class management. We also gave students the option of reporting whether a feature had no effect on either learning or class management or whether it had a negative effect. Classroom management (convenience) scored highest, followed by improved learning. Negative perceptions were minimal.

It’s somewhat disappointing to see that the interactive features that faculty used least were the features that students indicated contributed the most to their learning (see Figure 5-8). The students were especially positive about shar-
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ing materials with students (38.5 percent) and faculty feedback on assignments and quizzes (32.0 percent). Hanson found even stronger percentages. Features in Hanson’s study that students felt most improved learning included sample exams for learning purposes (88.2 percent), sharing materials among students (71.0 percent), and online readings (61.8 percent).7

One explanation for faculty’s lower use of and student criticism of tools that encourage student collaboration is that current course management systems do not yet have well-developed student workspaces, and the tools need improvement. This assessment is confirmed in the Pennsylvania State University survey of students on the use of ANGEL, where respondents deemed the message boards and chat rooms to be the most difficult features to use.8 Our data indicate that students recognize the technology’s strengths and weaknesses for communicating with each other. One University of Minnesota, Twin Cities, freshman described her experience collaborating with fellow students using the university’s CMS. “I had a group project, and we were instant messaging each other. I couldn’t get my device to work. I couldn’t read half of the conversation that was going on, but I can see the potential benefit even though I had a horrible experience.”

Students had mixed feelings about the use of discussion boards. They described classes where participating in online discussions helped them learn by facilitating greater engagement with their classmates. They had more time and a richer context within which to formulate their answers. Some students also found that the use of the discussion boards freed up class time to discuss common problems that had emerged through the online discussion. But some students thought the online discussion forums were designed poorly and, as a result, not a good use of their time. One student believed that required nightly online discussions ended up being busy work.

“Students don’t read other students’ responses, only those posted by the faculty member. They write responses in order to fulfill the participation requirements of the class,” noted one Colgate University student. “Students do have a sharp sense of knowing which courses used discussions well and which did not,” noted Michele Schreiner, director of a student computer lab at the University of Wisconsin–Madison.

Not surprisingly, and reinforcing findings from our earlier chapters, students rated the administrative and convenience features most highly (see Figure 5-9).9 A University

Figure 5-9. Student Perceptions About Course Management Systems’ Improving Class Management, by Feature

Respondents
of Wisconsin–Whitewater student noted, “I like faculty using the CMS. It keeps things up to date, which makes my life easier.” Students especially liked the ability to track grades online, which is a far cry from the days when grades were posted outside the faculty member’s office (using identification numbers, with student names scratched out) or issued on self-addressed postcards handed to the instructor on the last day of class or at the final exam. Some faculty found the posted grades of interest, as they often confirmed impressions that a colleague was a hard or easy grader while providing a comparison for the individual’s own grading policy.

In *Faculty Use of Course Management Systems*, faculty reported how use of the online gradebook in the CMS changed students’ performance in the class. Several faculty members noted that by seeing the grades online, students were reassured that there was no longer a “secret gradebook.” Students paid attention to their comparative performance in the class; this, in turn, created an incentive to improve their performance. Students liked having grades available online and being able to see the class grade spread. One University of Wisconsin–Milwaukee student noted, “I like seeing my grade. It helps me see where I’m doing poorly. It also causes me to put more effort into the class.”

Clearly, some features provide both administrative and learning benefits, and a number of students agreed (see Figure 5-10). At the top of the list was the ability to track grades (34.6 percent).

A significant number of students indicated that CMS features supported both class management and learning. We combined the percentage of students who said that the CMS improved learning with the percentage who said it improved learning and management. We did the same for those who said it improved class management. We then ranked
the features (see Table 5-3). Students ranked sharing materials with students highest in improving learning (52.8 percent) but clearly saw tracking grades as the most important feature. Fully 80.3 percent said it improved their ability to manage their classroom activities, and 47.9 percent said that it improved learning. We suspect that the ability to track grades creates an incentive to do better, which is what the students are affirming. Online discussions scored lowest in both categories.

Several students indicated that CMS features had no effect on their learning or ability to manage class activities (see Figure 5-11). Again, they scored the interactive features lower, which may reflect that faculty used them less or less well.

A small percentage of the students reported that particular CMS tools had a negative effect on learning or on class management. The syllabus and online reading features received the strongest negative opinions (see

<table>
<thead>
<tr>
<th>Features Used</th>
<th>Learning</th>
<th>Rank</th>
<th>Management</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing materials with students</td>
<td>52.8%</td>
<td>1</td>
<td>30.8%</td>
<td>6</td>
</tr>
<tr>
<td>Track grades</td>
<td>47.9%</td>
<td>2</td>
<td>80.3%</td>
<td>1</td>
</tr>
<tr>
<td>Faculty feedback on assignments</td>
<td>42.3%</td>
<td>3</td>
<td>27.0%</td>
<td>8</td>
</tr>
<tr>
<td>Sample exams online</td>
<td>42.0%</td>
<td>4</td>
<td>38.4%</td>
<td>4</td>
</tr>
<tr>
<td>Online readings</td>
<td>37.8%</td>
<td>5</td>
<td>42.0%</td>
<td>3</td>
</tr>
<tr>
<td>Turn in assignments</td>
<td>35.9%</td>
<td>6</td>
<td>34.6%</td>
<td>5</td>
</tr>
<tr>
<td>Syllabus</td>
<td>27.3%</td>
<td>7</td>
<td>28.6%</td>
<td>7</td>
</tr>
<tr>
<td>Online quizzes</td>
<td>26.8%</td>
<td>8</td>
<td>54.0%</td>
<td>2</td>
</tr>
<tr>
<td>Online discussions</td>
<td>22.5%</td>
<td>9</td>
<td>17.5%</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 5-3. Ranked Student Perceptions of CMS Benefits
Students gave fairly consistent reasons for negative assessments, and we can put these into several groups that are all remediable with improvements to the software and training, and the introduction of appropriate incentives for both faculty and students.

A few students found that the CMS resulted in less contact among faculty and students and felt impersonal. A Colgate University student commented, “I hated the use of the course management system drop box. It made it seem very impersonal. I felt like I was taking a robotics class, because the course management system is becoming the main tool. It should be a supplement.” A student from the University of Minnesota, Twin Cities, reiterated this view: “Any time that I’ve tried to use a course management system, there have been tons of problems. And it’s just so sterile. If I wanted to do distance learning, then I would have done distance learning. I want to have interactions with people. I don’t want to be chatting in Spanish on some Web site, especially with my classmates. It’s so pointless.”

The faculty’s perception of course management systems is quite similar to student

**Figure 5-12.** Student Perception that CMS Has Negative Effect, by Feature

- Syllabus: 7.0%
- Online Reading: 5.0%
- Turn in Assignments: 3.9%
- Sample Exams Online: 3.3%
- Track Grades: 2.5%
- Online Discussion: 2.3%
- Share Materials with Students: 1.6%
- Faculty Feedback on Assignments: 1.1%
- Online Quizzes: 1.0%
perceptions (see Figure 5-13). Most faculty perceptions are positive, some are neutral, and a few are negative—and for many of the same reasons that students give.

Ten percent of faculty surveyed reported that reliability problems negatively affected their use of the technology. Students expressed similar concerns. One student told us the CMS had crashed during finals week, which caused chaos because it contained all the course materials.

Students indicated a need for a more consistent approach to CMS use. A University of Wisconsin–Whitewater student described how “it can be very confusing [to students] for faculty to use a variety of ways to disseminate information—e-mail, a course management system, file sharing, and Web pages. As a result, you never know where to look.” Similarly, a student at the University of Minnesota, Twin Cities, compared her institution’s practice with that of another, where a friend was a student: “At my friend’s institution, the course management system has to be used by every instructor, and the instructor has to be versat

ile with it. Here it’s not required. It becomes confusing when you have one course where everything is on the course management system and another course where nothing is on the course management system.”

Finally, students and faculty commented on the need for training. Twelve percent of the faculty indicated that they would increase their CMS use if more training was made available. A University of Minnesota, Twin Cities, student recommended that “with so many courses now using a course management system, there is a need to have an introductory class on using a course management system at the freshman or sophomore level.” Some students, however, noted in interviews that such training was unnecessary. One Colgate University student said, “You don’t have to learn to use the course management system—you just do it!” In Chapter 4, we commented extensively on faculty and student skill sets using technology, and we won’t duplicate that discussion here. But it is clearly a significant but repairable problem, as are all those that we’ve identified and discussed.

![Figure 5-13. Faculty Reporting on How Course Management Systems Affect Faculty-Student Communication (N = 560)*](image)

Conclusion

Despite student concerns, our data show overall that students felt course management systems increased learning and improved class management. The more experience students had with a CMS, the more they liked it. The major benefits cited were convenience and the ability to manage their classroom activities, but students also acknowledged learning benefits from CMS use, especially when they received feedback from faculty. Unfortunately, the tools that the students said they gained the most learning benefit from were frequently those that faculty used less often.

Endnotes

1. P. Hanson, Project cms@WBW.edu, Pilot Study Report, October 2003, <http://web.brandeis.edu/pub/Teaching/WbwInfo/cmswbw_report.pdf>. This study compares experiences by students and faculty at Brandeis University, Wesleyan University, and Williams College.


4. The scale for this question was 1 = very negative, 2 = negative, 3 = neutral, 4 = positive, and 5 = very positive.

5. The Pennsylvania State University survey shows a similar pattern of features used. ANGEL Implementation Survey, op. cit., p. 2.

6. Hanson, op. cit., p. 6.

7. Ibid., p. 8.


9. Hanson found that 40 percent of the faculty at the three institutions studied placed importance on the fact that the CMS saved time. Faculty indicated that course management systems improved access (38.9 percent), saved time (7.0 percent), and improved learning (14.8 percent). The student responses tend to mirror our findings. Seventy-seven percent gave the highest score to gradebook features and syllabus (72.2 percent). The lowest score was given to online discussion (33.9 percent). Hanson, op. cit., pp. 5, 6, 8.

10. Morgan, op. cit., p. 68.

11. Ibid., p. 48.

12. Ibid., p. 53.

13. At Pennsylvania State University, 95 percent of the students surveyed indicated that their computer skills were sufficient for using ANGEL. ANGEL Implementation Survey, op. cit., p. 1.
6

Future Trends

The new generation of technology-savvy students currently enrolled in and entering college possesses unprecedented IT skill levels. They think about and use technology radically differently from earlier student cohorts. As a consequence, we expected to find that such students would demand greater use of technology in teaching and learning in the classroom. They did not. What we found was 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 most skilled students in the use of technology had mixed feelings about technology in the classroom.

We expected students to already possess good skills in using IT in support of learning. What we found was that many necessary skills had to be learned at the university, and the motivation for doing so was very much tied to the requirements of the curriculum.

The students in our survey had not—outside of the classroom and prior to coming to college—gained the necessary skills to use technology in support of academic work outside the classroom. Concomitantly, we found a significant need for further training in using IT to support learning and develop problem-solving skills.

Lastly, we found that both faculty and students used course management systems mostly for communication of information and administrative activities and much less in support of learning.

These findings have significant consequences. Student and faculty use of instructional technology is more limited than is often portrayed. Students seem to be slower than expected in developing adequate problem-solving skills for using IT to support academic learning, and this impairs technology’s current value to the institution. Higher education’s investment in learning technology is paying less than optimal returns because students and faculty don’t have the appropriate skills or motivation to use it effectively. Colleges and universities appear not to be reaching enough students and faculty with technology education and training. Some complacency may have set in because of the belief that millennial students require less additional training with technology. As any number of individuals have said, “The experts are coming to school.” And few metrics are in place to monitor improvement and overall usage. In all likelihood, some students—perhaps many—are leaving college and university with technology skills inadequate for the challenges they might find in the workplace or in graduate school.

We emphasize that our findings are much like an audit—a snapshot in time, an early picture of a process that has great potential to support learning and is most promising. Like Zemsky and Massey, we were both surprised
and disappointed by what we learned. But we would not characterize our snapshot as “thwarted innovation” as much as we would attribute much of what we saw to real growing pains.¹ We found enough good practice and favorable, if not enthusiastic, commentary from the students to know that technology’s potential in the classroom is enormous.

**From Convenience to Learning Revolution**

In 1997, Michael Hooker proclaimed, “Higher education is on the brink of a revolution.” He went on to note that two of the greatest challenges our institutions face are those of “harnessing the power of digital technology and responding to the information revolution.”² What Hooker and many others didn’t reckon with is the likelihood that higher education’s learning revolution would be a journey of a thousand miles rather than a discreet event. Indeed, a study of learning’s last great revolution—the invention of movable type—reveals, too, a revolution conducted over centuries leading to the emergence of a publishing industry, intellectual property rights law, the augmentation of customized lectures with textbooks, and so forth.

Nearly eight years after Hooker’s proclamation, higher education finds itself still poised on the brink of a revolution. In those eight years, IT has continued its inexorable penetration into myriad aspects of work, education, and recreation, including activities that our students and faculty hold dear. During this time, the video-game industry surpassed the motion picture industry in revenues, the University of Phoenix opened the University of Phoenix Online, many notable virtual university efforts came and went, and course management systems became a common element of higher education’s base of enterprise applications. During this same period, the use of information technologies in the classroom and residence halls became widespread and commonplace, and the research persuaded us that courses mediated with information technologies showed no significant differences in learning outcomes from those that were not. And in that time, as our study shows, student access to computing and narrowband networking has become nearly ubiquitous, and access to broadband networking and online information resources is increasingly commonplace.

Both the ECAR study on faculty use of course management systems and this study of students’ IT experiences conclude that while IT is indeed making important inroads into classroom and study processes, to date the effects of this penetration seem to signal important enhancements in the convenience of postsecondary teaching and learning and but not yet a “learning revolution.” This should not surprise us. The invention of movable type enhanced, nearly immediately, access to published information and reduced the time needed to produce new publications. This invention did not itself change literacy levels, teaching styles, learning styles, and other key markers of a learning revolution. These changes, while catalyzed by the new technology, depended on slower changes to social institutions.

As with our administrative ERP systems, the first wave of innovation in and use of learning technologies we observed was mostly a wave of convenience and improved transactions. Mundane instructional processes were rendered friendlier, accessible at all hours, and painless. Communication became easier and quicker. And certain efficiencies in terms of student and faculty time emerged. As with administrative ERP systems, we believe the second wave of learning technologies is all about taking the “information exhaust” from the transaction systems and rendering it into forms usable for analysis and supportive of effective decision making.
So in the learning context, we now have data in machine-readable form about how students study, what they study, when they study, how long study activities take, and how much repetition is needed and taking place. This mirrors the emerging use of student enterprise data to flag at-risk students for institutional interventions, for example. Institutions can use the student study data obtained from course management systems to develop new learning models and instructional methods and strategies. These data record students’ individual learning preferences and, when aggregated, let us study the relationship between preferences, interventions, and outcomes. These are preconditions for a great leap forward in teaching.

Seven important trends (and probably more) will likely drive the IT-enabled revolution in teaching and learning.

First, institutional learning and cognitive scientists will mine and analyze student course activity data and translate their findings into programs and effective practices that policymakers and practitioners (and ultimately students) can effect.

Second, student and faculty information literacy will increase, and academic standards of research and evidence in Web-dominated information environments will emerge. Students will need to discern what is good information and what isn’t. We believe institutions will need to redesign their curricula to guide this effort and provide necessary incentives for students to learn how to learn with technology. And we will see the emergence of more-rigorous training programs. Concomitantly, we expect to see greater engagement of the K–12 sector in these activities, as colleges and universities will inevitably impose student admission requirements relating to technology skill and use.

Third, the quality and usability of course delivery systems will continue to improve. The software will become increasingly easier and transparent to use. It will become more student-centric, giving students more tools to take greater control of and shape learning. In the long term, learning management systems will get smarter and increasingly adapt their user interfaces, drill requirements, instructional strategy, and other aspects to future students’ learning styles and needs. If today’s course management systems represent the industrial automation of certain aspects of the instructional process, tomorrow’s systems will make it possible to massively customize learning for the learner. Such improvements will liberate both teachers and learners to make graduate-style mentoring possible in many cases at the undergraduate level.

Fourth, networked scholarly information will continue to proliferate, along with improvements in both digital rights management and mechanisms (such as micropayments and licensing) for the recovery of economic returns on these rights. We expect to see a standardization of learning objects and their use. Rights management environments will become increasingly robust, setting the context, expectations, and goals of any rights management implementation. Such implementations will likely include:

- authoring and assembly tools,
- content repositories,
- learning management environments,
- rights management systems and services, and
- personal information systems such as e-portfolios.

Fifth, institutions will support exploration and integration of new capabilities and practices as they emerge from the video-gaming, virtual reality, simulation, and modeling arenas. These should lead to greater and improved information exchange and interaction between students and faculty.

Sixth, institutions will place greater emphasis on planning and creating comprehensive and integrated work plans for implementing...
technology in support of learning. At many institutions, much of the implementation currently is piecemeal and in the hands of a few innovators and early adopters.

Finally, institutions will encourage and support experimentation and innovation of learning spaces and strive to understand the complex relationship between the built environment, social interaction, and learning dynamics.

**Beyond “No Significant Difference”**

Does and can technology make a difference in support of learning? Is it making a difference? Our data show that it is, but selectively. Students perceive that technology makes a difference when used appropriately. But we know that most courses they take don’t use technologies such as course management systems. And some faculty and students avoid courses that use technology, with little negative impact on the quality of teaching and learning.

The scholarly community is also ambivalent: witness the “no significant difference” debate started by Richard Clark. Clark maintains that learning effectiveness is simply the outcome of instruction and that the media or technology through which instruction is offered has no effect at all. According to Clark, technology is simply a vehicle, like a truck. He contends that it has no impact on the form or the content of what is taught—nor on the outcome.³

Thomas Russell of North Carolina State University compiled and analyzed more than 350 studies that compare the effectiveness of distance education with regular face-to-face instruction. Russell showed that distance education is as successful as traditional face-to-face instruction.⁴ “No significant difference” exists in effectiveness between courses offered via different media and technologies.⁵

Ostensibly, the “no significant difference” debates addressed the effectiveness of distance education. However, Phipps and Merisotis clearly scrutinized the effectiveness of technology more broadly—as a tool for teaching and learning. They acknowledged that the “purpose about much of the research is to ascertain how technology affects learning and student satisfaction.”⁶

Ahmed Ali and Abdulaziz Elfessi surveyed 47 students taking an educational media and technology course at the University of Wisconsin–La Crosse. Twenty-four of the students took the course in a traditional classroom setting, and 23 took the course online. The authors found that the different learning environments did not produce a significant difference in students’ attitudes toward technology. They concluded that “technology plays a role in students’ learning, albeit a secondary role. Although students recognized the potential and significant role of technology in teaching and learning, the recognition is limited to the use of technology as an instructional medium, and not a key determinant of learning. The Web is an important instructional delivery medium that can rival, but not replace, classroom learning.”⁷

According to Carol Twigg, thinking only in terms of the “no significant difference” debate gets in the way of innovation in technology use. She warned that if we focus only on making teaching with technology as good as traditional education, we likely miss the ways that using technology might make education better.⁸

**Benchmarking and Quality Issues**

How do we address Carol Twigg’s challenge? How can we improve the ways students use technology to enhance their learning? Our study reveals numerous areas and issues that require further research.
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and attention by administrators wanting to improve students’ technology experiences and skills. We believe technology should be embedded in the curriculum and that the success of several disciplines, such as business and engineering, can help establish benchmarks. Institutions would benefit from a more comprehensive training program for students and faculty that is directed by clearly articulated goals for IT skill levels and literacy. Faculty need to use course management systems’ lesser-used interactive features more often and effectively. And all of these activities will benefit from the development of appropriate metrics, benchmarks, and empirical analysis.

Jane Henderson, e-Scholar teaching and learning director, University of Wisconsin–Stout, reflected on measuring the success of their laptop program. “So far we’ve been measuring satisfaction and use (of the laptop service). We need to move to measuring learning and skill.”

Several noteworthy benchmarking initiatives seek to identify the elements that must be in place to ensure highly effective use of technology in teaching and learning. The Institute for Higher Education Policy (IHEP) undertook one such initiative.9 Its research is based on surveys and interviews with faculty, staff, and administrators at six institutions (Brevard Community College, Regents College, University of Illinois at Urbana-Champaign, University of Maryland University College, Utah State University, and Weber State University). Seeking to go beyond the hyperbole that characterizes many studies on technology use in teaching and learning, the authors identified 24 benchmarks, divided into seven categories:

- student support,
- faculty support, and
- evaluation and assessment.

Most benchmarks in these categories addressed high-level infrastructural requirements or policies, which must be in place to ensure quality. For example, the “student support” category contains the following benchmarks:

- Do students receive program information including admission requirements, tuition and fees, books and supplies, technical and proctoring requirements, and student support services?
- Are students provided with hands-on training and information about securing materials from electronic databases, interlibrary loans, government archives, news services, and other sources?
- Throughout the course or program’s duration, do students have access to technical assistance, including detailed instructions regarding the electronic media used, practice sessions prior to the course’s start, and convenient access to technical support staff?
- Are questions to student support personnel answered quickly and accurately with a structured system in place to address student complaints?10

Quite interesting is what IHEP omitted. Among the benchmarks they tested and rejected were those relating to student learning styles and how to incorporate these into course planning and design. The following benchmarks were included in the surveys but failed to make the final list:

- Are various learning styles considered during course design?
- Are assessment tools used to ascertain the specific learning styles of students, which then determine the type of course delivery?
Are courses designed with a consistent structure easily discernible to students with a variety of learning styles? IHEP rejected these benchmarks because faculty and administrators believed them to be too difficult to implement and because research on learning styles is still in its early stages and not yet strong enough to base practice upon.  

We heard from numerous students about how technology supported their individual learning style. More important, they perceived this to be an important benefit of technology in the classroom. Tools that make it possible for students to take greater control of how and when they learn or provide them with a choice of visual and textual materials appear to make a difference to the students. If these features have a positive impact on learning, then it would appear to be prudent to establish metrics and measure them.

Similarly, IHEP rejected several benchmarks relating to student collaboration, including the following:

- Are courses designed to require students to work in groups using problem-solving activities to develop topic understanding?
- Do course materials promote collaboration among students?

These omissions are especially problematic, given the emphasis on collaboration and problem solving in studies of effective practices described in previous chapters and below. Students in our study ranked these activities among the highest in support of learning.

The Sloan Consortium in their Report to the Nation: Five Pillars of Quality in Online Education also developed a set of quality standards for technology use in teaching. They may be used as “a framework for measuring and improving an online program at any institution.” The five “pillars” are learning effectiveness, student satisfaction, faculty satisfaction, cost-effectiveness, and access. As with the categories and benchmarks developed by IHEP, they are intended primarily to be applied in asynchronous or distance-education settings. These pillars identify several issues crucial to students’ effective use of technology, but they do so at a very high level of abstraction.

Colleen Carmean and Jeremy Haefner identified a set of effective practices and issues to bear in mind when teaching with a CMS. Their analysis focused on ways to use a CMS to create an effective learning environment. However, their recommendations also apply to most classroom uses of technology. For them, technology does not and should not drive pedagogy. It can accommodate deeper learning principles and thereby help create effective learning environments. On the basis of research about learning, they identified five principles necessary for deeper learning, which occurs when learning is social, active, contextual, engaging, and student owned.

According to Carmean and Haefner, course management systems can help put into practice these principles. By so doing, they foster effective learning environments. For example, by providing easy access to asynchronous communication, visual information, and active learning, a CMS provides a more engaging learning environment. It respects diverse talents and ways of learning. It communicates high expectations. It encourages high-challenge, low-threat environments. And it emphasizes intrinsic motivators and natural curiosities.

Karen Swan focused on the course rather than the CMS. She summarized numerous researchers’ insights and created a list of prerequisites for making the most effective use of instructional technologies. Faculty must provide:

- clear goals and expectations for learners,
- multiple representations of course content,
- frequent opportunities for active learning,
- frequent and constructive feedback,
flexibility and choice in satisfying course objectives, and
- instructor guidance and support.

Swan paid particular attention to technology’s huge potential to support interactivity, which improves the student learning experience. Like Carol Twigg, Swan believes we should move away from the “no significant difference” debate and focus our energy on learning activities that technology can improve. According to Swan, technology can foster five kinds of interactivity:
- between the student and the instructor,
- between students and their peers,
- between students and content,
- between students and technology interfaces, and
- by vicarious interaction.

Swan described the learning impact of increased online interaction between students and instructor (referred to as teaching presence), students and their peers (referred to as social presence), and students and content. Interactions between a student and technology interfaces can promote or constrain the first three types of interactions described above and thereby discourage or promote learning. Vicarious interaction happens all the time in the classroom. For example, a student can learn from observing an interaction between the instructor and another student. This also occurs through discussions using the technology medium. Further research in these two areas, Swan suggested, can lead to improvements in technology use and, ultimately, greater learning effectiveness and student satisfaction.20

A New Wealth of Data

Enterprise systems, data warehousing, and course management systems are recording and making available to researchers and university administrators a plethora of detailed quantitative data on students and how they learn. These data on all aspects of student activity represent a gold mine of information for benchmarking and for developing new learning models and effective practices. They can be used to affirm that effective practices really are effective practices. As we learned from our study, course management systems are now unobtrusively collecting information on more than 80 percent of the students at the 13 institutions we studied. As these numbers continue to grow, the ability to map the learning activities of nearly 100 percent of the student body in courses at all levels and in all disciplines offers unprecedented opportunities to improve the quality of education. Researchers on effective learning practices will have a sound empirical base with which to test their hypotheses on what works and what doesn’t work in support of learning.

These data and findings will inevitably be fed into a cycle of institutional planning, resource allocation, implementation, and assessment of outcomes, which we discuss later in this chapter. A plan not based on data is worthless, and long-term success requires an appropriately funded plan. These data will support the formulation of plans that include metrics to track student and faculty performance; operational performance of the teaching and learning processes, including their quality and outcomes; and factors that contribute to desired outcomes, such as higher graduation and retention rates. In addition, used with the right technology and tools, the data can provide faculty, students, advisors, and administrators with on-demand reports, analyses, and alerts, which in turn support the teaching and learning process.

Accreditation and Effective Practices

As classroom technology use matures and plays an increasingly important role in support of quality education, the higher education accreditation bodies will likely take
greater interest and eventually establish technology criteria as a basis for accreditation. The North Central Association: Commission on Accreditation and School Improvement has established a set of guidelines for online courses and programs. Currently, some of their criteria specified for accreditation address technology, though they are illustrative rather than prescriptive. They are consistent with many of the effective practices elaborated upon in this chapter.

The North Central Association’s technology criteria examine how the organization plans for current and future technology requirements and how it prepares to incorporate technological innovations into the organization to meet system priorities. Among the criteria:

- The system has an ongoing instructional technology plan that addresses technology utilization, professional development, effectiveness, and the needs of all students and staff.
- All technology resources are conveniently accessible to all students, faculty, and staff and are integrated across the curriculum.
- Personnel with appropriate expertise are available to assist students and staff in making effective use of all technology resources.
- The system’s instructional technology plan includes a budget that is adequate for the needs of the system.
- The system evaluates and improves the technology plan on the basis of the system’s strategic priorities.

A plan that follows these criteria would specify that students must be able to or must demonstrate

- knowledge base for developing the capacity to use and manage technology;
- ability to evaluate the positive and negative effects of various technologies;
- ability to protect oneself from unethical, illegal, or inappropriate uses of technology;
- ability to select, use, and evaluate technologies other than computers;
- ability to select and use computers, peripheral hardware, and software to word process, create and manage database spreadsheets, and create multimedia presentations;
- ability to use technology ethically;
- knowledge of the characteristics and uses of computer hardware and operating systems;
- knowledge of the characteristics and uses of computer software; and
- understanding of relationships among science, technology, society, and the individual.

**Faculty IT Literacy**

A key finding emerging from our study is the need to improve faculty use of technology. The qualitative findings revealed a perception among many students that faculty technology use is not uniform and often wanting. Faculty members, like their students, use the convenience and management features of course management systems more than the interactive features, which students said contributed the most to their learning (see Table 5-8). Students also complained about inconsistent CMS use. Glenda Morgan found that some faculty indicated they would use course management systems if the institution provided additional training.21

Rhonda Epper and Tony Bates elaborate on effective practices in faculty development, building on the findings of the State Higher Education Executives Organization and the American Productivity and Quality Center study on faculty development practices at 45 institutions in both the corporate and education sectors in the United States and Canada. In *Teaching Faculty to Use Technology: Best Practices from Leading Institutions*,22 Epper noted that “one of the most important lessons learned over the past decade in higher
education is that while technology is obviously expensive, supporting its use is even more expensive,” and many technology administrators have been slow to appreciate and support the full costs. Where adequate funding and technical help have been provided, a more effective job has been done. Epper and Bates noticed the following:  
- Institutions were characterized by a culture pervaded by technology. The focus was on teaching and learning, not on the technology in and of itself.  
- All institutions had a strong instructional technology plan.  
- There had been and continued to be extensive investment in the technology infrastructure.  
- There was strong support from senior leadership for the use of technology in teaching.  
- There was support for faculty use of technology, exemplified by project funding, technical support, and computer upgrades.  
- There was support for students in the form of computer access, Internet accounts, and financial support.  

Epper and Bates identify several specific programs that illustrate how these guidelines can work in practice. At the Virginia Institute of Technology, faculty computer upgrades are linked to ongoing faculty development in technology use. Faculty at the University of Central Florida can participate in an online program that prepares them to teach using technology.  

Typically, institutions that exhibit best practices have a senior manager, such as an associate vice chancellor or a CIO, with responsibility for coordinating the support units’ activities. They also establish stable funding for faculty development and technology initiatives, and they set standards for selecting technologies and projects. The California State University System through its Commission on Learning Resources and Instructional Technology has developed standards and criteria for selecting projects involving faculty and student technology use.  

Paul Hagner advises that institutions considering making improvements to their faculty development initiatives should not think of particular practices in isolation but should think in terms of sets of practices that support one another, or “best systems.” He discusses “interesting practices,” organized within the following themes:  
- training in the use of teaching and learning technologies;  
- grants and start-up support for faculty;  
- “just in time” technical assistance for faculty;  
- assessment of the outcomes of technology integration into teaching and learning; and  
- information exchange and communication, especially how innovations spread among faculty as well as how faculty members learn about services and opportunities.  

In summary, institutional leadership must establish a funded priority for faculty technology development using effective practices as guidelines. They need to establish appropriate rewards and incentives. Technology innovation, skill, and use in the classroom should be considered in merit, promotion, and tenure decisions. In the absence of such incentives, many faculty members are unlikely to change how they teach and what teaching tools they use. Nor will they believe that technology makes a difference.  

**Student IT Literacy**  
No matter how well an institution implements faculty development in technology use, students still need related support and training. Our study shows that while some students are highly skilled in using technology, many still require support and training in using software and tools. Sixteen percent of
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the faculty who participated in ECAR’s Faculty Use of Course Management Systems study reported having decreased their CMS use because students found it difficult to use.\footnote{30} Student technology difficulties included problems in obtaining access, low technology skills, low student motivation to use a CMS, and low student preference for online materials. Our data support Zemsky and Massey’s conclusion debunking the myth that “the kids will take to this like ducks to water.”\footnote{31}

Few studies elaborate on effective practices in this area. One small-scale qualitative in-depth study\footnote{32} of how students used technology and what strategies would be most helpful advised that institutions and faculty

- articulate technology’s importance within their own disciplines and interests,
- develop processes for and reflective approaches to learning technology skills,
- identify motivational factors to learn and use technology, and
- explore how students can use technology for self-expression.

Software training classes are proliferating at colleges and universities, most often for no credit, but in some colleges for credit. A good example is the Software Training for Students program at the University of Wisconsin–Madison, which we discussed in Chapter 3. Some colleges are offering courses in Excel and similar applications for credit. We recommend that these courses earn no credits and be centralized. Institutions should determine a skill level needed of all students and then establish a coordinated structure and process that ensures that students obtain these skills institution-wide. The alternative is a piecemeal “Ma and Pa shop” approach that often yields mixed quality with highly variable outcomes across the institution. Nontraditional students’ needs warrant particular attention, especially if they have been out of school for some years. They will likely

need additional technology training. Also, our study found that students especially lack skills in overall computer maintenance, including file setup, virus protection, and recovery. These skills should be a basic part of any training program.

Cathy O’Bryan, manager of professional and technical education at the University of Wisconsin–Madison, advised, “I think all students coming in should go through an IT skills assessment. Those not meeting a minimal level of computer skills should be required to take for-credit courses to improve those skills. These courses should emphasize situational problems and seek to develop problem-solving skills rather than procedures.” Similarly, Jane Henderson, e-Scholar teaching and learning director at the University of Wisconsin–Stout, suggested, “We need to train students in information technology by using a first-year credit class where we teach basic skills and relate it to learning activities they are doing.” And a University of Wisconsin–Milwaukee student agreed. “We should have classes on the various applications with hands-on time. Everyone should take a class on Word and Excel.” A University of Wisconsin–Whitewater student offered a slightly different recommendation: “I would hate to require another course. It would be a waste of time. The university needs to set a basic standard for things you need to know so you can test out of it. Peer training would be good.”

As the need for classroom technology skills increases, higher education will likely look for help from the K–12 system, much as it did with foreign-language preparation. The use of course management systems in the K–12 system will help prepare students to use these tools in college, and instruction in selected applications such as PowerPoint and Excel would be most helpful. These skills may become admission requirements. A Colgate
undergraduate observed, “College is not the best place to start addressing technical skill problems. It needs to start before college, in K–12. In college, there is no down time.”

Several institutions have launched exemplary instruction technology training programs. Noteworthy is George Mason University, which in 1998 instituted a Technology Across the Curriculum program. The program has three broad aims: to ensure that technology is well integrated with academic content and geared toward student learning, to avoid “episodic” or ad hoc efforts at technology integration, and to facilitate support for both faculty and student technology use. The use of IT is embedded within the traditional liberal arts curriculum. Students are expected to extend their mastery of course content while learning technology skills and applying them in creative and problem-solving ways. The program expects students to achieve a defined level of skill in 10 areas:

- collaboration;
- the use and creation of structured electronic documents;
- technology-enhanced presentations;
- the use of electronic tools for research and evaluation;
- the use of databases to manage information;
- the use of spreadsheets to manage information;
- the use of electronic tools to analyze quantitative and qualitative data;
- the use of graphical and multimedia representational technologies;
- legal, ethical, privacy, and security issues in IT; and
- a working knowledge of basic types of software and hardware.

The curriculum requires numerous discipline-based projects undertaken by faculty with financial, technical, and pedagogical support from the Technology Across the Curriculum program and other campus support units.

**Toward Integrated Learning Management Systems**

Course management systems and other learning technologies such as e-portfolios promise to radically increase the workload of IT offices at colleges and universities in the near future, not to mention that of students and faculty. We predict that the effort and resources needed to support student and faculty use of these evolving technologies will soon surpass what is currently invested in administrative enterprise systems. Moreover, there will be enormous pressure to integrate the information and functions from the enterprise systems with the information and functions of course management systems and e-portfolios. Without greater integration, institutions run an unintended risk of replacing the old brick-and-mortar student service bunkers with digital bunkers and what Carl Jacobsen of the University of Delaware calls a “runaround by mouse.”

The reasons for greater integration are obvious and are very similar to those that caused universities to Web-enable administrative enterprise systems and rethink business processes. They include rising customer expectations and demand for customer access and control, a reduction of instruction’s administrative costs, a demand for simplicity and transparency in an increasingly complex environment, and elimination of procedural controls and simplification of processes. These reasons are all interrelated and mutually reinforcing.

It is clear from our study that students and faculty applaud the power of course management systems to support administrative activities, and students especially appreciate how the tool helps them take greater control of their learning experience. But their expectations will certainly rise as they continue to use the product and their ability to use it increases. The millennial students are impatient, and as
they learn to manage their classroom activities as well as their enrollment activities, we anticipate pressure from them or a visionary entrepreneur to create stronger and reinforcing links between the course management systems, e-portfolios, and one-stop student enrollment services.

Students will increasingly want to control and manage their entire college experience in a convenient and easy manner. That implies the necessity for tools that integrate administrative and classroom transactions and activities, facilitate course and curriculum planning, and permit subsequent self-assessment of performance. We would liken such a tool to Quicken, which lets the user track and pay bills, plan a budget and, at the end of the year, assess and understand why his or her budget plan failed or succeeded. And like Quicken, the new tool might also allow the institution to market programs, services, and events. The tool will also have to become easier to use and transparent like Quicken. And it cannot be loaded up with so many bells and whistles that it becomes overwhelming. One of the most common complaints among students and faculty in our study was that their CMS was too complex and required better training.

We note here that training will likely remain a priority even if the software becomes easier to use. The IHEP panel warned that as technology evolves and becomes simpler and more transparent to use, some might be tempted to conclude that the need to train students in technology skills will lessen. The opposite is true. “Simpler interfaces may broaden access to technology, but they do not make people technology literate. Individuals still need to develop critical cognitive and technical skills.”

We already see evidence of pressure to integrate these technologies and simultaneously provide students with greater control of their learning experience. A useful document for tracking trends and the future development of course management systems is the report of the National Learning Infrastructure Initiative (NLII) Next-Generation Course Management Systems Focus Session held in Tucson, Arizona, in March 2003. The report contains a well-organized set of recommendations to improve current course management systems, which also would broaden them to become more integrated learning management systems. The document provides a wealth of information and links to work on next-generation course management systems.

We found especially interesting their recommendation to free the tool from a particular course and from time constraints. Practically, this means giving students the ability to extract information on activities or learning products from a course taken earlier, or adding functions that let students manage all of their courses from a single site and communicate with students in all of their courses, not just within one course.

Concomitantly, such innovation will increase student access and control and their ability to communicate with one another, which was another major benefit students reported in our study. Student interaction was perceived to be the course management system’s single most important feature for improving learning.

Attendees at the NLII conference stressed that course management systems are currently too course- and faculty-centric and too little student- and learner-centric. Our data suggest that students would welcome the ability to take greater control of communications and its purpose. Currently, students cannot unilaterally establish a discussion group, for example. The tool needs to empower students. If it does, its value to students will increase, as will its use. Students will come to own the tool as much as the faculty does.

The tool should also further empower the student to assess his or her own performance
in various ways—not just by tracking grades, taking sample quizzes, and comparing grades with other class members. Course management systems can measure every transaction and activity, and these digital records can be linked to outcomes—progress and productivity. Such tools should be available to students in ways that make sense to them as well as to the faculty and researchers who can test the impact of effective practices recommended by NLII members. We envision students having the ability to create custom dashboards to monitor their learning performance.

Our data show that faculty and students use course management systems primarily to transmit information because the software is convenient to use, improves timeliness, and is efficient. Administrative chores, especially, are made easier. What’s lacking, we found, was the tool’s use to improve learning, although both students and faculty recognize learning gains and also see the tool’s potential for improved learning. The NLII session in Tucson addressed these concerns and emphasized skill development in knowledge management, interactive activities, and effective learning practices in general.

The tool must also enhance students’ ability to use networked scholarly information.

**Networked Scholarly Information**

This study has generally limited its scope to a core set of information systems, institutional services, and student preferences and behaviors related to the learning process and student experience. A companion study could and should be undertaken in the broad area described as networked scholarly information. A literature reading strongly suggests that the World Wide Web has become the research repository of choice even though it doesn’t mirror an academic library in important ways.\(^\text{38}\) As Marshall McLuhan predicted, wholesale changes in the nature of the communication medium are changing long-established communications norms and nuanced disciplinary differences in styles and manner of communication. These changes aren’t understood widely among the professoriate, making it nearly impossible to acculturate today’s students to clear expectations about things as basic as the evidentiary value of information residing on the Web.

**An Alliance with Computer Games**

Our study found that 69.9 percent of students play computer games, and male freshmen play more than any other subgroup in our study. We found that 36.8 percent of male freshmen spend five hours or more per week playing computer games. Is there some way to harness part of their effort and turn game-playing into a learning experience that goes beyond the development of navigation and typing skills? To what degree can games be designed to more deliberately improve critical thinking and problem-solving skills? A good example is Microsoft’s *Flight Simulator*, which has provided a foundation for learning in a novel and creative manner.

Video gaming, virtual reality, simulation, and modeling are robust and profitable industries that continually add new capabilities and practices that could lead to innovative and highly productive interaction among students, faculty, and information. Some universities are already experimenting in this area. The University of Southern California School of Engineering and School of Fine Arts plan to offer jointly a minor in computer games, focusing on animation, 3D modeling, programming, and design. MIT’s Comparative Media Studies program and the University of Wisconsin–Madison School of Education, together with LeapFrog Inc., are investigating how consumers might identify games that support learning. At this point, though, the effort to make games more educational...
is minimal. The private sector likely questions the profitability of educational games, and college-level educators may be skeptical on pedagogical grounds.

**Instructional IT Planning**

The implementation of course management systems and other classroom technologies would benefit from an institution-wide planning process resulting in an approved instructional IT plan, which must be part of a broader institutional planning process and plan. We suspect that many instructional technology initiatives are decentralized and provide for little monitoring and benchmarking. Too many initiatives support one-time efforts by individual faculty to improve individual courses even though many of these initiatives require long-term financial and departmental support. We believe it’s wiser to invest resources in department- or college-led initiatives that are tied to curricular improvement and which commit groups of faculty to the effort and provide ongoing resources. On the basis of our findings where students learn to use technology in support of learning, we believe the plans should be curriculum focused. A “let a thousand flowers bloom” strategy leads to slow and uneven adoption and to uneven and underleveraged outcomes—learning or otherwise.

In our interviews at the University of Wisconsin-Stout, IT administrators reflected on what their campus is doing well with IT. The initiatives they noted included the laptop program, a university portal, strong support from the chancellor, skilled IT staff, e-mail for all students with all official correspondence sent through the e-mail system, wireless access across the entire campus, and walk-up help services with extended hours. Attention was being paid to wide-ranging, linked activities. This is a good direction, but more is needed. The instructional IT plan should be tied to and closely aligned with the institution’s other IT plans to ensure that all student IT services, including e-mail, network access, and student administrative applications, are consistent and comprehensive.

Instructional IT planning should be an ongoing process of establishing priorities based on an assessment of the quality and performance of current instructional technology programs and services, future academic programmatic needs and opportunities, and resources available and needed for their implementation. It should be focused on improving the quality of academic programs and overall student performance.

A good plan in this area must be student-centric. We believe institutions haven’t spent enough time listening to students, especially when they express how and why they want to use technology for learning. We were astounded by the outpouring of student commentary on technology use in response to our survey’s open-ended questions. The instructional IT plan should foster cooperation among students, faculty, staff, and administrators in support of collective goals and priorities.

The instructional technology planning process should be broadly participatory and sensitive to the norms and culture of the colleges and their departments and other units. It should accommodate a variety of needs. The requirements of art and design courses differ from those in the social sciences. Plans should anticipate future requirements in areas such as film studies, from history to production; this discipline can no longer function without IT. Most geography students will use geographic information systems in their field of study. A growing number of writing courses—mostly in freshman composition—use computer-mediated writing. Graduate study in any science field, including the behavioral sciences, is necessarily IT-intensive. Planning will have to be
sensitive to future academic requirements. A one-size-fits-all solution is unlikely to work.

Instructional IT plans should be future oriented, with goals set in the context of each discipline’s expected future and then aggregated as well as possible.

As we noted earlier in this chapter, institutions should base planning on empirical data and continual analysis of the data, systematically using course management systems’ data-gathering capacity and data in the planning process. We anticipate that such plans will change constantly as new standards of performance, technology, demand, and opportunities present themselves. Planning, especially in this area, is an iterative, learning process.

Lastly, it is critical that collegiate as well as central academic and technology officers be responsible for the overall quality of instructional technology plans and planning and ensure that the IT plan is integrated with and supports the institution’s overall plan and mission.

A Concluding Recommendation

We emphasize again that our study is a snapshot in time of a rapidly changing environment. The tracking of trends is critical to understanding how students learn and how IT can improve overall satisfaction with the classroom experience. Longitudinal studies are needed, and we encourage our readers and their institutions to consider joining ECAR in a series of follow-up studies using the same (albeit improved) survey. Such studies will demonstrate whether initiatives currently under way are making a difference in how students use technology both in and out of the classroom, and they will show how IT affects the learning experience.

Endnotes

5. R. Phipps and J. Merisotis, What’s the Difference? A Review of Contemporary Research on the Effectiveness of Distance Education in Higher Education (Washington, D.C.: Institute for Higher Education Policy, 1999). Phipps and Merisotis take exception to Russell’s findings. They believed that much of his data and resulting insights were questionable because of methodological shortcomings, including sampling techniques and questionable measurement instruments.
6. Ibid., p. 31.
9. IHEP, Quality on the Line: Benchmarks for Success in Internet-Based Distance Education (Washington, D.C.: Institute for Higher Education Policy, 2000).
10. Ibid., p. 3.
11. Ibid., p. 15.
12. Ibid., p. 16.
14. Ibid., p. 3.
15. Ibid., pp. 4–6.
17. Ibid., p. 29.
18. Ibid., p. 32.
20. Ibid., pp. 17–23.
25. Ibid., p. 145.
26. Ibid., p. 147.
27. Ibid., p. 148.
30. Morgan, op. cit., p. 49.
34. See <http://cas.gmu.edu/tac/program/it_goals.html>.
Appendix A

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

Issued February 2004

Thank you for your willingness to answer this survey, which focuses on your experiences with and opinions concerning information technology. The information you and other undergraduate students are providing us will be reported in a study that will be available to higher education institutions. The primary goal of the study is to better understand student experiences with information technology and inform the leadership of your institution if the efforts in information technology are focused appropriately.

For the purposes of this survey, information technology refers to “personal electronic devices such as laptops and hand-held computers, cell phones, and institutional devices such as computers and associated devices.” Your answers will be compared with student responses from Colgate University; Drexel University; University of California, San Diego; University of Wisconsin System institutions, and the University of Minnesota.

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

Please complete the survey within the next two weeks. It should take you approximately 15 minutes to complete the survey. As thanks for your time and valuable input, each participant who provides an email address will be entered into a drawing for one of 100 gift certificates of $50 each. Every participating campus will have prize winners.

We appreciate your time and participation. If you have any questions or concerns, please contact your campus representative as noted in the email you were sent.

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

Section 1.

We can only survey students age 18 or older.

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

- No
- Yes

1.2 I give my consent to the following. [Required] <If no, go to end of questionnaire. If yes, go to 1.3>
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.

This study is being conducted by: Prof. Robert Kvavik of the Office of the Executive Vice President and Provost at the University of Minnesota and Glenda Morgan of the Office of Learning and Information Technology at the University of Wisconsin System.

Background Information
This study is designed to explore the issue of student skills with information technology as well as student perceptions of the value and advantages of its use in teaching and learning. We have the following research questions:

◆ What kinds of information technologies are students using and with what levels of skill?
◆ What do students perceive to be the value and advantages of the use of information technology?
◆ To what extent do skills transfer from the use of technology for entertainment?
◆ What obstacles do students face in their use of technology?

Procedures
If you agree to be in this study, please fill out the attached survey. The survey asks for basic background information, as well as questions 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
◆ Obstacles to your effective use of information technology

It will take about 15 minutes to complete the survey. Please answer the questions to the best of your ability. There are no right or wrong answers. 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 participating in this study.

The benefit to participation is to inform university officials of benefits of their technology investments for students.

Compensation
We will be holding a raffle for gift certificates of $50 for participating in this survey. If you choose to participate in the raffle you can include an email address in the space provided at the beginning of the survey. Once the survey has closed we will conduct a random drawing from the email addresses of all those who participated from your institution. This will occur within two weeks of the closing of the survey.

Your email 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 your email address 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 sort of 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 to participate or not will not affect your current or future relations with your institution (or with any of the institutions participating in this survey including the University of Minnesota; the University of Wisconsin; Drexel University; Colgate University; and the University of California, San Diego or with EDUCAUSE). If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions
The researchers conducting this study are Robert Kvavik, Glenda Morgan, and Judy Caruso. You may direct any questions to them: Robert Kvavik, 612.625-2400 <kvavik@umn.edu>; Glenda Morgan, 608.265-9559 <gmorgan@uwsa.edu>; or Judy Caruso, 608.263-7318 <judy.caruso@doit.wisc.edu>. You can print out a copy of this information to keep for your records.

Statement of Consent
1.2 I have read the above information. I have asked questions and have received answers. I consent to participate in the study. [Required]
   • No
   • Yes

1.3 If you are interested in entering the drawing for one of 100 prizes of $50 each, please enter your email address.

Section 2. Your Use of Electronic Devices
2.1 Which of the following electronic devices do you own? Check all that apply. [1.2 “Yes” respondents; multiple responses]
   • Personal desktop computer
   • Personal laptop computer
   • Personal digital assistant (PDA), e.g. Palm device
   • Smart phone (combination cell phone and PDA device)
   • Cell or digital phone

2.6 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 or more hours)
   • Classroom activities and studying using an electronic device
   • Playing computer games
   • Downloading or listening to music or videos/DVDs
   • Chatting with friends or acquaintances using instant messaging
   • Surfing the Internet for pleasure
   • Online shopping
2.12 How many hours each week do you normally spend on using an electronic device (computer, Palm device, etc.) at your place of employment?
- I do not work
- Do not use
- Less than an hour
- 1–2 hours
- 3–5 hours
- 6–10 hours
- 11 or more hours

2.13_2.21 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 or more hours)

- 2.13 Creating, reading, sending email
- 2.14 Writing documents (Word Processing)
- 2.15 Creating spreadsheets or charts (Excel, etc.)
- 2.16 Creating presentations (Powerpoint, etc.)
- 2.17 Creating graphics (Photoshop, Flash, etc.)
- 2.18 Creating and editing video/audio (Director, iMovie, etc.)
- 2.19 Creating web pages (Dreamweaver, FrontPage, etc.)
- 2.20 Completing a learning activity or accessing information for a course using course management systems (WebCT, Blackboard, Desire2Learn, Learn@UW, etc.)
- 2.21 Using a library resource to complete a class assignment (e.g., a library resource on your official university library web site)

2.22_2.32 What is your skill level using the following computer programs and applications? (Do Not Use, Very Unskilled, Unskilled, Skilled, Very Skilled)

- 2.22 Email
- 2.23 Instant messenger
- 2.24 Web surfing
- 2.25 Word processing
- 2.26 Spreadsheets (Excel, etc.)
- 2.27 Presentation software (Powerpoint, etc.)
- 2.28 Graphics (Photoshop, Flash, etc.)
- 2.29 Creating and editing video/audio (Director, iMovie, etc.)
- 2.30 Creating web pages (Dreamweaver, FrontPage, etc.)
- 2.31 Course management systems (Web-CT, Blackboard, Desire2Learn, Learn@UW, etc.)
- 2.32 Online library resources

2.33 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.)
- University-operated dial-up modem service
- Commercial broadband service (e.g., DSL modem, cable modem, etc.)
- University-operated wired broadband service
- Broadband wireless network
Section 3. Your Use of Technology in Classes

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

- I prefer taking classes that use no information technology.
- I prefer taking classes that use limited technology features (e.g., e-mail to instructors and limited use of PowerPoint in class).
- I prefer taking classes that use a moderate level of technology (e.g., e-mail, several power-point presentations, some online activities or content).
- I prefer taking classes that use technology extensively (e.g., class lecture notes on-line, computer simulations, PowerPoint presentations, streaming video or audio etc).
- I prefer taking classes that are delivered entirely “on-line” with no required face-to-face interactions.

3.2_3.7 To what extent do each of the following describe your experiences in your classes? (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)

3.2 I spend more time engaged in course activities in those courses that require me to use technology.
3.3 The use of technology in my classes met my expectations.
3.4 The instructor’s use of technology in my classes 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 I get better grades in courses that use information technology.
3.7 Faculty need to give us more in-class training for information technology they are using in the class.

3.8_3.14 To what extent has the use of information technology in classes helped you? (Strongly Disagree, Disagree, Agree, Strongly Agree)

3.8 The use of information technology in classes has helped me better understand complex or abstract concepts.
3.9 The use of information technology in classes has helped me to better communicate with the instructor.
3.10 The use of information technology in courses has helped me communicate and collaborate with my classmates.
3.11 The use of information technology in courses has resulted in prompt feedback from the instructor.
3.12 The use of information technology in courses provides more opportunities for practice and reinforcement.
3.13 Classes that use information technology are more likely to focus on real-world tasks and examples.
3.14 Classes that use information technology allow me to take greater control of my class activities (e.g., planning, apportioning time, noting success and failure).
3.15 Have you taken a class that used a course management system (such as WebCT, Blackboard, Desire2Learn, or Learn@UW)? [Required] <If no, go to 3.26. If yes, go to 3.16>
  ◦ No
  ◦ Yes

3.16 How would you describe your own overall experience using a course management system (such as WebCT, Blackboard, Desire2Learn, or Learn@UW)? [3.15 “Yes” respondents]
  ◦ Very negative
  ◦ Negative
  ◦ Neutral
  ◦ Positive
  ◦ Very positive

3.17_3.25 For each of the online features used in your classes, how did the features help you improve learning or your ability to manage your class activities? (Did not use, Negative effect, No effect, Improved learning, Improved my management of my class activities, Improved Learning and Improved my management of my class activities)

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

3.26_3.27 Which of the following benefits from using information technology in your classes was the most valuable to you?
  ◦ Improved my learning
  ◦ Saved me time
  ◦ Convenience
  ◦ Helped me manage my class activities (e.g., planning, apportioning time, noting success and failure)
  ◦ No benefits
  ◦ Other

3.27 describe “other” (optional)

3.28_3.39 What are the barriers for you (if any) to using a computer or information technology in your classwork? Check all that apply. [Multiple responses]

3.28 It feels like extra work with little connection to the course
3.29 I don’t have the necessary skills
3.30 I don’t have the technical support I need
3.31 It is too expensive
3.32 I don’t have sufficient access to a computer
3.33 I don’t have sufficient access to a printer
3.34 The applications don’t run on my computer
3.35 I have trouble connecting to the Internet from my place of residence. (I don’t have reliable access to the Internet.)
3.36 I have to set-up and trouble-shoot too many browser variations
3.37 There are no barriers
3.38 Other
3.39 Describe “other” (optional)

Section 4. Information About You

4.1 Which one of the following statements best describes you?
   - I learn best by working alone and thinking through concepts and problems myself.
   - I learn better by working alone in some situations.
   - I learn equally well by working alone and by discussing concepts and problems with others.
   - I learn better by discussing concepts and problems with others in some situations.
   - I learn best by collaborating with others and discussing concepts and problems with them.

4.2 What is your gender?
   - Male
   - Female

4.3 What is your age?
   - 18
   - 19
   - 20
   - 21
   - 22
   - 23
   - 24
   - 25
   - 26
   - 27
   - 28
   - 29
   - 30-39
   - 40-49
   - 50-59
   - 60-69
   - 70 or over
   - Decline to answer

4.4 What is your cumulative Grade Point Average (GPA)?
   - Under 2.00
   - 2.0-2.24
   - 2.25-2.49
   - 2.5-2.99
   - 3.0-3.24
   - 3.25-3.49
   - 3.50-3.75
   - 3.76-4.00
   - Don’t know

4.5 Are you a senior or freshman? [Required]
   - Senior
   - Freshman
4.6 Are you a full time or part time student?
   • Full Time
   • Part Time

4.7 Do you reside on campus or off campus?
   • On campus
   • Off campus

4.8-4.16 What disciplines are you majoring in? Check all that apply. [Multiple responses]
   • 4.8 Social Sciences
   • 4.9 Humanities
   • 4.10 Fine Arts
   • 4.11 Life Sciences, including Agriculture and Health Sciences
   • 4.12 Physical Sciences
   • 4.13 Education, including Physical Education
   • 4.14 Engineering
   • 4.15 Business
   • 4.16 Other or undecided

4.17 What is your ethnic group?
   • African American or Black, not of Hispanic origin
   • American Indian or Alaskan Native
   • Asian or Pacific Islander
   • Hispanic, Chicano, Mexican American, Latino
   • White, not of Hispanic origin
   • Other
   • I do not wish to provide this information

4.18 Which institution are you attending? [Required]
   • Colgate
   • Drexel
   • University of California, San Diego
   • University of Minnesota, Crookston
   • University of Minnesota, Twin Cities
   • University of Wisconsin–Colleges
   • University of Wisconsin–Eau Claire
   • University of Wisconsin–La Crosse
   • University of Wisconsin–Madison
   • University of Wisconsin–Milwaukee
   • University of Wisconsin–Oshkosh
   • University of Wisconsin–River Falls
   • University of Wisconsin–Stout
   • University of Wisconsin–Whitewater
Section 5. Thank You.
Thank you for taking the time to answer this survey. Comments that you might wish to make about the use of technology would be most welcome.

5.1 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 memo field]

Your survey responses will be submitted when you press the Finish button. Please do so now.

- END SURVEY -
Appendix B

Student Technology Use and Skills:
Student Focus Group Questions

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

There is a lot being said and written about the current generation of students being good at using technology and being tech savvy. Do you think this statement is true of yourself? Of your friends?
  What kinds of technology skills are you good at?
  What kinds of technology skills are you bad at?
  What kinds of technology skills do you think students in general are bad at?

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?

Do you have or have you had classes in which instructors used Internet technology (e.g., computers, the Internet, PDAs)?

What kinds of uses of technology have instructors made in the classes you have taken thus far?
  What are the major advantages that you see in the use of technology in the classroom?
  What is the major disadvantage that you see in the use of technology in your courses?

Do you think that the use of technology in your classes helped you in your learning? If so, how? If not, why not?
  What was the coolest use of technology that you’ve seen in any of your classes?

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

Have you experienced any trouble in getting access to computing facilities or the Internet in order to do course-related work? What kinds of problems did you run into?
What are the major obstacles that you see to more effective use of computer and information technology in your classes?

Have you found computer labs on campus to be an effective place to work? If so, what do you like about them? If not, why not?

Do you have enough access to a computer at your place of residence in order to do the online work that is required of you?

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

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?

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?
Appendix C

Student Technology Use and Skills: Administrator Interview Questions

What is your role in supporting/training students?

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

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?

What do you think is the breakdown from highly skilled, skilled, average, poor, to very poor skills among undergraduates?

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

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

Do you think the majority of students spend a significant amount of time using computers and the Internet for entertainment? If so, what activities are they doing? Games, music and video, shopping, etc.?

Do you think their skills transfer over to the academic realm? If so, how? If not, why not?

Do you think that most students find the use of technology helpful in their classes? 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 them 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)

If not, why not?

Do you think most instructors make good use of instructional technology?

What do you think are the obstacles to students’ making better use of technology in academics or becoming more skilled in the use of technology?

If you were doing my study, what kinds of things would you look at, using what kinds of research methods?

If you had to design a program to improve students’ use of technology, what would it look like?

Some people are saying that public-access labs on campus are going to become less and less popular with students as computer ownership, wireless access, etc., increase. What do you think of that idea?

How do you measure the success of what you’re doing in supporting/training?

What is different today from what you were doing three years ago?

What is changing in what you’re doing in the next 12 months? 24 months? etc.
Appendix D

Bibliography


IHEP, Quality on the Line: Benchmarks for Success in Internet-Based Distance Education (Washington, D.C.: Institute for Higher Education Policy, 2000).


