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## Executive Summary

*I use lots of technology, but my sister who is a sophomore in high school knows more about technology than I do. I've been too busy to keep up and I am getting outdated. I guess we are all dinosaurs to some extent.*

—A graduating senior

Chris Dede's Introduction to this study (Chapter 2) argues that the ongoing technology revolution is driving a sea change in communicating, teaching, and learning. Further, while faculty and institutions have automated conventional forms of instruction and made some steps in using technology to expand the range of students' academic experiences, we have barely scratched the surface. He points to a spectrum of information technologies (IT) that should cause the academy to rethink the very creation, sharing, and mastery of knowledge. These include

- ◆ the familiar "world-to-the-desktop" providing access to distributed knowledge and expertise across time and space through networked media;
- ◆ sociosemantic networking and the social bookmarking/tagging revolution;
- ◆ massively multiplayer online games (MMOGs) and multiuser virtual environment (MUVE) interfaces;
- ◆ augmented reality (AR) interfaces; and
- ◆ the evolving National Science Foundation (NSF) vision of the cyber-infrastructure, integrating computing, data and networks, digitally enabled sensors, and experimental facilities.

To help the academy navigate these times, Dede notes the need for both faculty experimentation and rigorous research. Using

analytic methods to study how undergraduates use electronic devices—and in turn how they are actively and tacitly shaped by their media—will provide insight about students' cognition, motivation, self-image, and learning that can inform designs for academic instruction and enculturation. Dialogues with students around research findings can deepen our understanding and help us identify which IT trends are merely stylish and which are truly transformational.

In fact, a new but growing literature focuses on undergraduate students and IT.<sup>1</sup> In 2004, the EDUCAUSE Center for Applied Research (ECAR) joined this effort and began its annual survey of undergraduates and IT with a threefold purpose:

- ◆ to provide information on the technology behaviors, preferences, and attitudes of higher education's undergraduates, especially as it relates to their academic experience;
- ◆ to provide information to college and university administrators that will help them implement campus technology environments for students; and
- ◆ to inform the practices of teaching faculty who are working to incorporate information technologies in rich and meaningful ways into their curricula and pedagogies.<sup>2</sup>

## Methodology

In this latest ECAR study, 103 institutions invited a sample of their students to participate in a survey about how they use technologies and the impact that technology has on their academic experience. The 2007 study builds on previous ECAR studies of undergraduates and IT and uses a multipart research approach, including

- ◆ a literature review (extending the 2006 literature review) and review of other relevant surveys;
- ◆ a quantitative Web-based survey of college and university freshmen and seniors at 99 four-year institutions (26,022 respondents, or 93.4 percent of the total) and general students at four two-year institutions (1,824 respondents, or 6.6 percent of the total);
- ◆ student focus groups, which provided qualitative data from 50 students at four institutions;
- ◆ analysis of qualitative data from 4,752 responses to the survey's open-ended question; and
- ◆ comparison of longitudinal data collected in the 2005, 2006, and 2007 surveys where available.<sup>3</sup>

Most respondents attended public institutions (79.8 percent), and more than a third (36.0 percent) attended institutions with enrollments greater than 15,000 students.

## Key Findings

ECAR learned much about undergraduates' IT experiences, and several themes emerged as we reviewed our results. These themes cover student technology ownership, use and skill with IT, student experience with IT in courses, and student perceptions about how IT contributes to their academic experience.

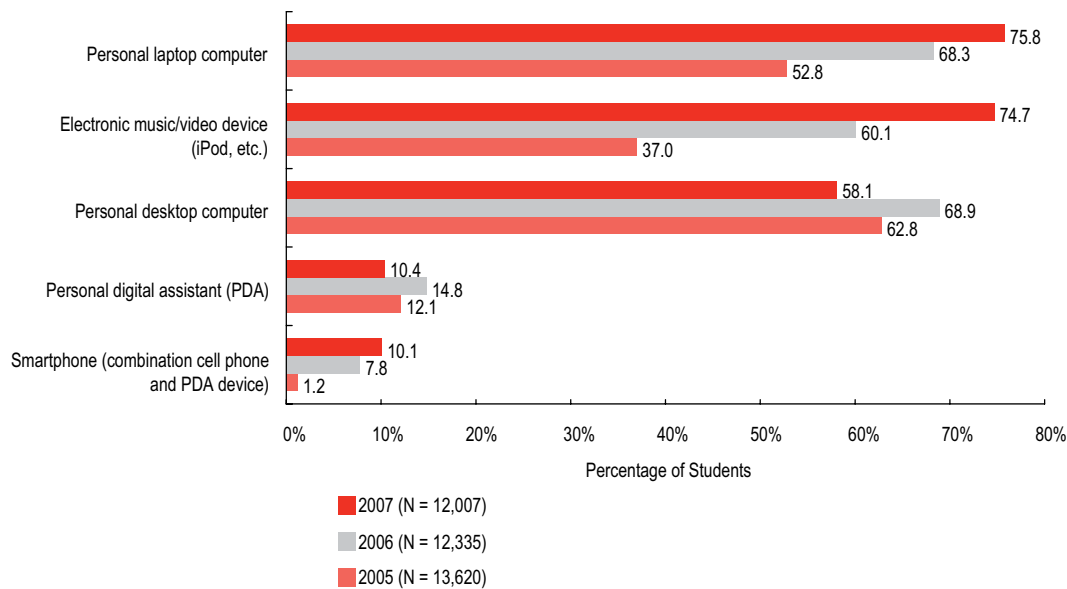
## Technology Ownership

While nearly all of our respondents own a computer (98.4 percent), laptops continue to

gain as the computer of choice. Nearly three-quarters (73.7 percent) of respondents own them. Longitudinal data for those institutions that have participated in ECAR studies over the past three years show that laptop ownership has increased from 52.8 percent in 2005 to 75.8 percent in 2007 (see Figure 1-1). In fact, students at our respondent institutions are entering college with new laptops in hand; this year, 64.0 percent of entering freshmen at four-year institutions have a laptop less than one year old. And most respondents (65.5 percent) own a computer two years old or less, well within recommended equipment replacement cycles. Yet one-fifth of respondents (20.4 percent) have a computer four years old or older, more likely to pose reliability and performance problems.

The majority of laptop owners tell us they are not bringing them to class; half (52.4 percent) never bring them at all. Weight and the risk of theft are frequently cited as reasons. However, at the other end of the scale, one in four respondents (25.0 percent) do make a habit of bringing their laptop to class regularly—weekly or more often.

Smartphones are also on the rise, owned by more than 1 in 10 (12.0 percent) of the full 2007 respondent population. Review of the longitudinal data in Figure 1-1 shows a significant but not startling increase over last year. For the 40 institutions participating in the past three years' studies, the percentage of smartphone ownership increased from 7.8 percent in 2006 to 10.1 percent in 2007. Ownership of PDAs, on the other hand, is slightly down from 2005. This is consistent with market research data, which points to the fact that the key features that once distinguished PDAs can now be found commonly on converged mobile devices. Among respondents who say they are early technology adopters, nearly one-fifth (18.0 percent) already own smartphones. Mainstream adopters will likely be close behind. This finding is important to institutions that closely watch the maturation



**Figure 1-1. Change in Technology Ownership from 2005 to 2007\***

\*Data for three-year comparisons are based on student responses from the 40 institutions that participated in each of the 2005, 2006, and 2007 studies. While institutions remain the same, the actual students responding are different for each year.

of handheld converged mobile devices as a Web-enabled technology that students can potentially use to access a wide variety of institutional services.

### Using Computers and the Internet

Today’s students spend a lot of time online. Respondents report spending an average of 18 hours per week actively doing online activities for work, school, or recreation, and 6.6 percent (more often male) spend more than 40 hours per week. Engineering and business majors use the Internet more often than others, a finding that echoes ECAR findings in 2005 and 2006.

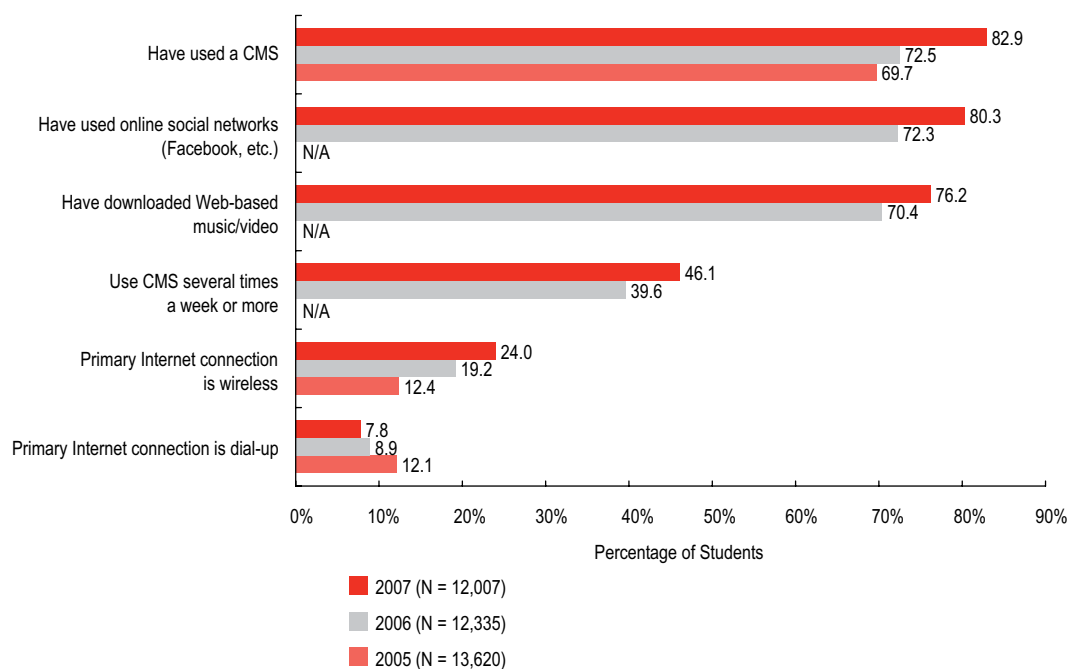
Our responding undergraduates overwhelmingly prefer high-speed Internet connections (91.5 percent). Only 8.4 percent depend on dial-up access to the Internet, and the longitudinal data in Figure 1-2 shows that the percentage of respondents depending on dial-up has steadily decreased since 2005. Those respondents who do not yet own a laptop or who attend associate’s institutions are the most likely to still depend on dial-up.

Even though respondents who use dial-up connections spend less time online overall (an average of 14.3 hours per week), they generally access e-mail, course management systems, and library Web sites with the same regularity as respondents using broadband.

Wireless as the first line of contact is increasing, with 21.8 percent of respondents now using this as their primary Internet connection. Again looking at longitudinal data, we find that wireless connectivity has increased from 12.4 percent in 2005 to 24.0 percent in 2007. The increase holds for both respondents using commercial Internet providers and those using their college or university as their Internet provider, reflecting the progress colleges and universities are making in rolling out wireless access in campus housing, classrooms, and public areas.

For our respondents, technology is first about communication. Nearly all (99.9 percent) create, read, and send e-mail, and 84.1 percent use instant messages (IM). The large majority of respondents also perform activities normally associated with

**Figure 1-2. Change in Technology Use from 2005 to 2007\***



\*Data for three-year comparisons are based on student responses from the 40 institutions that participated in each of the 2005, 2006, and 2007 studies. Data for two-year comparisons are based on student responses from the 65 institutions that participated in each of the 2006 and 2007 studies. While institutions remain the same, the actual students responding each year are different.

coursework. Most use an institutional library resource (94.7 percent), create presentations (91.7 percent) and spreadsheets (87.9 percent), and use course management systems (83.0 percent). Recreationally, 77.8 percent of responding students download music or video, and most do so on at least a weekly basis. Many (81.6 percent) use social networks such as Facebook, and most do so daily. They also play computer and video games either online or offline (78.3 percent). Not surprisingly, younger students report more frequent engagement in these recreational activities, as well as IM use. A smaller but still impressive number of students report using more complicated software: about a third (32.6 percent) use software to create or edit video and audio files, and 29.1 percent create Web pages.

We asked respondents how they liked to learn using various types of technologies. Most prefer to learn by running Internet

searches (72.0 percent); about one-third like to learn through text-based conversations (such as e-mail, IM, or text messaging) or by contributing to Web sites such as blogs and wikis. Interestingly, a solid half (53.3 percent) like to learn through programs they can control such as simulations or video games. This is important in the context of discussions about digital game-based learning in higher education and whether the extent of learning justifies the resources required to implement a game.<sup>4</sup>

## Communicating with Their College or University

Some speculate that students are shifting away from e-mail to more real-time data communication modes such as IM and text messaging, and that this shift might carry over into how they want to communicate with their institution. This is not the case among our respondents. Again this year, they overwhelm-

ingly (85.1 percent) favor e-mail for official college and university communications.

College and university leaders also debate about whether e-mail accounts are best provided by the institution or the private sector. To inform this discussion, we asked respondents if they preferred a college e-mail account or a commercial one for official communication with their institutions. A resounding 82.5 percent say they prefer a university account. As might be expected, this preference is strongest for 18- to 19-year-olds, especially those residing on campus.

### IT Skills and Training

ECAR survey respondents generally say they have “good” to “very good” skills for those core applications commonly used for coursework, including presentation software, spreadsheets, course management systems, and the institution’s online library system. This response is likely overstated, considering that the literature on self-assessment of skills finds that students overrate their skills in general, men more so than women. Seniors report higher skills than freshmen in using spreadsheets and online library resources, reflecting their experience gained from taking more courses. Gender differences are not great, with males and females reporting similar skill levels for common applications. Males do, however, report much stronger skills for computer maintenance and somewhat stronger skills using video/audio software. For the relatively few respondents who use graphics and video/audio software, skill levels reported are slightly less than “good.” In addition to thinking their skills are generally adequate, most respondents do not feel their institution needs to give them more training (34.0 percent are neutral and 40.2 percent disagree).

While the ECAR quantitative data indicates that respondents are fairly comfortable with their IT skills, analysis of respondents’ written comments paints a slightly different

picture. Students raised three major issues about training and support. Two are focused on faculty—the need for instructors to give students more training on technologies specifically required for courses, and the need for the faculty themselves to get more training so they can make better use of IT in their teaching. The third theme came from several hundred comments about the central and departmental help desks. While there were some positive comments about the helpfulness of staff in fixing technical problems, negative comments were far more frequent. These pointed most often to a lack of customer service orientation but also addressed problems with help desk availability, wait times, and fees. This suggests that the help desk function appears to be a relatively high priority for many students and is an important finding for IT leaders.

### IT in Courses

While most respondents are enthusiastic IT users and use it to support many aspects of their academic lives, most prefer only a “moderate” amount of IT in their courses (59.3 percent). This finding has been consistent over the past three years’ studies, and students continue to tell us that they do not want technology to eclipse valuable face-to-face interaction with instructors. Some recent research validates what these students say. An examination of more than 400 studies about factors contributing to student retention and degree completion concludes that “face time” with faculty and peers contributes to students’ feeling included and integrated into the academic environment, and this ultimately contributes to their academic success.<sup>5</sup>

Engineering and business majors prefer more IT in courses than others. Also, respondents who claim strong skills with software applications prefer more IT in their courses, as do those who say they are early adopters of technology. Important, though, is that again this year females and younger respondents

prefer slightly less technology in their courses than others.

ECAR looked specifically at what IT respondents were actively using as part of their coursework at the time of the ECAR survey (March/April 2007). The data identifies a set of core technologies used regularly by the majority of respondents during that quarter or semester: e-mail, course management systems, course Web sites, spreadsheets, and presentation software. Major requirements also play a role, with engineering majors using more discipline-specific IT and programming languages, business majors using more spreadsheet and presentation software, fine arts majors using more graphics software, and education majors using more e-portfolios. Community college students showed generally less use during this time for all these technologies. While few respondents used podcasts this quarter/semester (5.0 percent), student comments from the survey were overwhelmingly positive about podcasts as a supplemental tool for courses. A typical comment was, "I have a professor that puts all of his lectures online as podcasts, and it has been *extremely* helpful."

An important finding is that while more than 80 percent of respondents use IM and online social networking, they do not use these technologies much as part of their coursework. Students in our focus groups were quite consistent on this topic, saying that they prefer that IM and social networking remain within the scope of their private lives. The thread of their comments included such statements as, "It would be crossing the line for my advisor or instructors to find me on Facebook. But it's open to everyone!"

### Increased CMS Use

This year, 82 percent of respondents said they had used a CMS at some time. In four-year institutions, more seniors (86.8 percent) have used a CMS than freshmen

(78.3 percent). Among respondents from the four participating community colleges, only 67.7 percent have used a CMS. Students generally like using a CMS; 58.9 percent of survey respondents are positive about these systems, and 17.6 percent are very positive. Only 4.6 percent of those who use a CMS report an overall negative experience. In particular, respondents value most the ability to keep track of assignments and grades and to gain access to sample exams and quizzes through their CMS. These features directly relate to grade performance. From an institutional perspective, almost half of the 103 participating institutions show that 90 percent or more of their respondents have used a CMS.

For the first time since 2004, when ECAR began its studies of undergraduates and IT, the number of respondents reporting that they have used a CMS has increased significantly. Figure 1-2 shows that for longitudinal data, the percentage of respondents who have used a CMS has risen from 69.7 percent in 2005 to 82.9 percent in 2007. Longitudinal data also show that respondents now make more frequent use of a CMS, with 46.1 percent of respondents in 2007 reporting CMS use at least several times a week, compared with 39.6 percent in 2006. The ECAR findings about increased CMS activity are corroborated by current data from both EDUCAUSE and the Campus Computing 2006 survey.<sup>6</sup> These reports point to course management systems' accelerating role as a mission-critical application for teaching and learning.

### The Impact of IT in Courses

Respondents in 2007 continue to be generally positive in their views about IT's contribution to their academic experience and success. ECAR asked students whether they agreed or disagreed with the following statements:

- ◆ IT in courses improved my learning (60.9 percent agree).

- ◆ I am more engaged in courses that use technology (40.4 percent agree).
- ◆ IT in courses results in more prompt feedback from my instructor (73.1 percent agree).
- ◆ IT helps me do better research for my courses (70.5 percent agree).
- ◆ IT helps me better communicate and collaborate with my classmates (58.8 percent agree).
- ◆ IT allows me to take greater control of course activities (59.5 percent agree).

This distribution of responses is consistent across most demographic factors, with a few exceptions. Males report more engagement in courses requiring IT, and engineering and business majors agree more with all of these statements about the academic outcomes of IT. However, the respondents who are most positive about the impact of IT are those who prefer more IT in their courses, are positive about their CMS experience, describe themselves as early IT adopters, or think their instructors use IT well in courses.

It is important that three out of five respondents agree or strongly agree that IT in their courses has improved their learning. While this is a welcome finding, and consistent across the past three years' studies, we also acknowledge that 29.9 percent are neutral, and nearly 1 in 10 respondents (9.3 percent) disagree with that statement. Bottom line, a large minority of respondents chose not to assert that IT has a positive role in their learning.

IT seems to exert less of a pull on respondents with respect to its value as a tool of engagement. Most respondents are either neutral (38.8 percent) or disagree (20.8 percent) that they are more engaged in courses requiring IT. This may partially reflect respondent opinions expressed in the open-ended comments—that there is a very wide range in how well instructors use IT in courses.

Again this year, convenience is the clear winner for the “most valuable benefit of IT in courses.” More than half of respondents (55.5

percent) tell us that technology's contribution to “convenience” trumped technology's support for communicating with classmates and instructors, managing course activities, or improving learning. In fact, even though 60.9 percent of respondents agreed that IT in courses improved their learning, only about 1 in 10 respondents (10.3 percent) identified “improved my learning” as the most valuable benefit of IT in courses.

## The Digital Divide

Taking the pulse of the mainstream ECAR respondent provides important information for university administrators and faculty about where to focus resources that will benefit the most students. However, a one-size-fits-all technology strategy for teaching and learning must be tempered by a full understanding of the remainder of the student population. ECAR data also generate a profile of leading-edge and trailing-edge undergraduates so that their needs can be explicitly acknowledged and factored into institutional strategies.

Those who are high tech tell us they want much more technology; they experiment with new technologies and want to use these in courses. They are more engaged in sophisticated software such as that for creating graphics, video/audio, and Web pages. They spend a great deal of time online and like to learn through programs such as simulations and video games, and by contributing to Web sites such as blogs and wikis. They report strong IT skills across the board, and many own PDAs or smartphones and are ready to use them for institutional applications. They are often found majoring in engineering or business and are more often males than females. In fact, a surprising number of students exited the survey with a quick one-liner saying, “I just LOVE technology.”

At the other extreme is a class of students who through choice or circumstance make less use of technology. These respondents prefer limited or no technology in courses

and adopt technologies only when they have to. Like others, they use IT for communicating with their peers, but they are far less likely to claim advanced IT skills in the basics required for courses—course management systems, presentation software, and spreadsheets. More often, members of this group are female and attend associate's institutions. They do not spend as much time engaged in Internet activities and more often depend on dial-up connections. The technology they own is more often old, and some respondents do not even own a computer. Numerous comments were of this nature: "I'm a quick learner, but I'm a little nervous around new technology. It's useful, but I don't like to have to rely on it daily, in case I can't get to a computer with Internet access. I do appreciate what is currently offered at the computer labs."

### Students Speak About Faculty, Technology, and Learning

ECAR analyzed the 4,752 written comments from the open-ended survey question to get an in-depth understanding of what respondents were thinking when they generally agreed or disagreed with our survey outcome statement, "IT in courses improves my learning." Responses were categorized into three major themes that emerged: IT as an enabler of learning, IT as a barrier to learning, and the balance between technology and face-to-face interactions with instructors.

Major categories of respondent comments about *IT as an enabler of learning* were the observations that technology

- ◆ facilitates organization and control in the learning environment;
- ◆ facilitates communication with faculty and classmates;
- ◆ can make content more accessible, including class materials and Internet resources;
- ◆ is valuable in courses when directly linked to applications useful to future employment; and

- ◆ enables learning when professors use it effectively.

The first three categories about IT as a support for course activities—control, communication, and content—align nicely with ECAR findings that respondents are positive about these IT benefits. But perhaps the most important way students identify IT as an enabler of learning is when faculty use it well in courses. It is not surprising that students volunteered many instances where they learned more because of effective or creative use of IT in their courses. However, more students talked about the reverse, where an instructor's poor use of IT appeared as a barrier to learning.

Respondent comments about *IT as a barrier to learning* generated the following major categories:

- ◆ Problems exist with technologies themselves and their institutional implementations, especially campus networks and the course management systems students depend on for critical coursework such as submitting exams.
- ◆ The proliferation of technology has created a more complex learning environment, and faculty need to recognize this and factor it into their teaching.
- ◆ Faculty's poor use of technology (underuse, overuse, inappropriate use, and overdependence) detracts from the learning experience.
- ◆ Instructors sometimes overestimate student comfort with or access to technology resources.

The last three categories center on faculty. Just as an instructor's effective use of IT is a major enabler of learning, instructors' poor use of IT is perceived as creating a barrier to learning. Specifically, respondents are extremely sensitive to both how and how much technology is used in their courses—including underuse (not using basic IT available, such as grade posting), overuse (making the coursework overly

cumbersome), misuse (PowerPoint replacing active teaching), and overdependence on technology. Interpreting these comments as a whole is difficult because each student has unique ideas about what constitutes “underuse,” “overuse,” or “inappropriate use” of IT in the academic context.

The third theme concerns *the balance between IT and face-to-face interaction*. In both the open-ended survey comments and the student focus groups, students wanted us to know that technology is not a substitute for face-to-face interaction with faculty. This is also consistent with our quantitative findings that most students (59.3 percent) prefer only “moderate” technology in their courses.

## Conclusion

Revisiting the “rich and strange” sea change in teaching and learning described by Dede, what does the ECAR data tell us? Overall, we see evolutionary rather than revolutionary change. And as the pace of technology change continues to escalate, the challenge of keeping the best of the old and adding the best of the new gets harder. The gap between our low- and high-tech students may widen. The gap may also widen between instructors who are skilled at integrating technology when and where it can truly enhance learning both subject matter and new IT literacies, and instructors whose attempts to integrate technology do more harm than good.

For better or worse, students put responsibility for the link between technology and their learning squarely on the shoulders of instructors and administrators. With rare exception, students do not attribute IT-related learning problems to their own technical limitations. Instead, they comment, “Granted, some students need training at using information technology, but it’s mostly the *professors* who need help, not the students,” and “Technology seems to benefit me academically only when my professors

know how to properly employ the technologies afforded them.” If, on the basis of our survey comments, the student conclusions are correct, institutional strategies for optimizing technology effectiveness for learning are best focused in four areas:

- ◆ developing instructors’ technology skill sets;
- ◆ training instructors on how and when to effectively integrate technology and pedagogy;
- ◆ increasing instructor and administrator awareness about how their students differ in technology savvy and access to technology resources, and how to factor that into instruction; and
- ◆ improving the speed, reliability, and support of the institution’s network and academic applications, especially course management systems.

## Future Research: 2008 and Beyond

ECAR will again conduct the survey of undergraduates and IT in 2008. The survey will be updated to reflect changes in technology and to incorporate what we’ve learned from the 2007 study. Questions about IT use in and out of courses and student perceptions about IT’s impact on their academic experience will continue to form the core of the survey.

Beginning in 2008, each year’s survey will also feature a special topic area that is both important and timely to higher education. For 2008, ECAR will look at undergraduate use of online social networking. In its broadest sense, this encompasses traditional social networking sites (such as Facebook), multiuser virtual environments (MUVE), and massively multiplayer online games (MMOGs). ECAR will ask respondents how and why they use these technologies and how they view their potential as a learning tool.

ECAR invites colleges and universities to participate in the 2008 survey and, in return, receive information about their institution’s respondents.<sup>7</sup>

## Endnotes

1. ECAR is grateful to the many organizations like the Pew Charitable Trusts, NetDay, Student Monitor, and e-Marketer for furthering our understanding of evolving Internet (and related) student behaviors and consumer preferences of college age and younger populations.
2. In the initial 2004 study, 13 colleges and universities participated; in 2005, 63 institutions participated; and in 2006, 96 institutions participated. (See Robert B. Kvakik, Judith B. Caruso, and Glenda Morgan, *ECAR Study of Students and Information Technology, 2004: Convenience, Connection, and Control* [Boulder, CO: EDUCAUSE Center for Applied Research, 2004]; Robert B. Kvakik and Judith B. Caruso, *ECAR Study of Students and Information Technology, 2005: Convenience, Connection, Control, and Learning* [Boulder, CO: EDUCAUSE Center for Applied Research, 2005]; and Gail Salaway, Richard N. Katz, and Judith B. Caruso, *The ECAR Study of Undergraduate Students and Information Technology, 2006* [Boulder, CO: EDUCAUSE Center for Applied Research, 2006]).
3. Absolute change and relative change are calculated using longitudinal data available for the years 2005, 2006, and 2007. For comparison of 2005, 2006, and 2007 data, we use the 40 institutions that participated in the student study each of these years. For comparison where data is available only for 2006 and 2007, we use the 65 institutions that participated in the student study for both of these years. While these institutions are the same over these time periods, they have surveyed different students each year.
4. Richard Van Eck, "Digital Game-Based Learning: It's Not Just the Digital Natives Who Are Restless," *EDUCAUSE Review* 41, no. 2 (March/April 2006): 20, <http://www.connect.educause.edu/library/abstract/DigitalGameBasedLear/40614>.
5. Veronica A. Lotkowski, Steven B. Robbins, and Richard J. Noeth, *The Role of Academic and Non-Academic Factors on Improving College Retention* (ACT, 2004), [http://www.act.org/path/policy/pdf/college\\_retention.pdf](http://www.act.org/path/policy/pdf/college_retention.pdf).
6. The 2005 EDUCAUSE Core Data Service reported an increase in faculty use of course management systems, finding that 22.5 percent of institutions reported that a CMS was used by faculty in all or nearly all of the institutions' courses. This number increased to 25.6 percent in 2006. Casey Green's 2006 Campus Computing report finds that the percentage of courses using a C/LMS has been steadily rising since 2000 and increased about 5 percent from 2005 to 2006 to 46.8 percent. Further, the number of institutions having a strategic plan for C/LMS deployment is up from 52.4 percent in 2005 to 56.5 percent in 2006.
7. Students participating in the survey are assured that no confidential information about them will be made available to their institutions.