Key Findings

The ECAR Study of Undergraduate Students and Information Technology, 2006

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Undergraduate students. Our future. They are at once our youthful intelligentsia and our future knowledge workers. In the fall of 2004, nearly 15 million undergraduates enrolled in U.S. two-year and four-year institutions. Undergraduates represent 38 percent of all U.S. 18- to 24-year-olds. During 2003–2004, they earned 665,301 associate's degrees and nearly 1.4 million bachelor's degrees. Nearly one-third (32.4 percent) of them enrolled in colleges and universities in California, Florida, New York, and Texas (*Chronicle of Higher Education*, 2006). According to Student Monitor, in Fall 2003, undergraduates rated using cell phones, drinking beer, e-mailing, the Internet, and going to clubs as their five most "in" activities. (Student Monitor, 2006, http://www.studentmonitor.com/) They scored an average of 1028 on their SATs, and although students of color have made significant gains in college enrollment, African-American and Hispanic students still lag behind their white peers in the rate at which they enroll in college (American Council on Education, 2006). Nearly half (46.4 percent) of today's undergraduates receive either grants or loans to finance their education. During 2003–2004, nearly one-third of U.S. undergraduates (32.9 percent) worked full time, and 21.4 percent of them were already married. Just over half (54.3 percent) of the freshmen who entered college in 1997–1998 had graduated six years later (*Chronicle of Higher Education*, 2006).

The ECAR Study in Context

There is a substantial and growing literature about undergraduate students in the United States. Much of this literature focuses on the lifestyle of this important demographic group; some focuses on generational issues, and several important surveys exist to help us understand students' engagement in their education and their overall attitudes toward politics and the world around them. A new but growing literature focuses on undergraduate students and information technology (IT). Organizations like the Pew Foundation, NetDay, and Student Monitor try to help us understand the consumer preferences of this population, while others like the National Postsecondary Education Cooperative (NPEC) try to ascertain why some students succeed in college and others do not.

In 2003, the EDUCAUSE Center for Applied Research (ECAR) placed its stake in this growing domain and developed a survey of undergraduates and IT. The ECAR niche is unique insofar as our overarching goal is to provide information on the IT behaviors, preferences, and satisfaction of higher education's most essential and arguably most mercurial population. Even more, the ECAR study was designed to be read—and acted upon—by college and university administrators, and in particular by those administrators charged with implementing the IT environments these students will consume. As well, we hope that ECAR research will inform the practices of teaching faculty who are working to incorporate information technologies in rich and meaningful ways into their curricula and pedagogies. *The ECAR Study of Undergraduate Students and Information Technology, 2006* was designed to test hypotheses about generational behaviors and propensities and to leverage our growing understanding of Internet (and related) behaviors of other important population segments.[1]

Since our first study in 2004, the ECAR study of undergraduates and IT has become mature. In 2004, 13 universities participated in this study of freshman and senior students. In 2005, this number swelled to 63 colleges and universities, and in 2006, 96 two-year and four-year institutions participated. Fully 28,724 students responded to the 2006 ECAR survey. Most respondents were freshmen and seniors in four-year colleges and universities in the spring of 2006. Some 3,380 participants in this survey were enrolled in one of eight participating two-year institutions. Most responding students (83.8 percent) attended public institutions, and nearly two in five (37.8 percent) attended institutions with enrollments greater than 15,000 students.

Female undergraduates represent 63.2 percent of the participants in the ECAR study, despite oversampling of males. Participants in the ECAR study reflect considerable diversity in their choices of academic major, with 19.3 percent declaring majors in social sciences, 22.2 percent declaring as life or physical science majors, 10.2 percent as humanities majors, 19.5 percent as business majors, and 9.7 percent as engineers.[2]

Findings

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

Ownership and Use of IT and Skill with IT

Undergraduate students are most certainly wired with technology. Nearly all (97.8 percent) of our respondents own a PC. In fact, nearly two-fifths (38.3 percent) of the 18- and 19-year-old respondents begin their undergraduate experience with *both* a laptop computer *and* a desktop computer. The 2006 ECAR data suggest that owning a computer has become a prerequisite to attending college or university for most respondents. Three-fourths of responding freshmen from four-year institutions own laptop computers. The vast majority (72.8 percent) of these laptops are less than one year old. This is good news overall for campus technologists who must struggle to ensure the currency of the installed base of computers they need to support. Overall, ECAR survey respondents are showing a growing preference for laptop computers (see Table 1).

Table 1. Change in Technology Ownership, 2005 to 2006

	Report in 2006 (N = 13,819)	Report in 2005 (N = 15,382)	Percentage Change	Rate of Change
Personal desktop computer	67.3%	60.6%	6.7%	11.1%
Personal laptop computer	69.8%	55.1%	14.7%	26.7%
Personal digital assistant (PDA)	14.7%	12.2%	2.5%	20.5%
Smart phone (combination cell phone/PDA)	7.5%	1.1%	6.4%	581.8%
Electronic music/video device	61.3%	38.6%	22.7%	58.8%

Note: Comparisons of changes between 2005 and 2006 are based on data from the 49 institutions that participated in both studies.

Mobility is increasingly important to the students participating in this study. Almost one student in five (19.8 percent) of responding undergraduates owns either a personal digital assistant (PDA) or a smart phone or both. These undergraduates overwhelmingly prefer broadband network connections, and fewer than 10 percent depend on dial-up access to the Internet. More than one-third (36.1 percent) own a wireless hub! Importantly, 15 percent of two-year college respondents depend on dial-up access.

Today's students spend a lot of time using a raft of gadgets and a lot of time online. While the average respondent reports spending 23 hours per week using various technologies, more than one-quarter of male respondents report using electronics more than 30 hours per week. Engineering majors and business majors use IT more often than others, a finding that echoes similar ECAR findings in 2004 and 2005.

Undergraduates are communicators. Nearly all (99.9 percent) create, read, and send e-mail, and more than 80 percent send instant messages, most of them doing it daily. They use their arsenals of electronics to write documents for coursework (98.8 percent), search the Web and institutional library (94.0 percent), and create presentations (90.8 percent). Three-quarters of these undergraduates use course management systems, most of them using it several times per week or more. Recreationally, 70.6 percent of responding students download music or video files and use social networks such as Facebook.com. Most of them (73.4 percent) play computer/video games. A smaller number of students appear to be engaged in new media. More than a quarter of respondents (27.7 percent) report using software to create or edit video and audio files, and 28.6 percent of them create Web pages.

While some of the literature, particularly journalistic, suggests that students may be shifting from e-mail to more immediate data communication modes such as instant messaging, our respondents seem comfortable with both. For college and university administrators, the good news is that respondents overwhelmingly (84.9 percent) prefer e-mail to instant messaging, Web reporting, or other modes of communication for official communication with their institutions. The bad news is that only 11.8 percent of these respondents maintain only one e-mail account, and respondents are evenly split between those who prefer their college or university e-mail provider and those who prefer

a provider who is not their academic institution. We think that consideration of abandoning e-mail for official campus communications is premature. Complex, yes, but premature nonetheless.

ECAR survey respondents are generally confident in their skills using information technologies. Seniors report higher skills than freshmen in technologies that are instrumentally useful to their academic majors. Interestingly, incoming freshmen report similar facility with and knowledge of new media skills such as creating and editing audio and video files as do seniors. This may represent a new area of demand on both faculty and technology providers in the years ahead. More than one-third of respondents (34.3 percent) report little or no skill with course management systems.

When we asked survey participants how *they* would spend new institutional IT money on their behalf, 18- and 19-year-olds said, "Give us more network speed and access to music!" Respondents ages 20–29 said, "Give us more computer labs and IT training for students!" On student commented, "I believe that basic IT courses should be included in every undergraduate major on campus. Programs such as Excel and Word are so important and most students hardly even know how to input data. We need to push for this if we want a strong workforce."

Importantly, the value on student IT training expressed seems to rise with a student's age, reminding us perhaps that "that the less I know about a subject the more confidence I have" (Johnson, 1935).

Information Technology in Courses

Figure 1 illustrates that while most students surveyed are enthusiastic users of IT and use it to support many aspects of their academic lives, they are moderates where it comes to the amount of IT they want in their courses. Most (56.2 percent) of responding students overall indicate that they'd prefer only a "moderate" amount of IT in their courses.

Figure 1. Preference for Technology in Courses (N = 28,328)
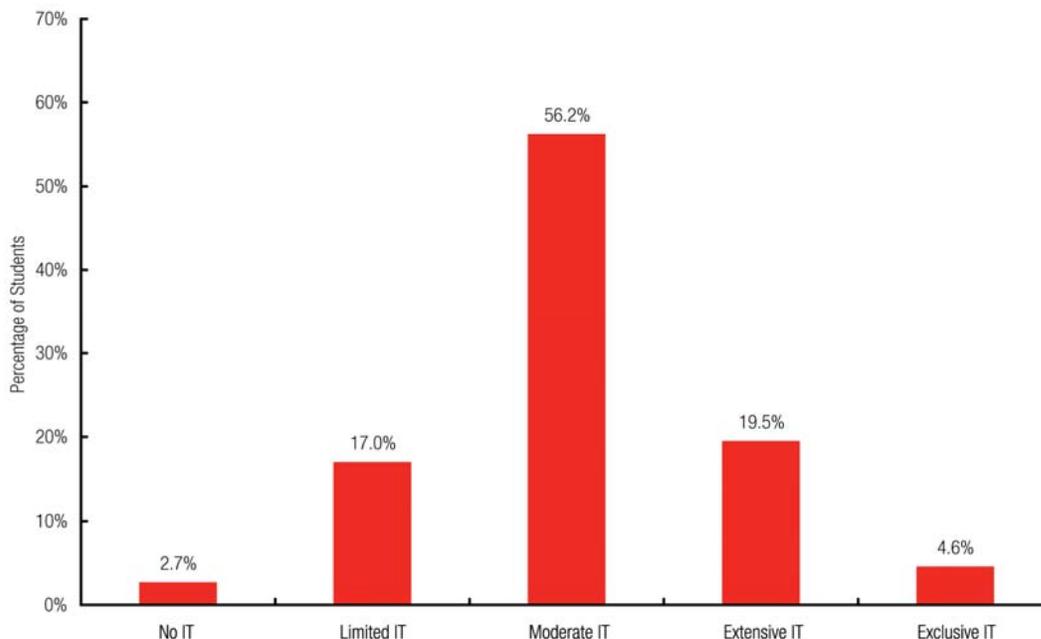
As a whole, younger respondents and female respondents to the ECAR survey prefer less technology in their courses than others. This finding suggests that while younger students arrive on campus with a lot of IT tools and self-described skills in IT-mediated communication and recreation, they are comparatively unskilled in IT to support academic purposes. Engineering and business majors prefer slightly more IT in their courses than others. Not surprisingly, respondents who claim knowledge of the advanced features of many software applications prefer technology in their courses. We do not know whether this reflects the power users' opportunities to shine, the real opportunity for IT to deepen understanding of course content, or a sentiment by less skilled IT users that their lack of IT skill may pose an additional barrier to learning. Likely all three forces are at work.

While respondents appear to resoundingly prefer laptop computers and some are loading up on PDAs and smart phones, they are largely not bringing computers to class. Most respondents (70.3 percent) never bring their laptop computers to class, and only 14.5 percent do so weekly or more often. Even 16.2 percent of responding students who are enrolled in courses that require a laptop fail to bring these devices to class. The weight of laptop computers and the risk of their theft are cited frequently as reasons students do not bring laptops to class.

Nearly three out of every four survey respondents (72.7 percent) have used a course management system (CMS). This percentage has not changed since 2004. This finding masks the evidence that among community college respondents to the ECAR survey, only 54.6 percent have used these systems. Much of the nonuse of a CMS in AA institutions, however, is among those who are not enrolled in a degree program, so this finding merits closer scrutiny. In four-year institutions, there is little difference in the proportion of freshmen and senior-year students having used these systems. Survey respondents like these systems. Three quarters (75.6 percent) of those who use them are, overall, positive or very positive about them. In fact, 18.3 percent of those who use a CMS are very positive about it. Only 4.5 percent of those who use a CMS report having an overall negative or very negative experience with it. Familiarity with these systems breeds contentment. Students who report using these systems daily are overwhelmingly positive about them. Responding students who use these systems less frequently are less bullish but remain consistently positive about them. Respondents rate the asynchronous aspects of these systems more positively than the synchronous elements. In particular, respondents value the ability to keep track of assignments and grades through these systems and to gain access to sample exams and quizzes online.

Making a Difference

The ECAR Study of Undergraduate Students and Information Technology, 2006 helps us understand how students feel IT is contributing to their academic experience and success. Responding students in 2006 continue to be positive in their views about IT's contribution. ECAR asked students whether they agreed with the following statements:

- IT in courses improved my learning.

- I am more engaged in courses that use technology.

- IT in courses results in more prompt feedback from my instructor.

- IT helps me do better research for my courses.

- IT helps me better communicate and collaborate with my classmates.

- IT allows me to take greater control of course activities.

Respondents were positive or very positive in their answers to all of these questions (see Figure 2). Very importantly, 64.4 percent agreed or strongly agreed that IT in their courses has improved their learning. Only 7.6 percent of respondents disagreed with that statement. Older respondents and business and engineering majors agreed more often with these statements about the academic outcomes of their experience. Respondents who prefer more IT in courses are positive about their use of course management systems and describe themselves as either early adopters of or innovators with IT. These respondents agreed more strongly with positive statements about their experiences and outcomes.

Figure 2. Student Experience with IT in Courses
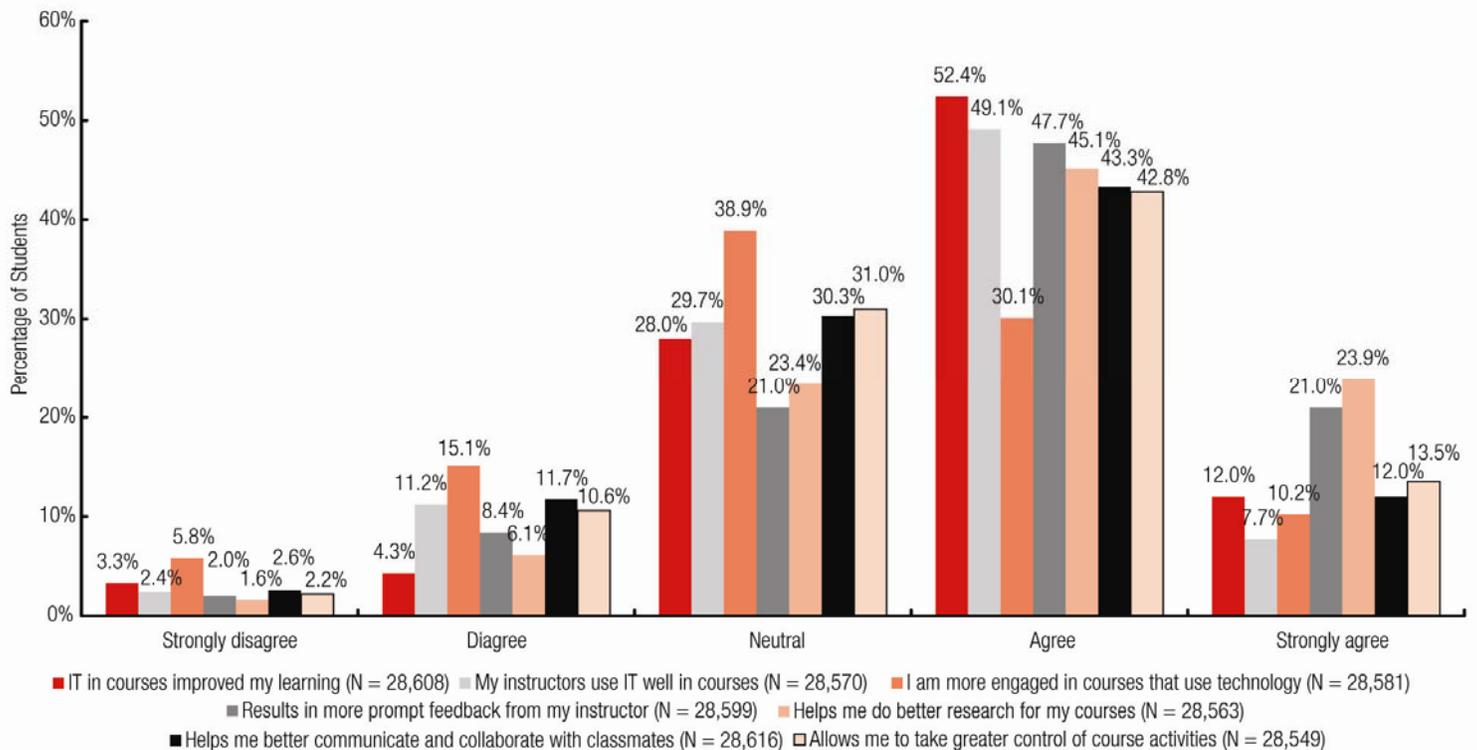
Respondents continue to rank convenience as the single most important benefit of IT in their academic experience. Nearly one respondent in five (19.3 percent) from a two-year institution indicated that improved learning was the paramount benefit of IT. This is higher than the responses from students at participating four-year institutions. This is a powerful finding, given that these students, on average, own fewer gadgets, depend more often on dial-up access, and have less access to course management systems than their counterparts in four-year institutions.

Fewer respondents in 2006 rated enhanced peer communication as the top IT benefit than did in 2005, while more of the 2006 respondents gave top marks to IT's facilitation of greater control over

course activities. It seems likely that the multiplicity of communication options enjoyed by these respondents may diminish their importance as distinct and identifiable technologies. That is not to suggest that communication is not essential. Said one student, "IT has helped with my undergraduate experiences because it helps me communicate with my professors and my peers about class and class assignments."

IT seems to exert less of a pull on respondents with respect to its value as a tool of engagement. While respondents agreed that they are more engaged in courses that incorporate IT, they do so mildly. This may in part reflect respondent opinion about the IT capabilities of their instructors. While most respondents (56.8 percent) agreed or strongly agreed that their instructors use IT well in class, 13.6 percent disagreed or strongly disagreed on this point. There is passion among some respondents on this subject. The need for additional training for instructors was a very frequent theme in the qualitative data. While this year saw the usual number of comments regarding faculty overuse or misuse of applications like PowerPoint, the underlying theme of faculty capability with technology was still highly prevalent, with *several hundred* comments in this area. The theme of particular interest as it relates to training is the set of comments by students citing the need for additional training for faculty. This theme is frequently conveyed as faculty use being nonproficient and as how training faculty would benefit both faculty and students. In an increasingly technology-related learning environment, this may suggest a link between faculty development in the use of technology and the effectiveness of technology for learning in the classroom—a linkage that students are aware of as impacting the learning experience. Said one respondent, "to move forward in information technology requires training the professors. More than half of the technology that is currently available for use is not even touched. Most professors have no idea how to work things on a simple level."

Not only are some respondents vocal about the mixed IT skills of some of their instructors, but they can also be frustrated with instructors' expectations of student IT skills. One student, among many, commented, "Profs never teach us to use IT, they usually just assume we know how and require us to use it, which results in self-teaching, and only enough to get by. I wish they would teach us to use the programs they require us to use (such as Excel and PowerPoint)."

Bottom Lines?

The ECAR Study of Undergraduate Students and Information Technology, 2006 unearths literally hundreds of interesting findings large and small. For college and university administrators who need to make consequential investment, service, and other priority decisions, some findings are more pressing than others. We therefore summarize some of the most important findings below:

- Overall, undergraduates like IT and use it in their social, recreational, working, and academic lives. Mobility is perhaps an enabler of this integration of social, recreational, and instrumental integration of IT.

- The Net Gen characterization of technophile students born in the Internet era applies to a substantial minority of undergraduates but not to the whole. In fact, an important minority of undergraduates do not appear enamored of IT, and some appear even to avoid it. Understanding the needs of leading-edge and trailing-edge undergraduate IT users is important for higher education administrators.

- College or university is a place where people mature as IT users as well as in other ways. While younger students can boast an arsenal of IT skills to underpin their social lives (such as e-mail, instant messaging, and social networking) and their recreational lives (such as computer gaming), they are less skilled or confident users of instrumentally useful technologies. The undergraduate's choice of and progress toward an academic major are closely associated with his or her preferences for, use and ownership of, and outcomes with IT.

- Respondents—across the spectrum of demographic or user profile—agree with a series of positive outcome statements about IT. These responses suggest that IT is helping students communicate, collaborate, learn, engage, conduct research, gain academic feedback, and control their course activities.

For Many, Wired and Wonderful

It is clear that the Net Gen appellation is insightful and true regarding those undergraduates who label themselves IT innovators or early adopters. These young people are indeed wired and wonderful and seem to have integrated IT comfortably into the fabric of their social, recreation, work, and academic lives. They own many gadgets, but it seems reasonable to speculate that over time, these early adopters will "go convergence," and we expect to see them (or their successors) arriving on campus with handheld devices that integrate computation, network access, and telephone and also serve as video and music devices. This segment of the undergraduate population really likes technology, uses it many hours a week, and appreciates its presence in the classroom. They feel that IT serves important purposes in their academic lives and strongly agree with statements about IT's contributions to learning, research, control over course requirements, and other outcomes. This techno-proficient group represents about a third of our respondents and is more often than not male and inclined to major in engineering or business.

For Some, Wired and Tired[3]

It is equally clear that this Net Generation within a generation does not speak for everyone. Not all undergraduates are coming to campus with a new laptop computer (and an old desktop device!). Some, in fact, seem to struggle with one computer four or more years old, and too many accomplish their academic purposes over narrowband connections. This is not a value judgment. In fact, respondents who use narrowband connections in general express lower levels of comfort and satisfaction with IT and ascribe less potency to IT's impact on important outcomes in their academic lives. Said one respondent, "I feel that the integration of technology in the classroom is useful, as it is important to be familiar with (considering we are a technology-driven society). However, I feel that a lot of professors assume that everyone has easy access to a computer." Another made the point even more poignantly: "The use of new technology is great in class; however, the income of college students prevents many from purchasing expensive items. I would like new systems to be used but not made as a requirement."

In short, there is a technology underclass on campus. More often, members of this underclass are female, too often they are found at two-year institutions, and most often they are found majoring in the humanities. These undergraduates like others use information technologies for communicating with their peers, but they are far less likely to admit to possessing advanced skills in academically

instrumental uses of IT like presentation software, spreadsheets, and the like. One IT-phobic respondent summed it up: "I hate computers and use them as little as possible. Computers today are supposed to be easy to use. I think they are very difficult to use. I also think people today rely way too much on computers for everyday tasks and need to get outside too."

University administrators and faculty must come to grips with the two faces of the undergraduate student body and reconcile the differences in student segments with one-size-fits-all technology strategies for the teaching and learning at the institution. Administrators must decide how much they can invest at the leading edge to keep the early adopters engaged and motivated, and how much they can invest in raising the comfort and skill of those late adopters on campus.

Maturing Digitally

Much of the concept of a Net Generation emerges from Don Tapscott's notion of growing up digitally (Tapscott, 1998). This ECAR study of undergraduates and IT suggests too that higher education is a place for students' technology usage to mature. First, it remains clear after three years of study that a student's choice of academic major is closely associated with a set of IT skills, choices, and preferences. This is not surprising. Business majors need to use spreadsheets and presentation software; engineers spend considerable time with technology; and so forth. Second, the data suggest that undergraduate skill and use of technology is tiered. On one tier, information technologies serve students' social needs. Undergraduates are great communicators, and skills and use in the technologies of communication such as e-mail and instant messaging are widespread. Communication is increasingly mobile, and students are investing in laptop computers, PDAs, and smart phones. Most of these students are engaged with social networking applications like MySpace and Facebook, and in fact, qualitative evidence suggests that many of our undergraduates spend a great deal of time in these environments.

The second tier is recreational. Undergraduates are engaged in computer-based gaming, though this province continues to be dominated by male respondents. Our respondents also download music and videos regularly.

The third tier is what we describe as academically instrumental and consists of information technologies and software applications that are being used in the service of a student's coursework or employment. The ECAR data suggest that students arrive on campus ready and eager to communicate and socialize. Data from other sources, such as Pew's study of teens and the Internet and NetDay confirm this. It is also clear from the ECAR data and from studies of IT and teens that today's undergraduates often arrive on campus with well-established recreational skills and habits with IT. Video game play is widespread among K–12 students, as is participation in social networks. The ECAR data suggest that undergraduate skill with and use of academically instrumental IT comes with age. Or more appropriately, this skill and use comes with specific academic experience. Freshmen respondents admit to lower skill levels in these technologies than do seniors, a finding that reinforces the notion that skill acquisition in this tier is tied to one's choice of academic discipline. In essence, undergraduates appear to arrive somewhat insecure and unskilled in producing presentations, creating spreadsheets, or using specialized software, while students with higher class standing in technology-intensive disciplines report higher skills.

The e's Have It

The question of ultimate consequence for every senior higher education administrator as well as for most parents is, of course, whether all of this IT is an educationally good thing. The question of outcomes in higher education is extraordinarily complex and rich. It is subject to ongoing debate. As a result, linking IT investments, preferences, and behaviors is problematic. Of course, so is linking of study habits or beer drinking to the achievement of educational outcomes. Notwithstanding this complexity and those reservations, we believe that students are reasonably reliable evaluators of the educational contribution of IT. We caution the reader that this is only one data point, and we also applaud efforts like the National Study of Student Engagement (NSSE) and the Collegiate Learning Assessment Project that together can triangulate toward a deep understanding of this complex issue.

The respondents to the ECAR survey are generally bullish about IT's contributions. Most (64.4 percent) agree or strongly agree that IT in courses is improving their learning. Two-fifths agree or strongly agree (40.3 percent) that they are more engaged in courses that incorporate IT, and more than two-thirds (68.7 percent) believe that IT facilitates prompt feedback from their instructors. More than half of ECAR respondents (55.3 percent) believe that IT helps them communicate and collaborate more effectively with their fellow students. It is important to note that learning theory generally suggests that instructor feedback and peer collaboration contribute significantly and positively to learning.

The ECAR Study of Undergraduate Students and Information Technology, 2006 finds once again that IT is understood and appreciated by students largely for its capacity to make student life more convenient. We invite the reader to take the plunge into this study with two thoughts in mind. First, while convenience is overwhelmingly the outcome most often ascribed to IT, we honor this fact here. As one begins to think about undergraduate students who are under unprecedented pressures to achieve academically; who are often their family's first-generation collegiates; who are often older and married, encumbered by increasing debt; and who are simultaneously working (many of them full time), the value of "convenience" cannot be minimized. In fact, one could speculate that IT may in fact make balancing these complex lives doable and enjoyable. As one respondent put it, "Having the ability to do courses online is WONDERFUL! It's a great way to balance schooling with a sometimes unpredictable work schedule. The convenience is unbeatable, and not having to be in a set place at a set time each week really works for me." Second, and finally, many of our respondents really do believe that IT is contributing to their learning. Among those students who prefer IT in general and who think of themselves as early adopters of IT, the positive attitude toward IT in the learning experience is impressive. It seems to us that the interesting question is no longer whether IT can contribute to learning but how we can activate interest and skill in IT in more of our students and their instructors.

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Endnotes

1. ECAR is particularly grateful for the work being undertaken under the aegis of the Pew Internet & American Life Project. This project, among other things, has studied the information technology behaviors, expectations, habits, and preferences of U.S. adults, teens, and pre-teens, making possible rich comparisons with data developed by ECAR about undergraduates. NetDay's Project Tomorrow, as well, provides much insight into the technology habits and preferences of K–12 students.
2. ECAR totals including all majors declared exceed 100 percent due to students who are seeking double majors.
3. This wonderful characterization comes from Jeanette Cureton, who delivered a speech of the same title at the ECAR Symposium, November 2002.

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A copy of the full study referenced above will be available via subscription or purchase through the EDUCAUSE Center for Applied Research (www.educause.edu/ecar/).