6
A Little Wind Ruffling the Curtains at Dawn

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

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

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

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

One significant and recurring theme in Oblinger and Oblinger's latest collection of articles is the importance of engaging students in a dialogue to better understand how they learn, what they expect, and how they use technology. "Only by understanding the Net Generation can colleges and universities create learning environments that optimize their strengths and minimize their weak-

nesses" (Oblinger & Oblinger, 2005). In the same volume, Gregory R. Roberts observes, "Few efforts have been made to directly engage students in a dialogue about how they would like to see their faculty and institutions use technology to help students learn more effectively" (Roberts, 2005). This chapter represents such a dialogue.

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

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

Comparing Results of 2004 and 2005 ECAR Studies

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

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

Ownership of Electronic Devices

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

Internet Access

More than 90 percent of 2005 respondents report broadband access, compared with 76

percent in 2004, and we see a significant shift to commercial broadband service (from 27.3 percent in 2004 to 39.8 percent in 2005) and away from college- or university-provided broadband service (from 49.0 percent in 2004 to 39.6 percent in 2005).

Use and Weekly Hours of Use

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

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

Perceived Levels of IT Skills

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

Table 6-1. Technologies Used, by Year

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

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

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

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

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

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

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

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

Preference for IT in Courses

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

Perceived Impact of IT in Courses

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

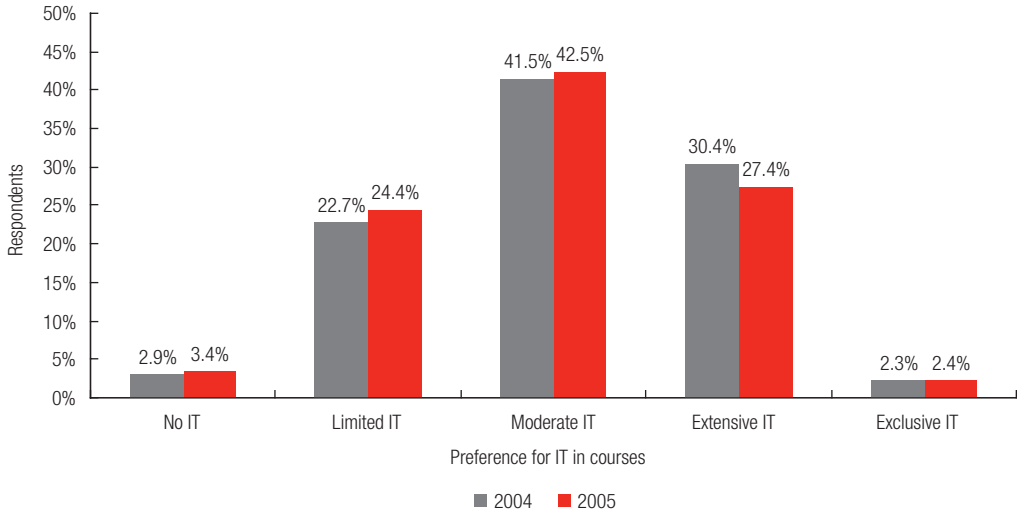

Figure 6-1. Change in Preference for IT in Courses, by Survey Year

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

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

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

you?" Fewer respondents in 2005 agreed that their institution needs to provide them with more IT training beyond that required for use in courses.

Course Management Systems

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

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

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

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

The Net Generation Student and the ECAR Student Framework

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

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

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

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

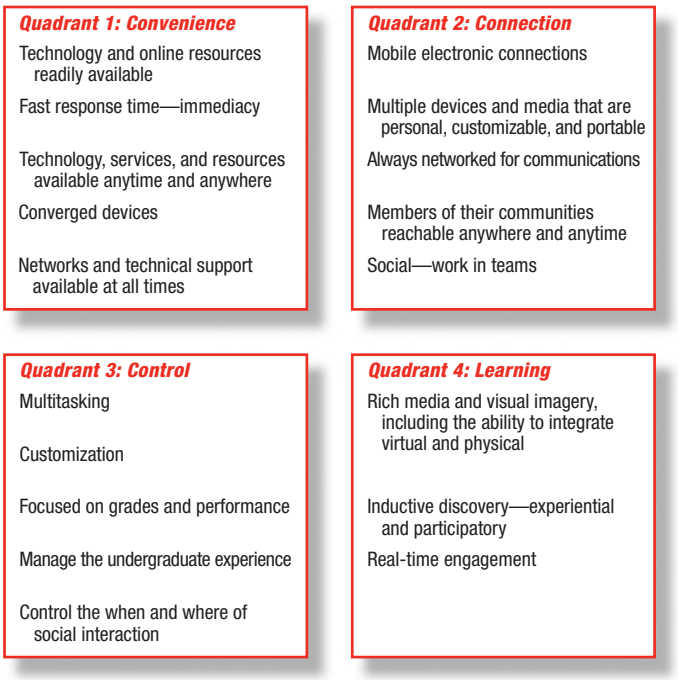

Figure 6-2. Net Generation Student Expectations and Preferences

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

How Do Students Describe Themselves in Our Survey?

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

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

Traditional students see IT in courses not as transformational but rather as supplemental. Students—for the present—prefer face-to-face interaction with their instructors and with other students. One respondent tells us, "Overall, I feel that using information technology could increase opportunities for classroom engagement and teacher-student accessibility. At the same time, though, it could become overwhelming and even distract from truly

understanding a certain discipline or subject. Basically, as long as we stay in control of technology and use it with balance and thought, it will definitely be reliable and useful."

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

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

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

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

We observe Net Generation attributes more readily in nonacademic contexts

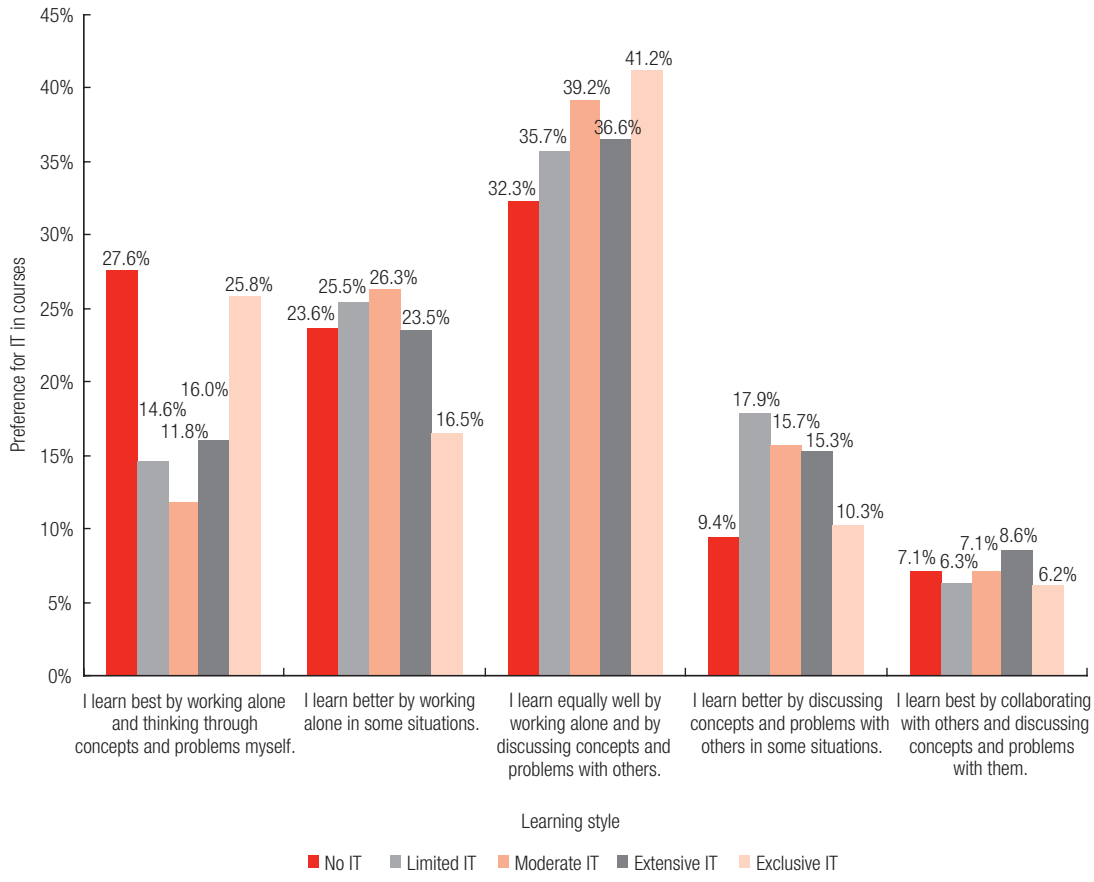

Figure 6-3. Impact of Learning Style on Preference for IT in Courses (2004)

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

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

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

Summary of Student Perspectives from Open-Ended Comments

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

Table 6-5. Topics in Student Commentary on IT

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

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

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

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

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

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

Student Words of Wisdom and Recommendations

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

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

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

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

Convenience

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

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

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

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

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

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

4. IT is expected to be reliable.

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

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

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

Connection

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

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

- "In the classroom, it is nice to have a PowerPoint presentation of the day's lecture, so students are able to see the notes and are able to copy them. It is much easier to read, and it is nice to have when I have to give presentations in class. I have used IT a fair amount, using e-mail to communicate to other students in class, PowerPoint for presentations, and the library resources to do research for papers. The library Web site is great to find journals for research,

and the electronic format is useful for transferring the information from school to home, where it can be printed at the person's convenience. The distance-learning class that I had was very useful for me, being able to e-mail my instructor my assignments when I had them done … at 2 p.m. in the afternoon or at 3 a.m. in the morning, whenever it was convenient for me. I didn't have to conform to someone else's schedule, which was convenient, since I had to take a lot of other classes and work as well throughout the year."

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

Control

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

7. Access to grades is very important.

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

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

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

Learning

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

9. Learning should be experiential, involving multiple senses.

- "I foresee the need to totally reengineer the classroom environment of the twenty-first century to maximize the benefits of the capabilities of IT to enhance the delivery of course content and ancillary materials like the syllabus and assignments. No

longer is education merely the transfer of knowledge from a professor to a student, but it is about the total transfer experience using all of the senses to receive and to process information."

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

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

11. Learning should be supported with visual tools.

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

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

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

13. Students value using real-time data.

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

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

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

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

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

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

16. Online testing needs improvement.

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

Other Student Insights and Recommendations

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

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

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

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

19. Students need more training.

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

20. Older students need special accommodation and training.

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

21. Support services are important and need improvement.

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

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

22. Courses that require technology improve computer skills.

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

23. IT should be supplemental to the course.

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

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

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

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

Social Software

As outlined earlier, "'Net Gen' students are digital, always connected, experiential,

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

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

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

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

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

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

One of the interesting findings from the conversation about blogging is that all the

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

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

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

Summary

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

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

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

Importance of the Curriculum

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

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

Several of these expected competencies will be technology intensive. Such mandates

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

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

Definition of IT Skills Needed for Learning

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

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

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

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

Comprehensive Training

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

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

Institutions should require all of their colleges to articulate concrete IT competencies for students in their programs. Once these competencies are articulated and compiled,

a work plan can be developed to achieve the proposed competency levels through courses, curriculum changes, help centers, and so forth.

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

Common Environment and Approach (Consistent Implementation)

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

IT Services and Support

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

Monitoring, Measuring, and the Importance of Data

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

Next Steps

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