Executive Summary

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

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

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

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

Methodology and Study Participants

The study consisted of four data collection and analytical initiatives:

- A literature review identified and clarified the study's major elements and created a working set of hypotheses to be tested. We also examined other higher education IT student surveys.
- A review of and comparison with last year's ECAR study on faculty use of course management systems, undertaken at the University of Wisconsin System under Glenda Morgan's direction, provided important context.
- A survey provided quantitative data from a sample of 9,350 freshmen and 9,050 seniors, with 4,374 respondents at 13 higher education institutions: Colgate University; Drexel University; University of California, San Diego; University of Minnesota, Crookston; University of Minnesota, Twin Cities; University of Wisconsin–Colleges; University of Wisconsin–Eau Claire; University of Wisconsin–La Crosse; University of Wisconsin–Madison; University of Wisconsin–Milwaukee; University of Wisconsin–Oshkosh; University of Wisconsin–Stout; and University of Wisconsin–Whitewater.
- Interviews with 132 students in focus group settings at six institutions and with 23 administrators who support student IT on their campuses provided qualitative data.

All information collected is confidential, and no personally identifiable data is available from the quantitative survey. We obtained institutional review board approval at all institutions except Drexel University, where the project was deemed exempt.

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

Key Findings

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

Technology Ownership

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

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

Internet Access

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

Technology Use Patterns

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

Hours of Technology Use

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

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

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

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

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

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

**IT in the Classroom**

When analyzing student IT use in the classroom, the study team reviewed factors that make good practice in teaching and learning, using Chickering and Gamson’s seven principles that contribute to good practice in teaching and learning.² Using this focus, we asked students about their use and preference for IT in the classroom in the areas of communication, active learning, feedback, time-on-task, and student control of class progress.

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

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

A student’s major was also an important predictor, with engineering students having the highest preference for technology in the classroom (67.8 percent), followed by business students (64.3 percent).

When analyzing students’ preferences for classes using technology, we found that a student’s GPA was not a significant factor. Students with lower GPAs preferred classes using technology equally with those students having higher GPAs. An exception was students with the highest GPAs (3.51 to 4.00), who modestly preferred less technology in the classroom.

**Technology’s Impact in the Classroom**

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

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

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

**Benefits of Classroom IT Use**

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

**Convenience**

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

**Management of Class Activities**

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

**Saved Time**

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

**Improved Learning**

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

**Communications and Presentation**

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

**Presentation of Work**

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

**Barriers to Classroom IT Use**

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

**Course Management Systems**

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

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

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

**CMS Benefits to Students**

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

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

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

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

**Future Trends**

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

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

**Improved Understanding of Student IT Use**

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

**Improved IT Literacy**

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

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

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

**Improved CMS Quality**

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

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

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

**Improved Information Availability**

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

**Improved System Capabilities**

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

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

Improved Planning

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

Although some institutions have done institution-wide planning for instructional technology deployment, instructional technology has more often been a local issue, limited to college and departmental boundaries. Instead, instructional IT planning should be
- centralized, including all academic departments of the institution;
- in sync with institution-wide strategic planning;
- in sync with other institutional IT plans;
- participatory, sensitive to the norms and cultures of the colleges and departments;
- accommodating of diverse needs, such as recognizing the difference between art and design course needs and those of the social sciences;
- future oriented, with goals set in the context of an expected future discipline;
- based on empirical data and continual analysis of student course activity data; and
- the responsibility of the institution's academic and technology officers.

Conclusion

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

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

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

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

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