

# HIGHER EDUCATION

## Mobile Learning Handbook



A resource on  
one-to-one  
computing  
environments  
for administrators,  
faculty and the  
higher education  
community.

*Underwritten by:*



**Gateway**<sup>®</sup>

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# Higher Education

## Mobile Learning Handbook

A resource on one-to-one computing environments for administrators, faculty and the higher education community

# Advice and comments from leaders in higher education.

“Implementing a one-to-one mandate creates an environment of equal opportunity for students of different backgrounds.”

“Count on one-to-one computing to become part of the culture and everyday life on campus and expect increased attendance.”

“Establish a committee or task force comprised of students, faculty, administration and IT representatives to determine needs before looking at potential vendors.”

“Mandated purchasing programs are much more effective than recommended programs because mandated purchases are covered through student loan programs, whereas recommendations are not.”

“It’s possible to save money with notebook programs because it eliminates the need for computer labs throughout campus. That money can shift to cover maintenance costs at no additional cost to the students.”

“Look to other schools’ programs to learn the best approach for implementing a mandate. Also begin planning the program at least 12 to 18 months prior to implementation.”

“Develop the technical and support infrastructure before implementation. It’s highly effective to use student technical support programs where trained students manage initial troubleshooting and technical issues.”

— various responses from Center for Digital Education research

# Table of Contents


<b>About This Guide</b> .....	ii
<b>Section 1. Higher Education in the 21st Century</b> .....	1
Connecting Digitally with One-to-One Computing.....	1
A Vision for the Future.....	2
Preparing for the 21st Century Workplace.....	2
The Horizon Report 2005 .....	4
How Anytime, Anywhere Computing Benefits Students.....	5
<b>Section 2. Successful One-to-One Initiatives</b> .....	6
Providing Universal Access in Higher Education.....	6
Tools for the Digital Age – the Tablet PC .....	7
One-to-One Computing Installations.....	8
Studies and Key Findings.....	17
<b>Section 3. Preparing for a One-to-One Initiative</b> .....	21
Building a Vision .....	22
Planning the Initiative .....	23
Implementation Considerations.....	24
Supporting the One-to-One Initiative .....	27
<b>Section 4. Financial Considerations</b> .....	31
Leasing Options.....	31
Purchasing Options .....	33
Alternative Funding Sources .....	35
Insurance Considerations.....	36
<b>Section 5. Additional Resources</b> .....	37
Organizations and Centers.....	37
Publications .....	37
Grants .....	37

# About This Guide

This handbook is for administrators, faculty, students, parents and others interested in understanding the strategy for successfully integrating one-to-one computing into college and university campuses. One-to-one computing — a model in which every student uses a notebook or Tablet PC for research, taking notes, completing assignments and wireless access anytime, anywhere — is changing higher education as we've known it and creating new possibilities for teaching and learning.

This strategic conversation serves as a foundation to prepare decision-makers for planning, funding and implementing mobile learning programs throughout campuses across the country. The guide is organized as follows:

- Section 1, *Higher Education in the 21st Century*, introduces the changing landscape in higher education, identifies current challenges for learning and provides projections for campuses planning to adopt universal student access in the near future.
- Section 2, *Successful One-to-One Initiatives*, identifies benefits of universal access and notebook or Tablet PC use. This section also provides examples of one-to-one computing programs at several campuses and highlights findings based on research and interviews.
- Section 3, *Preparing for One-to-One Initiatives*, identifies general guidelines for designing and deploying a computing initiative including vision, planning, implementation and support. Each area includes a planning checklist.
- Section 4, *Financial Considerations*, provides information on various approaches for funding a notebook mandate including leasing options, student purchases, grants and alternative methods of financing.
- Section 5, *Additional Resources*, offers a list of organizations, centers and publications for reference.

For further information, references to pertinent Web sites are included throughout the text and marked with the world  symbol.

# Section 1. Higher Education in the 21st Century

## Connecting Digitally with One-to-One Computing

One-to-one computing simply means one notebook PC for every student for anytime, anywhere mobile learning. This access to technology in higher education, also known as ubiquitous computing, is the universal adaptation of wireless technology with the distinction that the technology is always present and always available, anywhere on campus. Despite newness and rapid growth, campus computing programs share one common vision: to provide universal one-to-one access to information.<sup>1</sup>

Today many college and university campuses have wireless computer networks. Some campuses feature Wi-Fi environments where students and faculty use notebook computers — and increasingly Tablet PCs — anytime, anyplace, to connect with each other and the digital world.

Internet2<sup>®</sup>, the advanced network designed for enhanced access and research in higher education, already connects 206 universities in the United States alone. Internet2 promises digital video, distributed learning, virtual reality, remote instruction, digital libraries, virtual collaboration and more.<sup>2</sup>

Visit any Internet2 campus and you're likely to see students, eyes fixed on their notebook or tablet computers, watching a Web cast lecture via the university's advanced video network. These technology tools, once an anomaly, are becoming the everyday necessities for campus-wide learning and instruction. In addition to traditional criteria, students can now select schools based on the technology made available; that is, technology integrated into the educational experience provides students advanced skills for direct application in the workplace.

An EDUCAUSE study of nearly 400 colleges and universities in the U.S. and Canada reveals “wireless LANs (local area networks) are undergoing mainstream adoption within U.S. higher education.” Of the institutions surveyed, “half [of EDUCAUSE members] have implemented a wireless LAN, and most others (all but 8 percent) are planning for wireless. Most institutions that have implemented wireless networks are expanding them.”<sup>3</sup>

One-to-one computing is changing higher education as we've known it and creating new possibilities for teaching and learning.

## A Vision for the Future

The *New York Times* reports that Dartmouth College implemented a major wireless convergence project that condensed phone, cable and wireless systems into one Wi-Fi network.<sup>4</sup> The 236-year-old Dartmouth College has completely integrated its communications systems into a wireless infrastructure, covering about one square mile. The project, college officials told the Times, “keeps students on the forefront of wireless technology, and opens up endless educational and teaching opportunities while saving the college millions of dollars.” Officials say, “Dartmouth saved \$2.07 million by updating and condensing its current system instead of replacing it, and saves nearly \$1 million annually on maintenance, cabling and salary costs.”

Dartmouth’s Director of Computing, Larry Levine, explained to the *Dartmouth News*, “What makes this project unique is its academic potential combined with the ease with which people will be able to access the wireless Net.” The *Dartmouth News* lists some of the possible academic applications of the college’s wireless Net:

- Smart classrooms where professors can broadcast presentation materials to each student’s laptop in class and respond to individual and group questions posed electronically.
- Researchers can collect and analyze data from remote locations and receive instant feedback for collection parameters.
- Students can monitor class or laboratory projects from anywhere on campus, checking computer system status, observing biological or chemical equipment or monitoring other instruments.<sup>5</sup>

## Preparing for the 21st Century Workplace

Colleges and universities at the forefront of technology are also at the forefront in preparing their students for the workplace. Programs using new technology are especially relevant for opportunities in science, engineering and computer-related occupations, where the rate of opportunity is about three times greater than the overall growth rate for all other occupations.

According to the National Science Foundation’s report, *Science and Engineering Indicators 2004*, the U.S. Bureau of Labor Statistics predicts that in this decade (2000 – 2010) the U.S. economy is expected to provide approximately 15 percent more jobs, with employment opportunities for science and engineering jobs expected to increase by 2.2 million, or about 47 percent.

Ubiquitous computing in higher education is the universal adaptation of wireless technology with the distinction that the technology is always present and always available, anywhere on campus.

The federal Bureau of Labor Statistics predicts that approximately 86 percent of the projected increase in jobs will be in computer-related occupations including:<sup>6</sup>

- Computer software engineers – increasing from 697,000 to 1.4 million jobs
- Computer systems analysts – increasing from 431,000 to 689,000 jobs
- Computer hardware engineering – above-average employment gains, growing by 25 percent
- Medical science occupations – addition of 10,000 new jobs, or an increase of 27 percent

🌐 The U.S. Bureau of Labor Statistics prepares forecasts for all occupations. These are available online at <http://www.bls.gov/search/ooh.asp?ct=OOH>.

## Answering the Challenge for Our Future Workforce

The National Science Board warns that the proportion of U.S. college-age population earning degrees in science and engineering is disappointingly low and declining. The proportion earning such degrees in 14 countries in Asia and Europe is substantially greater than that in the United States.<sup>7</sup>

Data from the Third International Mathematics and Science Study led the NSB to observe that high school seniors in the U.S. “rank below their counterparts in 17 other countries in math and science literacy.”

“As a result,” warns the NSB, “the future strength of the U.S. science and engineering workforce is imperiled.”

Those who see this direct connection between higher education, global communication and the American economy are worried. William C. Symonds writes in *Business Week*:


*As America sleeps, other nations that have long since recognized the critical importance of science and technology education to their futures are moving ahead. The U.S. has grasped this lesson in many Olympic sports, where strong national programs have been established to ensure that America has world-class athletes. Unless the nation applies the same approach to science education, it stands to lose far more than a few gold medals. It could ultimately squander its leadership of the world economy.”<sup>8</sup>*

The increase in new technology-related jobs combined with the immense need to prepare students and other citizens for such jobs create a major challenge and opportunity for every college and university in the nation. The following points out computing trends that will pave the way for developing technology skills in our future workforce.

## The Horizon Report 2005

The *Horizon Report 2005*, a research project by New Media Consortium and the National Learning Infrastructure Initiative (an EDUCAUSE Program), makes clear that the real potential of ubiquitous wireless lies in the specific activities that it makes possible. To estimate when computing milestones may be achieved, the project uses three timelines or "horizons": a very near-term horizon of 12 months or less before broad adoption, a mid-range horizon of one to three years, and a long-term horizon of four to five years.<sup>9</sup>

- **Extended Learning.** On some campuses, they augment traditional instruction with technology tools that are familiar to students and used in daily life. Time-to-Adoption Horizon: One Year or Less.
- **Ubiquitous Wireless.** With new developments in wireless technology both in terms of transmission and of devices that can connect to wireless networks, connectivity is increasingly available and desired. Time-to-Adoption Horizon: One Year or Less.
- **Intelligent Searching.** To support the growing need to locate, organize, and retrieve information, sophisticated technologies for searching and finding are becoming available. Time-to-Adoption Horizon: Two to Three Years.
- **Educational Gaming.** Taking a broad view of educational gaming, one finds that games are not new to education. What is evolving is the way technology is applied to gaming in education, with new combinations of concepts and games appearing on the horizon. Time-to-Adoption Horizon: Two to Three Years.
- **Social Networks and Knowledge Webs.** Supplying the need to connect with each other in meaningful ways, social networks and knowledge webs offer a means of facilitating teamwork and constructing knowledge. Time-to-Adoption Horizon: Four to Five Years.
- **Context-Aware Computing/Augmented Reality.** These related technologies deal with computers that can interact with people in richer ways. Context-aware computing uses environmental conditions to customize the user's experience or options. Augmented reality provides additional contextual information that appears as part of the user's world. Goals of both approaches are increased access and ease-of-use. Time-to-Adoption Horizon: Four to Five Years.

 To review the full Horizon Report see: [http://www.newmediacenter.org/pdf/2005\\_Horizon\\_Report.pdf](http://www.newmediacenter.org/pdf/2005_Horizon_Report.pdf).

## How Anytime, Anywhere Computing Benefits Students

Why provide students with 24-hour access to networked notebooks? The answer lies in the growing importance of networked information and communications. According to Mark Resmer, et al, in the publication *Computers for All Students: A Strategy for Universal Access to Information Resources*, “Students must be able to access information resources that are integrated into their educational experience.”

Universal access:<sup>10</sup>

- Increases the amount and dynamic nature of knowledge that students learn.
- Focuses on the student as an independent producer of learning rather than a passive customer of teaching.
- Improves communication between faculty and students.
- Increases the pace of technological change.
- Changes the nature of the student; learning becomes anytime and full-time.

With current focus on the quality of learning, keeping students engaged, and preparing students for the future workplace, ubiquitous computing is not only becoming a necessity, it is becoming expected as expressed by the many students arriving on campus with their own computers.

To realize the benefits of universal access, many campuses are increasingly using one-to-one computing to its fullest by putting standardized notebooks or Tablet PCs in the hands of every student, faculty and staff member. The following section highlights successful notebook initiatives at various universities and colleges throughout the country.

“Students must be able to access information resources that are integrated into their educational experience.”

– Mark Resmer, et al, from the publication *Computers for All Students*.

## Section 2. Successful One-to-One Initiatives

### Providing Universal Access in Higher Education

Ubiquitous use of notebook computers became the next logical step once wireless networks were established on campuses. Now students can achieve mobile learning with access to a wireless network anywhere on campus, not just in the library or dormitories. During classes, students can now simultaneously visit specific Web sites that effectively demonstrate key concepts. For example, according to an *EDUCAUSE Quarterly* article by James Efav:

*After a lesson on prejudice and its reduction, a student found the “tolerance.org” Web site. ... The student forwarded that site to his teacher, who forwarded it to the other teachers, who then forwarded it to their students. Within three minutes, the instructor got a response from a student who had checked her home state and found out that there were known hate groups right in her back yard. She wanted to know why the authorities allowed the hate groups to function if their existence was known. It is clear that the reality of prejudice was brought to life for that student.<sup>11</sup>*

Efav states, "What is so encouraging to the researchers is the progressive interaction: A student inspired by the class used his laptop at the first opportunity to do more research, and shared it with his instructor. Another student then visited that site and had a ‘real life’ learning experience.”

While the EDUCAUSE researchers note that this interaction could happen without using a laptop, the study also shows that “students use their laptops in the time between classes to check e-mail or accomplish other class-related activities.”<sup>12</sup>

Beyond interaction, other potential benefits of one-to-one initiatives include:

- Preparing students to be technologically proficient in the future workplace.
- Providing equal access for all students regarding availability of technology.
- Decreasing dependence on computer labs by providing access anywhere, anytime.
- Improving recruitment and retention of faculty and students.
- Increasing student involvement in campus activities by increasing contact with instructors, study groups and peers.
- Empowering students to enrich self-learning. For example, in an NSSE survey, 76 percent of seniors self-reported educational and personal gains resulting from appropriate use of technology.<sup>13</sup>

## Tools for the Digital Age – the Tablet PC

Tablet PCs provide a user interface that is as easy to use as a pen and pencil, making it extremely easy to embed computers into curricula. As John Williams, Director of the Intelligent Engineering Systems Laboratory at MIT, explains, “The Tablet PC acts like a pen and paper, so students can quickly sketch out their ideas. Even sketching complex shapes or writing math equations is easy — something that is an otherwise time-consuming process using a laptop and presentation software or a CAD (computer-aided design) system.”<sup>14</sup>

Using the pen directly on the screen, the Tablet PC enables students to organize and search handwritten notes, convert handwriting to text and e-mail, capture text and pictures, and share notes for collaborative work. In addition, students can use the Tablet PC to record lectures and then sync their handwritten notes to the lecture.

When students use the Tablet PC in class, it lays flat so it does not obstruct the view between student and instructor. Also suited to the classroom environment, handwriting on the tablet is quiet, unlike multiple keyboards clicking.

With the Tablet PC positioned as the next probable program choice in the future of portable, wireless computing on campuses, Microsoft lists the following benefits:

### ***Top 10 Benefits of the Tablet PC in Education:***

- Use one of the most advanced operating systems
- Work from anywhere with one of the most mobile PCs ever
- Take all your notes electronically
- Use ink anywhere, anytime
- Record lectures and presentations using linked audio
- Personalize your experience
- Let your voice do the work
- Get more done in less time
- Help protect critical data
- Deploy and manage easily

🌐 For more information see: <http://www.microsoft.com/windowsxp/tabletpc/evaluation/bymarket/education/toptenbenefits.mspx>.

In a recent Microsoft case study, Robert Rohr, lead programmer for the University of Vermont School of Business Administration, stated that it is exciting to see students using the Tablet PC for taking notes on a sonnet in an English class, drawing supply-and-demand charts during economics, and doing math equations. This use of technology, beyond the core business classes, points to how comfortable students become with using the Tablet PC.<sup>15</sup>

Students can order a free software pack for Tablet PCs that enables them to keep an organizer/planner, create electronic flash cards for efficient study and organize handwritten notes.

🌐 For details go to: <http://www.microsoft.com/windowsxp/downloads/tabletpc/educationpack/overview.mspx>.

“It is exciting to see students using the Tablet PC for taking notes on a sonnet in an English class, drawing supply-and-demand charts during economics, and doing math equations.”

– Robert Rohr,  
lead programmer,  
University of Vermont  
School of Business  
Administration

# One-to-One Computing Installations

Before planning a one-to-one initiative, it is important to look at the successful implementation of one-to-one programs at various institutions.

## Mayville State University

Mayville State University (Mayville, N.D.) was the first campus in the nation to implement a Tablet PC initiative. The university has nearly 70 academic programs and enrolls more than 900 students. The university wanted technology that would facilitate an increasingly interactive classroom experience. It also wanted to increase students' technology literacy so they would be comfortable using these advanced learning tools.

Because Mayville State faculty and students had been using notebooks with great success since 1997, campus leaders felt that Tablet PCs could be incorporated without extensive training. The Gateway® model chosen provided students the benefits of the Tablet PC and the functionality of a traditional notebook. The university was intent on deploying this technology to all students simultaneously for the 2004-2005 academic year, beginning with the summer semester.

"There were no technological surprises with the summer deployment. We made the few refinements that were fully anticipated," reported Keith Stenehjem, Mayville State's Chief Information Officer. "As for the user experience, we would not have moved forward if the faculty and students had not found the machines easy to use and believed that the Tablet PC-notebook had extensive academic value."

University officials explain that by July 2004, 800 Tablet PCs were delivered to Mayville for distribution to all students for the academic year. The Tablet PC has given every Mayville State faculty member and student the technical power and flexibility to teach and learn in the way they can be most effective. The computer facilitates an interactive lecture experience, improving the attention level of students and making the delivery of content more interesting.

As common practice, instructors project lecture presentations on overhead LCD screens. To encourage participation, with the Tablet PC capability instructors can emphasize important points with handwritten marks that students see in real time.

Students and faculty are enthusiastic about how the Tablet PC accommodates individual teaching and learning styles. One student discovered how to use the speech recognition function on the notebook and recites lecture notes to the PC to have the notes transcribed and saved in a text document. Personalizing the students' learning experience through technology can be an exciting draw for potential new students.<sup>16</sup>

🌐 For more information see <http://www.gateway.com/work/pdf/edu/Mayville.pdf>.

“We would not have moved forward if the faculty and students had not found the machines easy to use and believed that the Tablet PC-notebook had extensive academic value.”

– Keith Stenehjem,  
CIO, Mayville  
State University

## Winona State University

Winona State University (Winona, Minn.), the first teacher-training institute west of the Mississippi, has an enrollment of more than 8,000 students. The university is divided into five distinct colleges, offering liberal studies as well as specialized professional, technological and occupational degrees.

The university wanted to keep enrollment rates up, maintain the affordability of the institution, combine advanced curricula with the latest technology and help students become comfortable with technology they may use in future careers.

In the initial one-to-one program stages in 1994, the university allowed students to either purchase a specific laptop model from the school or to buy their own PCs. Having multiple platforms in a single classroom became a challenge to professors. So, in early 2004, the university decided to standardize to a single provider for PCs. Officials believed that standardizing allowed the faculty to focus more on teaching instead of solving various IT issues.

To take its one-to-one program to the next level, Winona State created a Tablet PC program in which every student and faculty member would have a PC to use in and out of the classroom. The objectives of the program were to serve the students better and take back classroom space by eliminating a majority of the computer labs on campus. In the university's vision, students would be able to access the Internet, write papers and communicate with faculty and other students anywhere on campus without needing to wait in line for a computer. As a side benefit, the university could save money by being able to add classes without having to construct new buildings.

Choosing the Tablet PC allowed students to view full documents on the 14.1-inch XGA TFT display, lay the PC flat to allow better visual contact between students and instructor, write notes with a digital pen, and later convert notes for use in assignments.<sup>17</sup>

Each incoming freshman now receives a Tablet PC at registration. Juniors and all faculty and staff of Winona State University also received the same computer — adding up to 4,000 Tablet PCs deployed in the first year alone. By the fall of 2005, Winona will have deployed more than 7,000 Tablet PCs, making this the largest Tablet PC deployment in North America.<sup>18</sup>

🌐 Results of a survey conducted at this university are included later in this section (see page 19). For more information on the Winona State program see <http://www.gateway.com/work/pdf/edu/winona.pdf>.

By the fall of 2005, Winona will have deployed more than 7,000 Tablet PCs, making this the largest Tablet PC deployment in North America.


## Dakota State University

Dakota State University (Madison, S.D.) was founded in 1881 as the first teacher education institution in the Dakota Territory. In 1989, the university underwent a fundamental shift in focus with an addition to the mission statement, noting dedication to integrate information technology into curriculum.

DSU President Dr. Douglas Knowlton notes the university as a leader in the integration of technology in the learning experiences of all students: "In every area of study you will find that your learning is enhanced by this access to information. Whether you are interested in working with computers, teaching, or developing and managing a business, in our new knowledge and information based economy your ability to access, organize, analyze and present information becomes a key to success."<sup>19</sup>

In keeping with the university goal of prioritizing technology, Dakota State University became the first university in South Dakota to implement a one-to-one computing initiative, and provide wireless Internet access to all students. The Wireless Computing Initiative Program, which began in the fall of 2004, provides each full-time freshman and sophomore with a Tablet PC, and anytime Internet connectivity on their wireless campus. Dakota State pushed the initiative to help students become more independent and effective learners. The initiative supports faculty in helping students cultivate sufficient technology skills necessary in online research and information analysis and presentation.

Because the Wireless Computing Initiative Program is a mandate, students can apply for their laptops as part of a financial aid package. The reasonable fee of \$275 per semester covers the cost of the actual laptop, software, insurance and access to support and services.

 To learn more about their wireless computing initiative, visit <http://www.dsu.edu/WMCI/>

## Albany College of Pharmacy

Albany College of Pharmacy (Albany, N.Y.) maintains a reputation as one of the finest pharmacy institutions in the world. With 70 full-time faculty members, more than 100 courses and 1,000 students, the college offers a unique program customized for students which encourages personal and professional development to help them attain their full potential. ACP aims to prepare their students as thoroughly as possible for careers in the pharmaceutical field.

Today, pharmacy professionals depend on technology for accurate record keeping and information sharing. To ensure a smooth transition for students from classroom to workplace, Albany College of Pharmacy needed to provide students and instructors with the most advanced technology available. And the school needed to guarantee equal access to all students.

“In our new knowledge and information based economy your ability to access, organize, analyze and present information becomes a key to success.”

– Dr. Douglas Knowlton,  
president, DSU

As ACP began investigating how to enable students to easily move into the pharmacy workforce, school leaders realized the computer-lab model was insufficient to meet student demands; it simply did not provide the anytime access that is critical on a college campus. Rather than add seats to the lab, ACP introduced a program that would put technology in the hands of every student. With the implementation of the Mobile Computing Technology Program in 2003, the university requires new students to purchase a Tablet PC from the Office of Information Technology.

With the decision to standardize PCs, the college evaluated several advanced systems. ACP selected a convertible notebook-to-Tablet PC. The versatility of the tablet feature allows instructors and students to write directly onto the screen. During lectures, instructors can write directly on the tablet, access information on the Internet and share information electronically with the class.

As e-prescriptions gain popularity with medical doctors, students gain applicable experience using tablet functionality — a skill directly in accordance with the school's mission to prepare students for the professional world. Albany College of Pharmacy continues to work to make sure their students can graduate and begin careers prepared with the technology-readiness expected of pharmacy professionals.<sup>20</sup>

🌐 For more information see: [http://www.acp.edu/student\\_infotech.html](http://www.acp.edu/student_infotech.html).

## Colorado Technical University

Colorado Tech's main campus was founded in Colorado Springs in 1965, but has expanded to include three satellite locations and Colorado Tech Online. CTU boasts an applied real-world teaching approach, and industry-current programs that prepare students for career success in the business and technology industries. One satellite campus located in Sioux Falls, South Dakota, offers students an enhanced learning environment, based on a notebook initiative.<sup>21</sup>

When Colorado Tech faced a tuition increase, the university needed to augment the value of its education and maintain its current enrollment. Without increasing the size of its campus, CTU had to offer more classes within its existing physical space. With the value-added deployment of Tablet PCs for students, enrollment numbers remained consistent, even with the increase in tuition.

In the months following the notebook implementation, CTU claimed that enrollment grew 30 percent year-over-year in light of the 20 percent increase in tuition. With one-to-one computing, CTU also extended class offerings without expanding the physical site. In a survey conducted at the end of a summer quarter, 90 percent of CTU students reported that using the Tablet PCs enhanced the learning environment.

🌐 For details see: [http://www.gateway.com/work/pdf/edu/co\\_tech.pdf](http://www.gateway.com/work/pdf/edu/co_tech.pdf).


## Seton Hall University

Six years ago Seton Hall University (South Orange, N.J.) implemented a laptop-computing program and key support services. According to the Seton Hall Web site, “One of the cornerstones of the university’s technology plan is making technology ubiquitous throughout the educational experience. This commitment is embodied in the university’s Mobile Computing Program, an innovative, academic program with three components:

- **Ubiquitous Access:** All full-time undergraduate students are provided a [notebook] as part of their tuition and fees. The computer is upgraded every two years.
- **Curricular Integration:** The University supports and encourages faculty to integrate the use of this important tool into the curriculum.
- **Infrastructure and Support:** The University provides the technology infrastructure and support services that enable students and faculty to make effective use of this teaching and learning tool.”<sup>22</sup>

As part of the Mobile Computing Program, Seton Hall now provides wireless Internet and Intranet access throughout most of its campus including wired and wireless classrooms, residence halls and public spaces.

According to the accomplishments listed on Seton Hall’s Web site, in 2004, “Internet2® went live for the Seton Hall community... enabling research faculty to take advantage of video conferencing, remote instrumentation, scientific visualization, grid computing, and other state-of-the-art Internet2 research applications. ... This upgrade doubled the overall capacity of the university’s Internet connection.”

 For more information on Seton Hall’s technological accomplishments, see <http://technology.shu.edu/page/Achievements!OpenDocument>.

## University of North Carolina at Chapel Hill

At the University of North Carolina at Chapel Hill (UNC), the Carolina Computing Initiative (CCI) ensures that:

- Students, faculty and staff have appropriate technology and use it effectively in various endeavors.
- Beginning with freshman in 2000, all undergraduates must own laptop PCs that meet university specifications.

According to UNC’s Web site description of the CCI, “the laptop requirement is both a recognition of and response to UNC’s responsibility to prepare students to live and work successfully in the 21st century. It is also an obligation to make computer ownership purposeful and affordable.

Thoughtfully executed, the Carolina Computing Initiative paves the way for information technology to be as second nature to the [UNC] community as pens, paper and books are now.”<sup>23</sup>

In 2001 the university began using “its laptop-computing infrastructure to experiment with a new kind of textbook, or media book,” Marian G. Moore, the vice chancellor for information technology, told the *Chronicle of Higher Education*. “Unlike traditional textbooks,” reports the *Chronicle*, “media books may contain hypertext links, audio and video clips, computer simulations, and the means to graph data that students enter.”

For example, one media book at Chapel Hill is designed for teaching basic cell and molecular biology. Another book describes three 19th-century artists and how the environment influenced their art.

“We’d be making a huge mistake if we didn’t try to push the edge of the envelope with such projects,” Moore explained.

Moore also explained that part of the “rationale for the [laptop] requirement was to reduce Chapel Hill’s spending on information technology. In its first year, the requirement helped to reduce the university’s technical-support costs. But in a few more years, [administrators] will be able to spend less on fixed assets such as computers in classrooms, laboratories, and dormitories because all students will own laptops.”

“I guarantee you this will cost less than doing it the old way — it doesn’t make financial sense to do it the old way,” Ms. Moore said in her interview.<sup>24</sup>

## Wake Forest University

The Computer-Enhanced Learning Initiative (CELI) at Wake Forest University (Winston-Salem, N.C.) is a faculty-based initiative that develops effective instructional uses for computers. The objectives are:

- To preserve WFU’s tradition of personal and individual instruction, enhanced by the resources of computer technology;
- To help WFU take a leadership role in integrating computer-technology into a liberal arts education true to the ideals of “pro humanitate” and intellectual integrity;
- To foster an environment of collaborative and life-long learning by facilitating intellectual exchange within the extended WFU community; and,
- To identify, develop, and disseminate computer applications that contribute to learning and scholarship across the wide array of disciplines at WFU.<sup>25</sup>

“The laptop requirement is both a recognition of and response to UNC’s responsibility to prepare students to live and work successfully in the 21st century. It is also an obligation to make computer ownership purposeful and affordable.”

– UNC’s Carolina Computing Initiative, UNC’s Web Site

## Buena Vista University

Buena Vista University (Storm Lake, Iowa), adopted its plan for universal access in May 1999. The plan was recommended by a team representing a cross-section of the BVU community, including most areas in the academic and administrative divisions of the institution. Students and faculty recommended the plan. BVU believes its plan, called the “eBVyou” program, benefits students because it:

- Puts BVU Graduates a Step Ahead – Providing instant access to digital information is part of a national trend toward giving students the computer and technology-related skills they need to compete in the job market.
- Enhances Learning Opportunities – Today’s technology enables educators to break free of an exclusive “teaching by telling” method. Network computing now makes it possible for us to devise innovative ways to help learners find and assemble information.
- Facilitates More Interaction and Collaboration – With the wireless network and laptops for everyone, students can gather and collaborate whenever and wherever they need to work together.
- Provides Better Support and More Usable Computer Time – Students are able to store their files in two places (on their notebook computer, and on the wireless network), so any downtime for network maintenance leaves students virtually unaffected.
- Keeps Pace with Cutting Edge Technology – The laptops will be replaced every two years, so each student can expect to have at least one system upgrade in a four-year cycle.<sup>26</sup>

“Everything a student used to have to go to a computer lab to do, they can now do wherever they happen to be.”

– Ken Clipperton,  
BYU’s managing  
director of informa-  
tion services

BVU’s managing director of University Information Services, Ken Clipperton, told *Converge* magazine that he sees student-centered learning at work every day because of eBVyou. “All our full-time students have wireless notebooks with continuous access to the campus network and all the resources of that network: digital library materials, online course platforms, the Internet and various resources that represent e-mail, instant messaging for collaboration and communication tools. When it came to classroom design, BVU didn’t want to ‘bolt down’ their classrooms. The wireless notebook technology eliminated the concern. Everything a student used to have to go to a computer lab to do, they can now do wherever they happen to be.”<sup>27</sup>

BVU also includes additional technology in classrooms such as digital projectors, DVD players, audio, cable TV and mobile laptop-docking stations, which use a simple design that can be out of sight if needed.

🌐 For more information see: <http://www.bvu.edu/~ebvyou/about.htm>.

## Drexel University

Drexel University (Philadelphia, Pa.) has a long-standing commitment to integrating computer technology into academic programs. Almost two decades ago, Drexel began to require all students to have personal access to a microcomputer, making computer technology “an integral part of the academic experience.”

Drexel was the first major U.S. university to be 100 percent wireless, including all dorms, parking lots and libraries, with inside/outside wireless access.

“It began in 1997 with a pilot in key locations (library, computing center, student center); by 2000 all the campuses were provided with access points throughout. The strategy was to ensure ubiquity first, and then strengthen coverage in areas of greatest demand. The subsequent explosion in the numbers of laptop computers used by faculty and students led to a rapid expansion of wireless capacity.”<sup>28</sup>

## University of Vermont, School of Business Administration

The University of Vermont, School of Business Administration (BSAD) began requiring students to have desktop computers in 1984 and moved to a laptop requirement in 1999. Beginning in 2005, the university required students to have convertible notebook/tablet computers. The school believes that a convertible notebook combined with a Tablet PC will further enhance the flexibility of technology in the classroom. “A Tablet PC,” explains the university, “enables the user to write with their normal handwriting onto documents and to keep all of their notes... which eliminates the need for students to use traditional notebooks. The [Tablet PC] also provides handwriting and speech recognition and the functionality of a full laptop computer with the added features of the tablet.”<sup>29</sup>

🌐 For details see: <http://www.bsad.uvm.edu/Admissions/FAQs/MobileComputingFAQ.htm>. Also see Microsoft’s case study at <http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=16829>

## University of Minnesota at Crookston

The University of Minnesota at Crookston has provided a portable notebook or laptop computer and network access to every full-time student and faculty since 1993. The university uses the term “ubiquitous computing” to describe its distinctive educational environment. As a “laptop university,” the ultimate goal is to provide the technology skills that allow students to minimize any technology learning curve they encounter. That means students must “quickly master new technologies and the university believes that’s an attractive selling point from an employer’s perspective.”

“The strategy was to ensure ubiquity first, and then strengthen coverage in areas of greatest demand. The subsequent explosion in the numbers of laptop computers used by faculty and students led to a rapid expansion of wireless capacity.”

– Drexel University

UM Crookston lists these benefits of its laptop program for students:

### **Virtually Unlimited Access**

Using network ports and wireless connections located throughout campus — including all classrooms and residence hall rooms — you'll be able to access the Web from virtually anywhere on campus — 24 hours a day, 7 days a week.

### **More Opportunities to Communicate**

Using the laptop computer and e-mail increases your amount of contact with people—friends, family, professors, and others.

### **Learning Is More Interactive, Fun, and Effective**

Simulations, learning games, threaded discussions, and video presentations add an extra dimension to your coursework. Web-based course materials also provide convenience. And since multimedia resources offer text, audio, and video, you can learn through different modes, making the entire process more student-centered and more effective.

### **Technology Skills Are Supported by Everyone at UMC**

Everyone teaching and learning on campus has a standard laptop computer and software, so it's likely that if you have technology questions, your roommate, your professor, or the person next to you in class can help.

### **Learning How to Deal with Change**

Technology is always changing. Regular software and hardware upgrades are commonplace. Because you'll deal with this process on a daily basis at UMC, you'll be able to work with new software and technology, minimizing any technology learning curve you encounter.

### **Gain a Competitive Edge**

In a world where people with technology skills increasingly have the most options, we want to make sure UMC graduates leave with the strongest technological edge.<sup>30</sup>

## **Framingham State College**

Framingham State (Mass.) College's laptop program is intended to bring "technology-rich tools and resources into the classroom through which instructors can expand and deepen the learning experiences of their students."<sup>31</sup>

All new day-school students entering this college are required to own a wireless laptop computer. President Heineman announced an initiative in May 2001 that made Framingham State College the first Massachusetts college to implement wireless laptop computing for all students. This bold new initiative, called FIT (Framingham Infuses Technology), built on Framingham's commitment to integrate new instructional technologies into the curriculum."<sup>32</sup>

## Other Campuses with One-to-One Computing

“With seven of its public colleges slated to mandate notebook use within the next two years, Massachusetts is at the forefront of a national movement to bring computers into college classrooms,” according to the *Boston Globe* (December 28, 2004). Bridgewater State College and Worcester State College implemented the requirement last fall. Salem State College and Massachusetts College of Liberal Arts begins in fall 2005, followed by Westfield State and Fitchburg State in 2006.<sup>33</sup>

Other colleges or universities that are incorporating innovative computer approaches in their classrooms include:

**Vanderbilt School of Engineering / FAQ on required laptops**

[http://frontweb.vuse.vanderbilt.edu/vuse\\_web/transit/faq.asp](http://frontweb.vuse.vanderbilt.edu/vuse_web/transit/faq.asp)

**University of Cincinnati, College of Design, Architecture, Art and Planning**

<http://www.daap.uc.edu/admissions/compreq.php>

**Iowa State University, College of Design**

<http://www.design.iastate.edu/leaseprogram.php>

**University of Missouri, School of Journalism, required all students in the school of journalism to have laptops.**

<http://www.journalism.missouri.edu/undergraduate/computer-requirements.html>

## Studies and Key Findings

An EDUCAUSE Center for Applied Research report, *Respondent Summary, Wireless Networking in Higher Education in the U.S. and Canada*, shows that “74 percent of those with wireless networks indicated that their expectations have been met, and an additional 14 percent noted that their expectations have been exceeded.” The study included wireless networks that were in the early stages of implementation.

Respondents also rated the following key factors in importance (on a scale of 1 to 10):<sup>34</sup>

Wireless Network Key Factors	Respondents rating 8 -10 in importance
Student anytime access	51%
Growth ability (of the network to cover more spaces)	43%
Classroom access	43%
Faculty anytime access	41%
Solve specific problems	38%
Leading edge perception	35%
Commuter student access	30%
Easier move/add/change	24%
Savings over installing wired	21%
Competitive pressures	21%
Operating cost savings/wired	11%

“With seven of its public colleges slated to mandate notebook use within the next two years, Massachusetts is at the forefront of a national movement to bring computers into college classrooms.”  
 — Boston Globe

In another study, *Information Technology Networking in Higher Education: Campus Commodity and Competitive Differentiator*, the EDUCAUSE Center for Applied Research examined the state of IT networking in higher education. This research “provides the first comprehensive empirical information about the higher education networking environment, both from an every-day-practice perspective and from a strategic perspective.”<sup>35</sup>

This ECAR study shows that institutions experiencing success “provide a reliable, scalable, secure, adaptable, and fault-tolerant network infrastructure.” The study reveals that while there are financial, political, environmental, managerial and technical challenges, “colleges and universities are not only focusing their efforts on these basic requirements, but further leveraging their networks to strategic ends. There is now a real possibility that current networking environments can enable transformational change in our core mission of improving student learning, while also reducing the costs of instruction.”<sup>36</sup>

A Gateway-sponsored white paper, *Schools Elevate Student Learning Experience Through Wireless Technology*, written by Jocelyn Young of IDC, identifies considerations particular to colleges and universities: “In trying to deliver the best educational experience to students, vocational institutes, colleges, and universities are united by a common set of challenges.” These challenges are unlike those of typical private businesses and include:

- **Limited space.** Unlike businesses, schools are limited to their current physical environment and have few options when it comes to expanding the capacity of their location.
- **Tight budgets.** Even as businesses struggle with tightening budgets, schools are facing falling endowment levels and reduced state funding. Schools need to consider not only the up-front costs of implementing technology but also the ongoing support costs.
- **Mobile student body and employees.** Schools need to enable their students, faculty and staff to access technology from locations other than a traditional computer lab. Schools face challenges in enhancing two-way communication among students, faculty, and staff and in enabling people to be more productive in their daily routines such as doing homework, posting test grades or doing administrative tasks.
- **Focus on core “product” of academics.** Schools have a broad ecosystem of stakeholders to satisfy, including students, faculty, administration, alumni, boards of trustees, the local community, and (increasingly) federal and local government.”<sup>37</sup>

🌐 For more information see [http://www.gateway.com/work/docs/edu/gtw\\_ed\\_paper\\_072303.pdf?cmlid=work/ed/k12/success.shtml](http://www.gateway.com/work/docs/edu/gtw_ed_paper_072303.pdf?cmlid=work/ed/k12/success.shtml).

“There is now a real possibility that current networking environments can enable transformational change in our core mission of improving student learning, while also reducing the costs of instruction.”

– ECAR press release (2005)

## What Other Studies Show

Winona State University performed a test of notebooks/tablets to aid in the decision to use Tablet PCs. In the Microsoft-sponsored study, students and faculty tested several models, both slate and convertible, and provided feedback over a three-week period. In addition, entire pilot classes received evaluation units and students and faculty tested various software packages over a full year (starting in August 2003).

After the convertible Tablet PC was selected as the standard, a survey of 455 first-year students and 130 instructors revealed the following regarding the one-to-one program:<sup>38</sup>

### ***Student Results(2005):***

- 58 percent reported that they found the convertible tablet more useful than a traditional laptop.
- 47 percent reported using the stylus within tablet-mode.
- 25 percent reported using MS OneNote — a note-taking management program — to take notes in class.
- 34 percent reported that the tablet has improved the classroom environment; 27 percent reported that the tablet has improved their study habits.

### ***Faculty Results(2004):***

- 51 percent indicated that they used digital ink regularly in and out of class.
- Three most common instructor applications:
  - Using OneNote 2003 on a public screen during class and sending notes to students after class.
  - Marking up PowerPoint 2003 slides during class and making annotated slides available online.
  - Using digital ink and the tracking features of Microsoft Word 2003 to mark up student papers.

## Key Considerations for One-to-One Programs

The Center for Digital Education conducted research and interviews with various university and college officials and identified the following key points regarding one-to-one programs:

### ***Best Advice for Implementing a One-to-One Computing Program:***

- Look at existing models and work upon the lessons that others have learned.
- Get the parents involved early and keep them informed.
- Practice high levels of communication with the vendor, faculty and student representatives to stay aware of rising issues and address them as early as possible.

“Get the parents involved early and keep them informed.”

— Center for Digital Education research

“A key challenge is developing the infrastructure and training for staff while planning the ‘nuts and bolts’ of the implementation.”

– Center for Digital Education research

- Consider all the implementation tools that will be necessary aside from the computer itself. Look at the network and library and look into making sure that the university can supply useful electronic resources to help motivate students and faculty to utilize the technology.
- Key points in working with a vendor are considered to be communication and a strong relationship. In one school, the director has the home phone numbers of his account managers and several VPs — it is very important to the director that he can get in contact with the vendor and solve problems as they arise.

### ***Biggest Challenges to Consider:***

- The biggest challenge was setting up and maintaining an efficient and operable maintenance system.
- Battery life is becoming an ever-increasing issue.
- The biggest challenge was the slow rollout of the program. The college found that the faculty would not use the technology in the classroom because only freshman had the technology. It wasn't until after the four-year rollout that faculty would start using technology in the classroom.
- A key challenge is developing the infrastructure and training for staff while planning the ‘nuts and bolts’ of the implementation.

### ***Factors to Consider When Choosing a Vendor:***

- The top deciding factors in selecting a vendor and technology were durability, price and accidental damage protection.
- The main requirements in both the vendor and technology were professional development and software applications included with the hardware.
- The university looked for a company that would partner with the university, whose hardware had a low failure rate and who would be flexible with pricing. The technology simply had to be current and close to cutting edge.
- Compatibility with the university's current networks.

The next section provides guidelines for preparing to implement one-to-one computing on campus.

# Section 3. Preparing for a One-to-One Initiative

The deployment of a one-to-one computing initiative requires thorough planning and project management. Whether an institution is considering a notebook mandate, or is recommending standardized PCs, launching a mobile learning program is a significant undertaking. While there are myriad approaches to designing, managing and deploying a computing initiative, this section presents key actions in four functional areas:

- **Vision** – Building the vision should occur before the actual plan is set in motion. During this initial fact-finding and research period, senior administrators establish a task force/planning committee comprised of department heads, key faculty members, IT leaders and representation from students.
- **Planning** – During goal setting and planning, the task force develops the overall strategic plan including timing, staffing requirements, identifying potential vendors, and funding considerations. Once all parties reach buy-in and agreement, plans must be refined and all concerns communicated and addressed.
- **Implementation** – Implementation includes tasks such as selecting the vendor, defining the network and infrastructure specifications, initiating a pilot project and conducting evaluations, and finally deploying the program including distribution of notebooks, and later refreshing or handling of older PCs.
- **Support** – Technical support includes all initial and ongoing professional development and training for faculty and students and such services as the help desk, maintenance, and online help information.

Communication is at the foundation of each juncture in the process — from defining the initial vision and goals, to preparing the actual strategic plan, explaining the process and scope to all stakeholders, and finally providing ongoing instructions to students and faculty regarding the program and equipment use. Specific communications tactics are identified throughout this section.

Section 3 provides a strategic overview of each functional area and presents a checklist of key steps or actions that may occur within that area. For information on financing and funding a program, see Section 4.

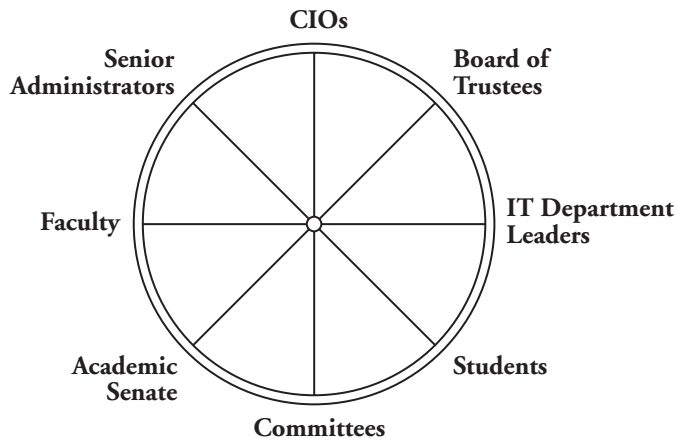
## Building a Vision

Every successful mission starts with a vision of what the future can or should be like. High-level officials must provide every interested party with a compelling rationale to launch a one-to-one initiative. An inspiring validation of the project will help motivate the administration, faculty and students to see the initiative succeed.

For American colleges and universities, both top-down and bottom-up strategies are effective in technology decision-making. From the point of view of a “learning organization,” it is important that faculty and administrators share vision and work collaboratively.<sup>39</sup>

Research indicates that senior administrators and IT department leaders are highly influential participants who drive the initial and ongoing vision for one-to-one computing mandates. Therefore, it is critical that the CIO or senior administrator champion the project and begin to build a task force or planning committee comprised of not only administration, IT staff and faculty, but also representation from students.

Research indicates that senior administrators and IT department leaders are highly influential participants who drive the initial and ongoing vision for one-to-one computing mandates.



Including faculty in all phases of a one-to-one initiative, from planning to implementation, will ensure more successful programs. On some campuses, faculty endorsements may be necessary and may include a faculty vote in early adoptions. Pilot programs in smaller departments or colleges in large universities may also serve as demonstration projects and capture faculty enthusiasm that can be leveraged to other departments or colleges across an entire university.

During the initial research and fact-gathering phase, many peer colleges or universities are willing to share the lessons they have learned through guidance and planning documents that are freely available. In some cases, hardware or application-hosting service providers offer start-to-finish assistance with entire packages that bundle hardware and software solutions.

# Planning the Initiative

A strategic plan should be broad but also illustrate how a one-to-one notebook or Tablet PC initiative will be an integral part of a quality learning experience and higher academic achievement. Based on goals, vendor programs, and the strategic plan, the committee must also develop a plan for financing the project; for example, it must be determined if the notebooks will be leased, purchased, or partially funded through grant money, and so on.

Before launching a one-to-one initiative, it is imperative that all the constituencies involved have a thorough grasp of the objectives, its implementation and support strategies, and expected outcomes. It is also critical that the committee address how to communicate the upcoming changes and impact of the mandate. The committee can communicate plans in updates via e-mail listservs, the campus Web site, and newsletters and announcements in campus and community newspapers.

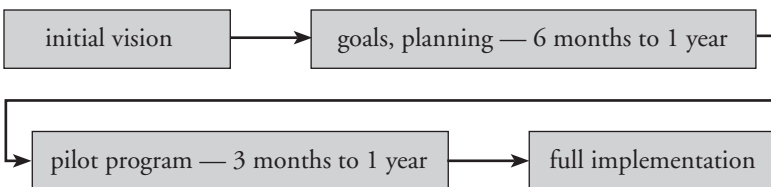
When planning a one-to-one mandate, consider the following checklist recommended by Gateway and endorsed by the Center for Digital Education:<sup>40</sup>

## Overall Strategy - Planning Checklist

- Establish a task force.
- Get recommendations about program planning from technology vendors; in particular determine options regarding a mandate in which all notebooks and software deployed are standardized for greatest program benefits and reduced IT costs.
- For universal, comprehensive access, identify infrastructure and wireless network requirements and detailed notebook specifications.
- Determine a plan for funding the project; for example, determine if students will purchase or lease the notebooks.
- Design a detailed timeline to help direct and manage both pilot projects and full-scale implementation programs. Develop timelines with input from all stakeholders.
- Develop communications to inform administration, faculty, students, and other stakeholders about the program.

### *General Timeframe for Deployment*

Most research conducted to date shows that the length of time from initial planning until implementing a one-to-one initiative is generally one to two years. A pilot program can last three months to one year with actual deployment to follow.



## Implementation Considerations

As the number of computers rises exponentially, and as end-user needs for network time and traffic space increase, even the best initiatives with sophisticated, onsite information technology resources and elaborate wireless infrastructures may be challenged. Thorough planning, testing, evaluating, diagnosing, and correcting — integrated into an overall implementation design for a network solution — offer the greatest assurance of successful deployment and technology use.

### Equipping the Campus with Universal Access

To implement a well-designed, well-executed notebook initiative, consider these fundamentals: the computer, network connectivity and infrastructure, security, and project deployment. For information on professional development and training, see Supporting the One-to-One Initiative later in this section.

The most essential piece of a successful technology project is the notebook or Tablet PC and the array of software applications bundled with it. ECAR's *Study of Students and Informational Technology* supports the notion that a wireless computing program needs to build on the computer infrastructure that already exists in a campus environment.<sup>41</sup>


A needs-based survey of student and faculty requirements and desires is the best way to determine the most appropriate hardware and software configuration, including the computer's overall dimension and weight, screen size, processing speed, memory and connectivity.

Typical minimum technical requirements would include a three-year warranty, the current vendor-recommended maximum hard drive and memory sizes, built-in wireless cards, a built-in CD-ROM drive, one or more USB ports (for jump drives and other devices) and a battery that can last at least 7 hours, if not more to avoid recharging between classes.

It is also important to evaluate how students and faculty will use the computers to provide the hardware necessary for optimal functionality. The number and kind of peripherals can add flexibility and functionality to any laptop, regardless of its configuration, but they also increase its cost.

Finally, it is important to know if the computers can be upgraded or refreshed two to three years following deployment. Upgrading the operating system, hard drive, and optical drive are significant aspects of keeping the technology current with new consumer preferences and applications.

For more information on mobile computing systems see:

 Microsoft Windows Anywhere 2005 provides a good example at: [http://www.microsoftwindowsanywhere.com/virtual/materials/mwa/30\\_pulsipher.pdf](http://www.microsoftwindowsanywhere.com/virtual/materials/mwa/30_pulsipher.pdf).

Thorough planning, testing, evaluating, diagnosing, and correcting — integrated into an overall implementation design for a network solution — offer the greatest assurance of successful deployment and technology use.

📍 Another example is provided by Deloitte Research – Creating a Mobile Enterprise in the United States (2003), at: [http://www.mda-mobiledata.org/MDA/pdfs/deloitteresearch/mobile\\_data\\_us.pdf](http://www.mda-mobiledata.org/MDA/pdfs/deloitteresearch/mobile_data_us.pdf).

📍 Intel® Higher Education Curriculum Forum: Wireless Computing Curriculum at <http://www.intel.com/education/highered/Wireless/Wireless.htm>.

## Network Connectivity and Infrastructure

Wireless notebooks or Tablet PCs demand a network of easily accessible resources that includes everything from the printers to the Internet. The key to access is connectivity. A professionally plotted array of appropriate wireless access points will ensure that faculty and students have the information they want, when and where they want it.

For specific considerations and the latest research, see the most recent study, *Information Technology Networking in Higher Education: Campus Commodity and Competitive Differentiator*, from EDUCAUSE Center of Applied Research (ECAR, February 2005, by Judith A. Pirani and Gail Salaway with Richard N. Katz and John Voloudakis). This study was “designed to provide the first comprehensive empirical information about the higher education networking environment, both from an everyday-practice perspective and from a strategic perspective. It identifies what networking technology and practices are currently in place and what future directions are anticipated and planned. Systematic quantitative data can help institutions make more informed decisions regarding networking approaches and plans, and hopefully contribute to the improvement of networking in higher education.”<sup>42</sup>

📍 See the EDUCAUSE Web site at: <http://www.educause.edu/LibraryDetailPage/666?ID=ERS0502>.

📍 Also visit Intel’s Web site for a basic primer on Wired or Wireless: [http://www.intel.com/personal/do\\_more/wireless/wifi.htm?iid=ipc+wireless\\_tools\\_wiredvswireless&](http://www.intel.com/personal/do_more/wireless/wifi.htm?iid=ipc+wireless_tools_wiredvswireless&).

Also see: Go Wireless at: <http://www.intel.com/personal/wireless/index.htm>.

📍 For more information on WAN’s and LAN’s go to: <http://www.intel.com/business/bss/industry/education/higher.htm>.

## Evaluating Your One-to-One Program

Develop a manner of evaluating the pilot program and the final deployment. The evaluation should include a general description of the process used to evaluate the program, including procedures for monitoring, implementing, collecting information on student outcomes, and assessing the effects on teaching and instructional practices. The approach should incorporate

A description of the project plan including implementation milestones should be available as an online resource for all stakeholders (users and nonusers) to read.

evaluation methods that are consistent with the assessment program already used in the college or university. Or follow an evaluation template used at a peer university or college.

The technology evaluation provides the necessary information to help convince boards of directors of the worth of additional funding. Ongoing evaluation fine-tunes a program and guides any mid-course corrections to keep the project on target and within stated objectives.

🌐 For more information, see the two-year research project, *Strategic Implications of an Educational Technology Assessment* at: <http://www.educause.edu/ir/library/pdf/eqm04210.pdf>.

🌐 For an evaluation example, see the *National Survey of Student Engagement* (NSSE) at <http://www.indiana.edu/~nsse/>.

🌐 To review the entire 2005 survey, go to: [http://www.iub.edu/html/2005\\_inst\\_report.htm](http://www.iub.edu/html/2005_inst_report.htm).

Again, a description of the project plan including implementation milestones should be available as an online resource for all stakeholders (users and nonusers) to read.

When preparing to implement a one-to-one mandate, consider the following technology-focused checklist.

## Implementation – Technology Planning Checklist

- Establish a wireless network with complete coverage and sufficient access points to handle logins at the busiest times.
- Standardize everything: hardware, software, Internet access and browser, and e-mail, including the latest security systems.
- Select the latest technology possible, particularly for technical universities.
- Select the vendor/supplier.
- Have a plan for gradually distributing equipment and automate the process as much as possible.
- Provide notebooks to faculty months in advance of deployment and provide adequate training on hardware and instructional integration. This will greatly reduce IT help time and associated costs.
- Run a small-scale pilot in an academic program for one year or one semester before campus-wide deployment.
- Prepare an evaluation of the pilot programs.
- Have additional power options available on campus: extra batteries, extra chargers and quick hook-ups.
- Develop a comprehensive plan for backing up files and teach students the importance of backups.

- ❑ State a clear responsibility policy for students and provide insurance or require students to have their own insurance.
- ❑ Have a plan for cycling aging computers out of the program through student purchase, tuition fees or lease. Another option may be an asset recovery program from the vendor.
- ❑ Communicate implementation plans to all interested parties and provide equipment orientation and distribution policies and procedures to faculty and students.

## Supporting the One-to-One Initiative

Support services, which are critical for successful implementation of any one-to-one computing program, should begin at the inception of the project and continue throughout implementation and after deployment.

### Faculty Support and Professional Development

Ongoing professional development provides necessary technical training and helps faculty members integrate the technology into course content in meaningful ways. To give faculty the opportunity to become familiar with the technology and further develop their curriculum, it is important to provide notebooks to instructors well in advance of a pilot program or full-scale implementation.

A key component of any technology planning includes professional development that demonstrates relevant instructional approaches. Surveying faculty for a better understanding of their own perceived needs — from technology skills to awareness and use — will help determine the type and level of development needed to accomplish their instructional goals.

Professional development should also include opportunities for early adopters to become coaches and mentors to their peers. It is important that faculty become as self-sufficient as possible and have information available online for just-in-time delivery. A number of Colleges of Education are using online tutorials such as *Atomic Learning*.

🌐 For testimonials on the *Atomic Learning* Web Site, see <http://www.atomiclearning.com/testimonials>.


### Teaching Centers for Professional Development

A number of campuses have created technology-related teaching centers that provide a place for faculty to meet for formal and informal professional development. Incentives for integrating technology typically include either computers (notebooks) or stipends/grants for developing content (online, courses, etc.) or both, depending on the institution's needs and financial capabilities. Faculty typically opts to have a wireless notebook or Tablet PC, valuing its versatility, access and the option to take it home for true 24/7 availability.

Ongoing professional development provides necessary technical training and helps faculty members integrate the technology into course content in meaningful ways.

## Learning Resources for Faculty and Students

Some vendors offer, or can help plan for, learning resources. For example, the Intel® Innovation in Education Web site contains resources designed to improve the effective use of technology on college or university campuses. Another valuable resource for faculty or students is the Intel® Higher Education Program. This online guide demonstrates “a sustained commitment in collaboration with educators and government leaders worldwide to help today’s students prepare for the demands of tomorrow.”<sup>43</sup>

 For more information, see the Intel® Higher Education Program at: <http://www.intel.com/education/highered/index.htm>.

For another resource, Gateway offers the LearnWithGateway professional development program, which provides an array of instructor-led courses covering such topics as:

- Maximizing the Use of Computer Technology in Your Classroom
- Getting the Most from Your Tablet PC: Technology in the College Classroom
- Best Practices in the Use of SMART Boards for Higher Education
- Technology-Integration for College/University Leadership
- Virtual Live Online Professional Development
- Training Material Creation (based on your choice of products)
- Technology Integration: A Methods Course for Education Majors in the School of Education

 For details, go to: <http://www.learnwithgateway.com>.

## Technical Support and Maintenance

One-to-one initiatives must include technical support, available either on-site with the institution or through the vendor. Most vendors offer a range of service and support products, which depend on the requirements and preferences of the institution. These services include:

- Technical support staff training, including individuals whose institutions are considering self-servicing for repairs.
- Parts and loaner devices – Consider parts agreements in relationship to the length of the leasing period.
- Warranties – Be sure to understand what is and is not included in the vendor’s warranties and communicate this clearly among staff, students and faculty.
- Repair – Consider having parts available on site and include technical staff time, including troubleshooting, diagnosis, repairing, verifying and/or having to return the devices to the vendor for escalated repair. Be sure to establish the repair process and a solid record keeping system.

- Vendor-provided modules on an exchange basis as well as online ordering of parts, shipping and so on. Limiting downtime is extremely important in a 24/7 environment.
- Help desk and online technical support – FAQs for student and faculty should provide some relatively easy explanations of how to perform basic technical functions. For example, most of the computers should be set to do automatic updates or security patches.

Professional (vendor) support dedicated to the institution and consulting services of system engineers may, in some cases, be budgeted with large-scale projects.

## Insuring the Notebooks

If a college chooses to own the computers, most risk insurance programs can provide them with a policy rider that will cover the notebooks. Students' and parents' homeowner policies may also provide some coverage for damage or loss if the computers are student-owned.

Many computer vendors provide accidental damage protection programs or extended warranty opportunities for the computers they sell. Costs for repairs and/or replacement should be discussed and clearly communicated with students.

For information on insurance cost and deductibles, see Section 4 Financing Considerations.

## Communicating User Guidelines to Students

Written communications to students, usually available on the campus Web site, should be reviewed carefully for all details and signed by the appropriate levels of authority — especially when the program provides university-owned computers. For example, one-to-one computing guidelines should:

- Provide an explanation of notebook or Tablet PC requirements to students and parents.
- Invite new users to review the institution's Web site to review frequently asked questions (FAQs) to help familiarize them with details and to help them manage expectations.
- Recommend new users view an online video or attend campus demonstrations on how to care for the computer including charging, cleaning, and other use and care tips.
- Describe the importance of using the proper carrying case.
- Describe the use policy including distribution policies and procedures, insurance requirements and refresh/upgrade options.

## Support – Planning Checklist

- ❑ Train faculty in the use of technology and mentor them in how to integrate the technology in their coursework. Identify specific short-term and long-term actions the institution will take to ensure achievement of these objectives.
- ❑ Provide ongoing professional development for faculty and ongoing training for students.
- ❑ Plan all aspects of technical support and maintenance.
- ❑ Identify and adopt an insurance program to cover equipment damage, theft, etc.
- ❑ Set up an authorized service center on campus and have the vendor reimburse you for repairs.
- ❑ Develop and update all online communications and instructions for student and faculty access.

The checklists in this section are adapted from *Student Laptop Mandates, Creating the Competitive Campus*, a strategy paper with insight from the Center for Digital Education and underwritten by Gateway.

🌐 To access the paper go to [http://www.gateway.com/work/pdf/edu/HED\\_white\\_paper.pdf](http://www.gateway.com/work/pdf/edu/HED_white_paper.pdf).

# Section 4. Financial Considerations

The cost for mobile learning is multi-faceted and the budget planning process should consider many factors including the cost of networking and infrastructure, software, training, support and more. Before engaging in financial planning, senior administrators should consider options such as leasing programs, student purchases, grants and alternative methods of financing as highlighted in this section.

A key consideration in determining cost is how the institution designs and manages the notebook initiative. For example, a university may recommend that students purchase a certain notebook or Tablet PC and standardized software. With this type of recommendation, also known as a “soft” mandate, the institution may offer students special negotiated prices and loan programs for purchasing the computers.

Under a notebook mandate, however, where all incoming students are required to have the same type of notebook or Tablet PC, the institution may lease the notebooks from the vendor and in turn charge the students an appropriate increase in tuition or fees. This lease arrangement with students provides many options and services over the long term.

## Leasing Options

Some one-to-one mandates request that students purchase their notebooks or Tablet PCs (see Purchasing Options later in this section). However, a common practice for financing one-to-one mandates is to offer a program based on tuition fees that may cover:

- Lease of the notebook or Tablet PC, including software and licensing
- Unlimited access to the wireless network including e-mail and network accounts
- Extended warranty
- Insurance coverage
- Support and training services
- Replacement and/or upgrades typically after two or three-year cycles
- Option to own the computer upon graduation

Before engaging in financial planning, senior administrators should consider options such as leasing programs, student purchases, grants and alternative methods of financing.

A key benefit of a tuition-based leasing arrangement is that students can use financial aid toward the cost of the notebooks.

A key benefit of a tuition-based leasing arrangement is that students can use financial aid toward the cost of the notebooks. This makes the notebooks and universal access available for all students including those who are eligible for financial assistance.

According to Iowa State University's College of Design, the leased-laptop program provides computers to students using "a low-cost, multi-year payment option that can leverage financial aid packages and provide students with the same versions of software found in the college labs."

At ISU, the fee assessed for College of Design students is \$750 per semester for six semesters and includes:

- Software used in the college labs (including updates).
- Insurance through the university (\$500 deductible, full replacement cost).
- Full support from college computer support staff (hardware and software).
- Billing from university through student U-Bill.
- Financial support award increased if applicable.
- Option to purchase laptop at end of three years (transfer of ownership).

🌐 For more information about the lease program at ISU College of Design, go to: <http://www.design.iastate.edu/leaseprogram.php>.

🌐 For information about ISU's wireless program, see: <http://www.it.iastate.edu/wireless/>.

In another example of a lease program, Winona State University provides a laptop for every student and assesses a fee of \$500 per semester, which includes hardware, software and technical support. The fee also covers insurance, but students pay a deductible of \$500 for a lost or stolen laptop. There is also damage coverage for non-warranty repairs with the maximum amount payable by the student set at \$200 per incident. Students keep their laptops over the summer. At the end of the lease, students have options for replacing an old laptop with a new one.

🌐 For an informative collection of FAQs, see Winona State's Web site at <http://www.winona.edu/its/Laptop/faq.htm>.

At Buena Vista University (Iowa), students receive computers in return for paying higher tuition, which increased about \$1,000 per year. More importantly, the university anticipates financial aid covers 75 percent of the direct cost of attending BVU, even with the computers. Buena Vista officials used municipal bond funding and "own" the computers, but allow students to purchase the laptops at the end of the two-year refresh cycle. The university equipped each of its 1,400 full-time students and faculty with notebook computers in the fall 2000 semester, and a campus-wide wireless network makes it possible for students and faculty to study and work anytime, anywhere on BVU's 60-acre campus.

🌐 See the story about Buena Vista in the *Chronicle of Higher Education*, October 13, 2000 at <http://chronicle.com/free/v47/i07/07a06401.htm>.

## Comparing Lease to Purchase Costs

In another example, Colorado State University College of Business provides a laptop lease program to undergraduates.<sup>44</sup> On their Web site, students can find the following cost-comparison table to help them see the benefits the college extends with such a program.

Colorado State leases laptops to freshman for four years at about \$200 per semester. At the end of four-years, students have the option to purchase the computer. If a student decides to leave the College of Business before their contract is up, they can either purchase the computer for the remaining amount of the lease, or turn in the computer for a pro-rated refund.

Comparison of Laptop & Associated Software Costs to the Student			
Laptop	University Lease Program	Student Owned*	Student Owned
Base Cost	\$1,099	\$1,099	\$1,099
4 Yr Warranty	\$126	\$250	\$250
SafeWare (4 Year)	\$160	\$400	\$400
<b>Total Hardware</b>	<b>\$1,385</b>	<b>\$1,749</b>	<b>\$1,749</b>
Word 2000	\$24	\$220	\$110
Office XP	\$68	\$495.50	\$250
Project	\$20	\$360	\$180
Visio Pro	\$20	\$400	\$200
Altiris	\$15	\$0	\$0
<b>Total Software</b>	<b>\$147</b>	<b>\$1,475.50</b>	<b>\$740</b>
<b>Total All Costs</b>	<b>\$1,532</b>	<b>\$3,224.50</b>	<b>\$2,489</b>

\*The first "Student Owned" column reflects a higher Total Cost based on a student upgrading software after two years.

## Purchasing Options

For programs that recommend a particular notebook or Tablet PC, a common method of financing is through student purchases. In this case, the institution sets a minimum hardware standard, recommends computer models, and negotiates prices with vendors. For student recommended purchases, the institution may provide financing for loans and offer repair and support as part of the vendor contract. Some mandates require students to purchase a notebook or Tablet PC. In this case, if it is a requirement, students may use financial aid toward the purchase of a computer.

For example, the one-to-one initiative at the University of North Carolina at Chapel Hill requires that undergraduates purchase (not part of tuition) laptop computers that meet university-recommended specifications. The university offers a program of low-interest loans for the purchase of a notebook or other computers available from the student stores. This loan covers one personal computer, a printer, standard productivity and utilities software,

mouse, network cables, surge protector, carrying case, and security cable up to a maximum of \$3,500 total with a minimum loan of \$500. The North Carolina State Education Assistance Authority provides funds for the loans.

🌐 For more information see: <http://www.unc.edu/cci/faq/index.shtml>.

## Additional Aid from Grants

State grants can be a source of technology program funding for universities, to aid students in the purchase or lease of a notebook or Tablet PC. A few state university systems have received technology grants to provide computers to students, or to contribute to the initial phases of technology implementation. For example, the North Dakota University System receives a grant from the state legislature to ensure technology is current on all North Dakota State University campuses. The Legislative Assembly for technology improvement has allocated more than \$25 million to the State Board of Higher Education from the state budget general fund. The State Board of Education determines which technology initiatives receive funds, with preset appropriations for the On-line Dakota Information Network, the Higher Ed Computer Network, and the Interactive Video Network.<sup>45</sup>

Grants will rarely cover permanent and ongoing costs of any technology initiative. In most cases, universities use grant money for the following areas of technology implementation:

- Purchasing a limited number of notebooks for students to rent from the library.
- Contributing to lowering the cost of purchase for students when using a notebook becomes a requirement.
- Aiding in technology program development.

In Texas, the Telecommunications Infrastructure Fund provided \$74,929 for “telecommunications initiatives and distance learning projects in schools, libraries and hospitals” throughout the state. To make laptops available to students at the University of Texas at Tyler, the Tyler Robert R. Muntz Library applied for and was awarded the Telecommunications Infrastructure Fund, which enabled the university to purchase the computers, install a wireless network, and amp up other technology-related services.<sup>46</sup>

In California, a lottery grant<sup>47</sup> awarded to San Jose State University enabled them to develop the Wireless Laptop Pilot Project. Once awarded, the executive committee of the academic senate makes a recommendation to the president of the university and requests departments to submit proposals. The School of Art and Design, the College of Education, and the School of Journalism and Mass Communication received funding. Those departments then collaborated with Academic Technology in the planning and implementation stages. Upon implementing the technology plans, each department’s faculty sets the requirements and expectations for students. If owning a laptop becomes a mandate, every faculty member in a department must approve the measure. Mary Jo Gorney-Moreno, associate vice-presi-

dent for academic technology, reports that portable computer availability and the Wireless Laptop Pilot Project have resulted in:

- Increased student productivity
- Higher quality in student work
- Quicker and deeper learning
- Research and learning environmental freedom

Mary Fran Breiling, Director of the Wireless Laptop Project, believes one major benefit of the initiative is that students can use their laptops to access research tools, databases, their own documents and hard drive in the environment of their choice — they do not have to be transported to an artificial environment.<sup>48</sup>

🌐 For more information on this Wireless Laptop Project, see <http://www.sjsu.edu/wireless>.

## Resources for Grants

Many resources, including education grants databases, are available online. See these resources for higher education and technology grant information:

- Technology Innovation Challenge Grant Program  
<http://www.ed.gov/programs/techinnov/index.html>
- SMARTer Kids Foundation  
<http://www.smarterkids.org/hed/index.asp>
- Higher Education Resource Hub  
<http://www.higher-ed.org/>

## Alternative Funding Sources

Minnesota State University, Mankato (MSU) took a creative approach to pooling resources. Two agencies shared a common desire for technology improvement; they were simultaneously planning technology initiatives and investigating funding for such implementations. The College of Business and the Student Technology Committee combined their resources and focused their efforts to bring campus technology current and provide the students with the anytime access a college education and environment demands. Initially, the College of Business was pursuing a laptop requirement for in-class time, while the Student Technology Committee was trying to move MSU into wireless reality. The combined efforts also paid off in equipment donations.

To fund their project, the two agencies pooled monies from various sources, including large donations from alumni, the Student Senate Association, the Information and Technical Services office, and a laptop lease program. Students who brought their own laptops paid \$250 per semester for help desk support and infrastructure enhancement.<sup>49</sup>

University endowments and donations may also offer alternative approaches to financing a computing initiative.

## Insurance Considerations

For institution-owned equipment leased to students, institutions have found ways to communicate clearly to students about insurance and damage or theft and a cost-recovery strategy. For example, at Buena Vista University, computers are insured against loss and theft with a \$500 deductible for which students are responsible. If equipment is damaged, students are responsible for all repair costs not covered under the warranty. Some universities recommend that students cover their computer under a homeowner's insurance policy, which may cover the deductible.

For example, at St. John's University, the deductible is \$250 for damage and \$400 for the first loss or theft and \$1,000 for the second. A \$1,500 charge is required at registration and held until the student returns the laptop. At Wake Forest, there is a \$1,000 deductible for theft and \$250 for all other losses.



## Summary — The Value of Initiatives

The benefits of one-to-one initiatives are far reaching and savings are possible. For example, one-to-one mandates:

- Increase retention of students and faculty and improve recruitment rates.
- Prepare students to be better qualified in the workplace.
- Increase the quality of the learning experience and thereby engage students in their own motivation to learn.
- Reduce or in some cases eliminate the need for on-site computer labs.
- Provide access and communications anywhere, anytime.

Given the increasing aptitude of today's college students, who were raised with technology, leaders in higher education must also look ahead to the next wave of technically savvy students currently using one-to-one programs in K-12 schools across the country.

Today's students are more autonomous, they require that higher education has a real-life benefit and that their time is spent wisely. Mobile learning programs can help satisfy that need. Perhaps the important question is what would be the cost of *not* providing universal access and one-to-one computing at institutes of higher learning?<sup>50</sup>

The top  
deciding factors  
in selecting a  
vendor and  
technology were  
durability, price  
and accidental  
damage protection.

— Center for Digital  
Education research

# Section 5. Additional Resources

## Organizations and Centers

U.S. DEPARTMENT OF EDUCATION (US DOE) <http://www.ed.gov>

U.S. DEPARTMENT OF LABOR (US DOL) <http://www.dol.gov/>

U.S. DEPARTMENT OF LABOR BUREAU OF LABOR STATISTICS  
<http://stats.bls.gov/home.htm>

## Publications

Student Laptop Mandates, Creating the Competitive Campus.

See <http://www.centerdigitaled.com/reports.php>

Microsoft Corporation. “Anytime, Anywhere Learning.” (March 2005).

See <http://www.microsoft.com/education>

## Grants

Technology Innovation Challenge Grant Program

<http://www.ed.gov/programs/techinnov/index.html>

SMARTer Kids Foundation

<http://www.smarterkids.org/hed/index.asp>

Higher Education Resource Hub

<http://www.higher-ed.org/>

The NEA Foundation – “For the improvement of education”: <http://www.neafoundation.org/programs/howtoapply.htm>

SEIR\*TEC Grants and Funding Page (SEIR\*TEC = SouthEast Initiatives Regional Technology in Education Consortium) (For Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina only) <http://www.seirtec.org/grants.html>

The Technology Education Lab. “Preparing Minds for the 21st Century” - Grants and Funding page: <http://www.techedlab.com/grant-funding.html>

<sup>1</sup> The late Mark Weiser at Xerox Palo Alto Research Center first used the term “ubiquitous computing” to describe a vision of future technology that would always be available, often monitoring or anticipating the user’s needs, even when the user was not explicitly aware of the technology. This definition of “ubiquitous computing” is used by the Ubiquitous Computing Evaluation Consortium in a report by Keefe and Zucker entitled “Ubiquitous Computing Projects: A Brief History,” Ubiquitous Computing Evaluation Consortium, SRI International, April 2003. <http://ubiqcomputing.org/Overview.pdf>

<sup>2</sup> Internet2® is a consortium being led by 206 universities working in partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow’s Internet. Internet2 is recreating the partnership among academia, industry and government that fostered today’s Internet in its infancy. The primary goals of Internet2 are to:

- Create a leading edge network capability for the national research community
- Enable revolutionary Internet applications
- Ensure the rapid transfer of new network services and applications to the broader Internet community.

<http://www.internet2.edu/>

<sup>3</sup> Paul Arabasz, IDC, and Judith Pirani, Sheep Pond Associates, *Wireless Networking in Higher Education* (Boulder CO: Educause Center for Applied Research, Vol. 2, 2002). This study provides an analysis based upon responses from nearly 400 colleges and universities in the United States and Canada conducted in December, 2001, and is supplemented by six case studies.

<http://www.educause.edu/ir/library/pdf/ers0202/rs/ers0202w.pdf>

<sup>4</sup> Katie Zezima, “At Dartmouth, Advanced Wi-Fi,” *The New York Times*, May 4, 2005. <http://www.nytimes.com/2005/05/04/technology/techspecial/04zezima.html?ei=5088&en=163c1497441a33bf&ex=1272859200&adxnln=1&partner=rssnyt&emc=rss&adxnlnx=1116909523-HUrvEnbW4j8LjPsvuJTRmQ>

<sup>5</sup> *Dartmouth News*, February 28, 2001. <http://www.dartmouth.edu/-news/releases/2001/feb01/wireless.html>

<sup>6</sup> National Science Board, *Science and Engineering Indicators 2004*. Chapter 3 addresses the science and engineering labor force. <http://www.nsf.gov/statistics/seind04/c3/c3r.htm>

<sup>7</sup> National Science Board, *Science and Engineering Indicators 2004*. Chapter 3 addresses the science and engineering labor force. The full chart showing the relative positions of 19 nations in 1975 as compared to 2000 can be examined at: <http://www.nsf.gov/statistics/seind04/c2/fig02-34.htm>. The United States ranked fifteenth among these nations in the portion of its 24-year olds holding degrees in natural sciences and engineering.

<sup>8</sup> The National Science Board report is quoted in “America’s Failure in Science Education,” by William C. Symonds, *Business Week Online*, March 16, 2004. [http://www.businessweek.com/technology/content/mar2004/tc20040316\\_0601\\_rc166.htm](http://www.businessweek.com/technology/content/mar2004/tc20040316_0601_rc166.htm)

<sup>9</sup> *The Horizon Report 2005 Edition* is a joint publication of the New Media Consortium (NMC) and the National Learning Infrastructure Initiative (NLII), an EDUCAUSE Program, and made possible through a grant from the McGraw-Hill Companies. This second edition of the NMC’s annual Horizon Report describes the continued work of the Horizon Project, “a research-oriented effort that seeks to identify and describe emerging technologies likely to have a large impact on teaching, learning, or creative expression within higher education.” [http://www.newmediacenter.org/pdf/2005\\_Horizon\\_Report.pdf](http://www.newmediacenter.org/pdf/2005_Horizon_Report.pdf)

<sup>10</sup> Mark Resmer, Diana Oblinger, and James R. Mingle, “Computers for All Students: A Strategy for Universal Access to Information Resources,” State Higher Education Executive Officers, November 1995. <http://www.educause.edu/ir/library/html/nli0008.html>

<sup>11</sup> James Efaw, et. al., “Miracle or Menace: Teaching and Learning with Laptop Computers in the Classroom: A study of integrating laptops into classroom instruction found statistically significant improvements in student learning,” *Educause Quarterly*, 27.3, 2004.

<sup>12</sup> James Efaw, et. al., <http://www.educause.edu/apps/eq/eqm04/eqm0431.asp>

<sup>13</sup> *Student Engagement: Pathways to Collegiate Success*, 2004 Annual Survey Results, National Survey of Student Engagement, Center for Postsecondary Research, Indiana University, Bloomington, School of Education, Eigemann Hall, Suite 419, 1900 E. 10th Street, Bloomington, IN 47406.

<http://www.indiana.edu/~nsse/html/report-2004.shtml>

[http://www.indiana.edu/~nsse/2004\\_annual\\_report/pdf/annual\\_report.pdf](http://www.indiana.edu/~nsse/2004_annual_report/pdf/annual_report.pdf)

<sup>14</sup> Microsoft, “Massachusetts Institute of Technology (MIT) Changes the Face of Education Using Tablet PCs,” November 2002. <http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=13513>

<sup>15</sup> Microsoft Corporation. "University of Vermont Gives Business Students Real-World Technology Experience." Microsoft Office System customer Solution Case Study (May 2005). <http://www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=16829>

<sup>16</sup> Mayville State University case study. <http://www.gateway.com/work/ed/hi-ed/success.shtml>

<sup>17</sup> Winona State University case study. <http://www.gateway.com/work/ed/hi-ed/success.shtml>

<sup>18</sup> Winona State University *News/Events*. "WSU-Gateway-Microsoft Announce Tablet PC Partnership" (June 17, 2004). <http://www.winona.edu/newsmanager/anmviewer.asp?a=969&z21>

<sup>19</sup> Dakota State University. <http://www.dsu.edu/WMCI/presidentmessage.htm>

<sup>20</sup> Albany College of Pharmacy. <http://www.acp.edu>

<sup>21</sup> Colorado Technical University. <http://www.ctusioxfalls.com>

<sup>22</sup> Seton Hall University, Mobile Computing Program. <http://technology.shu.edu/page/Mobile+Computing+Program!OpenDocument>

<sup>23</sup> The University of North Carolina at Chapel Hill, Carolina Computing Initiative. <http://www.unc.edu/ci/milestones/about.html>

<sup>24</sup> "Chapel Hill Seeks Best Role for Students' Laptops," the *Chronicle of Higher Education*, September 21, 2001. <http://chronicle.com/free/v48/i04/04a03101.htm>

<sup>25</sup> Wake Forest University, Computer-Enhance Learning Initiative. <http://www.wfu.edu/organizations/CELI/>

<sup>26</sup> Buena Vista University, *The eBYou Plan*. <http://www.bvu.edu/~ebvyou/about.htm>. Also see [http://www.gateway.com/work/pdf/edu/HED\\_white\\_paper.pdf](http://www.gateway.com/work/pdf/edu/HED_white_paper.pdf).

<sup>27</sup> "Wireless Ripples," *Converge*, March 2001. [http://www.bvu.edu/~ebvyou/news\\_converge.htm](http://www.bvu.edu/~ebvyou/news_converge.htm)

<sup>28</sup> Drexel University, *Information Resources and Technology, A Guide for Faculty and Staff* (September 2003). The Office of Information Resources and Technology. [http://www.drexel.edu/IRT/services/faculty%20guide/guide\\_03.html](http://www.drexel.edu/IRT/services/faculty%20guide/guide_03.html)

<sup>29</sup> The University of Vermont, School of Business Administration, Mobile Computing Requirement. <http://www.bsad.uvm.edu/Admissions/FAQs/MobileComputingFAQ.htm>

<sup>30</sup> University of Minnesota at Crookston, Laptop U Program. <http://www.crk.umn.edu/technology/laptopu/benefits.htm>

<sup>31</sup> Framingham State College, Laptop Program [http://www.framingham.edu/wireless/wireless\\_project.htm](http://www.framingham.edu/wireless/wireless_project.htm)

<sup>32</sup> Framingham State College, Laptop Program Why Laptops? [http://www.framingham.edu/wireless/why\\_laptops.htm](http://www.framingham.edu/wireless/why_laptops.htm)

<sup>33</sup> Schworm, Peter, "Framingham State puts paperless classes to test," *Boston Globe*, December 28, 2004. [http://www.boston.com/news/education/higher/articles/2004/12/28/framingham\\_state\\_puts\\_paperless\\_classes\\_to\\_test/>>\(+accessdate\)](http://www.boston.com/news/education/higher/articles/2004/12/28/framingham_state_puts_paperless_classes_to_test/>>(+accessdate))

<sup>34</sup> EDUCAUSE Center for Applied Research, ECAR Respondent Summary: *Wireless Networking in Higher Education in the U.S. and Canada* (Boulder CO: EDUCAUSE Center for Applied Research, Vol. 2, 2002). This study provides an analysis based upon responses from nearly 400 colleges and universities in the United States and Canada conducted in December, 2001, and is supplemented by six case studies. <http://www.educause.edu/ir/library/pdf/ERS0202/ekf0202.pdf>

<sup>35</sup> A. Pirani and Gail Salaway, et. al., *Information Technology Networking in Higher Education: Campus Commodity and Competitive Differentiator* (2005). The research is based on survey responses from 517 chief information officers and network directors in higher education, qualitative interviews with 12 higher education leaders about their view of the future of IT networking in higher education, and three in-depth case studies involving four U.S. institutions and SURF, a Dutch higher education and research partnership. Findings at: [http://www.educause.edu/ir/library/pdf/ecar\\_so/ers/ERS0502/ekf0502.pdf](http://www.educause.edu/ir/library/pdf/ecar_so/ers/ERS0502/ekf0502.pdf).

<sup>36</sup> EDUCAUSE Center for Applied Research (ECAR) press release, February 8, 2005. <http://www.educause.edu/PressReleases/1190&ID=1167>

<sup>37</sup> Jocelyn Young, *Schools Elevate Student Learning Experience Through Wireless Technology*, An IDC White Paper Sponsored by Gateway® (2003). [http://www.gateway.com/work/docs/edu/gtw\\_ed\\_paper\\_072303.pdf?cmlid=work/ed/k12/success.shtml](http://www.gateway.com/work/docs/edu/gtw_ed_paper_072303.pdf?cmlid=work/ed/k12/success.shtml)

<sup>38</sup> Study results from Winona State University, presented by Scott Kennedy, Productivity Advisor, Microsoft Corporation. (June 2005).

<sup>39</sup> Although many authors use the term "a learning organization," our use reflects our understanding of the term as described by Peter W. Senge, et al., *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization* (New York: Doubleday 1994).

<sup>40</sup> Center for Digital Education, *Student Laptop Mandates, Creating the Competitive Campus*. This report is available online: <http://www.centerdigitaled.com/reports.php> or at [http://www.gateway.com/work/pdf/edu/HED\\_white\\_paper.pdf](http://www.gateway.com/work/pdf/edu/HED_white_paper.pdf).

<sup>41</sup> ECAR *Study of Students and Informational Technology*, 2004. [http://www.educause.edu/ir/library/pdf/ecar\\_so/ers/ers0405/Ekf0405.pdf](http://www.educause.edu/ir/library/pdf/ecar_so/ers/ers0405/Ekf0405.pdf)

<sup>42</sup> EDUCAUSE Center of Applied Research (ECAR). *Information Technology Networking in Higher Education: Campus Commodity and Competitive Differentiator*, February 2005. Judith A. Pirani and Gail Salaway with Richard N. Katz and John Voloudakis. This ECAR research study is designed to illuminate a host of current network management practices related to IT in higher education; opportunities for connectivity to external networks; the institutional context of organization, leadership, and management; current and emerging technologies and converged networks; and the future of networking. See <http://www.educause.edu/LibraryDetailPage/666?ID=ERS0502>.

<sup>43</sup> Intel® Higher Education Program <http://www.intel.com/education/highered/index.htm>

<sup>44</sup> Colorado State University, College of Business. <http://www.biz.colostate.edu/ugrad/laptopPro.htm>

<sup>45</sup> To view this part of the North Dakota state budget, see the pdf at <http://www.state.nd.us/lr/fiscal/biennium-reports/58-2003/budget-analysis/interim/pdf/215comply.pdf>.

<sup>46</sup> To read more about how the University of Texas used the state grant to increase technology access on campus, see their press release at <http://www.uttyler.edu/News/pressrelease/2002/sept9b02.htm>. Also visit <http://www.uttyler.edu>.

<sup>47</sup> The California State University (CSU) System awards funding to each campus. The grant is not substantial enough to fund a university-wide initiative, so each campus decides which departments will be awarded funding.

<sup>48</sup> For more information on the Wireless Laptop Pilot Project, visit [www.sjsu.edu/wireless](http://www.sjsu.edu/wireless).

<sup>49</sup> For details on the Minnesota State University technology plan and implementation process and for information about a small scholarship program to increase student interest in and help students afford laptops, see <http://krypton.mnsu.edu/~wayne/MyPublications/ImplementingWireless.htm>.

<sup>50</sup> Professor Ted Smith, *Ubiquitous Computing in Higher Education* (page 17), a survey published by the Observatory on Borderless Higher Education (October 2003) <http://www.ulster.ac.uk/academicoffice/download/T&L/8Dec2004/ubiquitous-obhe.pdf>

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