

21st Century Campus

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Executive Summary

Colleges and universities have one overarching goal: to teach students in a way that increases comprehension and retention, resulting in a more effective learning experience. And most are finding that, through technology, they can achieve that goal.

With the help of technology, higher education institutions are rethinking the concept of the classroom, implementing tools that allow for collaboration, peer-to-peer learning and experiential learning.

The tools exist today, and they are only getting better. Even as advances continue to be made, many universities and colleges have taken bold steps toward implementing their vision, with stunning results.



Outfitting a 21st Century Classroom

The 21st century classroom may include some or all of the following:

- Interactive whiteboards
- Videoconferencing technology
- Streaming video
- VCR, DVD and CD players
- LCD monitors
- High-definition TVs
- Dual or triple projection systems
- High-resolution document cameras
- Video and slide projectors
- Audio amplifier
- Audience response system
- Advanced switching and external interfaces
- Multiple data ports
- Wireless microphones
- Modular furniture

Technology as the Enabler

No longer are college classrooms the static, blackboard-driven rooms they were just 10 years ago. Today, many colleges and universities are implementing wireless technology, electronic whiteboards, mounted projectors, and advanced printers and cameras into the classroom environment, with the goal of creating a better learning experience.

It's really that goal — creating a better learning experience — that is propelling "smart" classroom initiatives forward. University presidents and CIOs have realized that focusing on the triumvirate of interactivity, flexibility and integration, instructors will be more effective in imparting knowledge and students will retain that knowledge better.

University leaders also know that technology is the enabler that will create the 21st century learning experience. By implementing the right combination of technology, students will have a much richer learning experience, while instructors will have more tools at their disposal to create an interesting, effective learning environment.

No two "smart" classrooms are alike; depending on the subject being taught, the preferences of the instructor, the school's budget and other factors, some classrooms are "smarter" than others. For example, one classroom might have a simple video projector, wireless microphone, and computer and network access, while another might have the full complement: full audio and video capabilities, a "smart" podium, electronic whiteboard, videoconferencing, cameras and software designed to integrate the learning experience.

The Pace of Implementation

Although all colleges and universities want as many "smart" classrooms as possible, budgets don't often allow across-the-board implementation. Instead, many institutions are choosing a phased approach based on a variety of factors, including department and ease of implementation.

Departments that have courses requiring a multidisciplinary approach, or research-intensive curriculums that make extensive use of technology, are often the first to get "smart" classrooms. On other campuses, CIOs or IT managers choose a handful of classrooms as testbeds, using them to test different types of equipment in a small number of classrooms before attempting a more full-scale implementation.

Another factor determining the pace of implementation is the building itself. It's much less expensive and easier to build smart technology into new construction than retrofitting older classrooms, which often involve unforeseen obstacles, such as asbestos removal. But the growing ubiquity of wireless networking has made even retrofitting older classrooms much faster and less expensive than even a few years ago, while keeping the historical integrity of the building intact.

The 21st Century Classroom

When it comes to the classroom of the future, technology is the catalyst. Wireless technology was a huge breakthrough, and coupled with innovative hardware, software, interactive technology of all types and a huge dose of ingenuity, progress continues to move forward.

“Technology isn’t the goal of the 21st century classroom, but it’s definitely the enabler,” says Nicole Engelbert, lead analyst for vertical markets technology at Datamonitor Inc., a New York-based market research firm. “Technology is enabling the kind of creativity and interactivity that really engages students, thereby dramatically improving the teaching and learning process.”

These are the technologies that are making the 21st century classroom a reality:

Wireless

Without wireless technology, the 21st century classroom would be difficult, if not impossible, to achieve. Wireless technology makes older classrooms easier and less expensive to retrofit, and allows instructors to teach from every corner of the room. The burgeoning 802.11n standard, which promises even greater speed, will spur more universities to create more “smart” classrooms.

Hardware

- LCD screens
- Projectors
- Document cameras
- Printers
- Mobile carts

Interactive Technology

- Electronic podiums/touchscreens (Promethean’s ActivPanel, Numonics). Images from a PC are projected onto a screen. Instructor’s annotations using a pen are displayed on the screen. Allows teachers to maintain eye contact with students.
- Interactive whiteboards (Hitachi, Panasonic, Promethean). Creates a more interactive teaching and learning experience.
- Student response systems (Promethean’s ActiVote, RM 2KNOW). Wireless handheld voting devices with accompanying software, allowing students to quickly respond to polling questions or quizzes.

Software

- Classroom management software (Altiris Vision). Allows instructors to conduct online quizzes and polling in real-time, block IM applications to specific websites, blank students’ screens, and more.
- Lecture capture software (TechSmith Camtasia Relay). Records and automatically distributes lectures and presentations. Viewers can access video online, via a learning management system, or on peripheral devices, such as iPods.

Five Ways to Use Tech Tools

Advice for colleges and universities on implementing technology includes:

1. Map out a technology plan. A systematic approach helps a college or university stay on track and avoid wasting dollars. Building the right platform from the start can provide the flexibility and scalability required for future growth.
2. Look for ways to maximize your budget. Use open source code and systems when appropriate, and purchase items through preferred manufacturers in order to obtain volume discounts.
3. Identify opportunities to improve processes. Technology alone cannot drive improvement. Educators must revamp the way they teach and handle workloads. And security controls, including authentication and encryption, must stay at the forefront.
4. Provide training. New technologies, including Wi-Fi, electronic whiteboards and personal digital assistants, require training in order to provide a maximum return on investment.
5. Work with partners. A strong relationship with a supplier or integration partner can pay huge dividends. An institution can tap into the partner’s technical expertise without paying large fees to consultants.

What's Next

Keeping tabs on the latest trends and trying to identify worthwhile experiments before they become commonplace is all in a day's work for a higher education CIO.

According to The Future of Learning Technology from the Alliance for Higher Education Competitiveness, these areas will become mainstream in the next seven years:

- Tools to help students work productively, such as improved note-taking systems, collaboration applications for working with other students and faculty, and online search functions for academic content
- Pedagogical tools to help faculty members easily create online lesson plans and study guides
- Hybrid programs that merge classroom and online learning environments
- Online assessment tools that link students, faculty and administration

The Vision: Interactivity, Integration & Flexibility

Interactivity. Unlike the college classrooms of the last century, today's colleges and universities strive to make learning an interactive process. That means greater student-instructor and student-student interaction and fewer formal presentations. "The goal," according to Mike Schmedlen, education industry executive at Lenovo, "is to engage students more fully in the hopes of increasing engagement, comprehension and participation. Technology-enabled learning environments also provide a platform for more individualized and, therefore, more relevant and contextualized learning."

The technology that fosters interaction can take several forms. Many innovative classrooms today use electronic podiums or touchscreens, where images from a PC, along with instructors' annotations, are projected onto a screen. Often, this is achieved by connecting an LCD mini-board or tablet monitor to a PC affixed to a podium. The electronic podium typically comes with hundreds or thousands of charts, images, shapes, annotations and other software-based capabilities.

"I haven't seen a technology take off like that in the market in a long time," Datamonitor's Engelbert says. "It moves away from the model of heads down frantically taking notes to students engaging with the instructor about the content."

That's definitely the case at Worcester Polytechnic Institute in Worcester, Mass., where interactive podium technology is becoming more and more ubiquitous. Because the university is technology-focused and many courses include complex equations and problem-solving, the ability for the faculty to annotate presentations, and save and redistribute documents is particularly valuable.

"It's great for faculty to be able to write out formulas and problems, let students see how they are created and solved step by step, and be able to review them after class," says Thomas J. Lynch III, vice president for information technology and WPI's CIO.

Another extremely popular interactive technology is the interactive whiteboard, a digital device with keyboard and mouse functionality, as well as character recognition, used for visual presentations. Connected to a PC, it generates images or data, which are then projected to the board.

Montgomery County Community College in Blue Bell, Pa., relies heavily on interactive whiteboard technology in more than 50 of the classrooms on its main campus, and in many classrooms on its second campus as well. The college began using the technology on a small scale in 2001, when recently retired mathematics instructor Roseanne Hofmann discovered them at a conference. Once other instructors saw the benefits, they began requesting them as well.

During the past several years, Hofmann discovered several valuable uses for the whiteboards, including integrating them with worksheets, PowerPoint presentations, Excel spreadsheets, flash learning objects, the Internet and calculator simulations. One of her most innovative uses was integrating the electronic whiteboard with TI SmartView, a calculator software tool.

"I could drag the calculator screen where I wanted it and embed it in my notes so the students would see which keys I pushed and what created the graph," she says. "It was especially helpful for students who missed something in class or for online students."

Another up-and-coming interactive technology is the student response system, which some educators refer to informally as "clickers." With this technology, students are outfitted with wireless handheld voting devices that allow instructors to capture student responses and export the results to other software, such as Microsoft Excel.

Hofmann also relied on student response technology at Montgomery County Community College, often using it to pose a question. "I would often use it as a barometer to find out if the students understood the concept, and I would know within seconds whether I needed to kick it down a notch," she says.

Integration. Technology is a great enabler, but little happens without integration. That means integrating all of the technologies used in a way that fosters interoperability and learning.

Hardware integration is one big trend — the ability to control all audio/visual devices from one source, such as a podium. That's happening today, according to Shari Sentlowitz, manager of government and education marketing at Sony Electronics.

Another important integration touch point is the content — the ability to receive rich content from various sources such as the Internet, cable TV

and radio, and have it delivered to the classroom and shown on LCD screens or projectors. That's also routinely done in today's college classrooms.

And more is on the way. Oracle, for example, recently launched its Enterprise Student Administration Integration Pack (SAIP), which helps integrate major vendor-supplied and open-source learning management systems with other technology in the learning environment. This type of progress is what will make the 21st century classroom truly effective, Datamonitor's Engelbert says. She predicts similar partnerships between manufacturer technologies in the near future.

Arizona State University is taking integration to an entirely new level with its Decision Theater, an interactive 3D environment with a 260-degree screen that can display panoramic computer graphics or 3D video content. It uses seven digital image projectors to beam stereo images onto seven high-definition screens to achieve the 260-image surround. The room, which can hold 25 people, also includes tools for collecting participant input and interaction

Flexibility. Tracy Gray, director of the National Center for Technology Innovation and managing research scientist at the American Institutes for Research in Washington, D.C., which tracks education trends, says more instructors are creating multimedia modules that they can expand, enhance with audio or video and post online to complement their course offerings. There's no such thing as a standard technology classroom setup, Gray says. However, universities are focused on purchasing hardware and software that will enable students to access technology everywhere on campus, from the classroom to their dorm room.

For today's universities, flexibility is key — flexibility to teach the way students learn, and to allow instructors to use whatever means necessary to get their messages across. In large part, that means staying away from one-size-fits-all classrooms and technology — things like desks bolted to the floor and displays built into desks. Instead, the trend is toward modular furniture, movable hardware, and configurable technology of all types.

It even extends to things that were unimaginable even a few years ago, such as dual-screen projection, which allows instructors to project questions or illustrations on one screen while showing Internet activity or a PowerPoint on another screen. In the sound arena, it might mean providing ambient miking throughout the

classroom, freeing the instructor from wearing a lapel microphone or changing batteries, and improving sound quality for lecture recording.

The University of California at Riverside is perhaps the poster child for flexibility with its Hyperstruction Studio, a learning facility that is configurable and flexible in every possible way. Flexibility was extremely important in the concept of the room, which encourages active and participative learning, peer-to-peer learning and team-based learning, according to Dr. Leo Schouest of the Academic Computing division at UC Riverside.

For example, the studio, which holds 24 students, has flexible, modular furniture that can be arranged in various groupings and face any direction. Each of the four walls can be configured differently; perhaps one has a whiteboard, another projects images from a screen, and so on. Technologies run the gamut from a dual projection system, a mobile interactive whiteboard, a networked computer with wireless peripherals, a high-resolution document camera, an audience response system, advanced switching and external interfaces for additional computers, multiple data ports and videoconferencing.

Flexibility also means enabling learning outside the classroom. Arizona State University, for example, takes advantage of the fact that students today are armed with sophisticated technology by offering a suite of 250 web-delivered applications, which students can access without installing.

Security in the 21st Century Classroom

On most college campuses, classrooms are used by various classes and instructors during the course of the day. The state-of-the-art classroom includes a host of expensive equipment, often left in open classrooms at several points during a typical day.

To thwart those who might seek to remove expensive equipment, universities should put together a comprehensive plan, says Stephanie Atkinson, a managing partner at Compass Intelligence, a market research firm in Scottsdale, Ariz. Atkinson recommends implementing a plan to have instructors check out and return specific equipment.

All universities and colleges should take these steps:

- Implement and publicize a policy for equipment security that includes how to check out equipment and spells out the responsibilities of both instructors and the IT department.
- Implement monitoring technology, such as surveillance cameras, in classrooms.
- Consider having staff ID cards programmed to open doors to classrooms housing expensive equipment or give appropriate staff security codes.
- Don't forget the basics, such as simple cable locks on equipment.

Learning Management Systems

Spending by U.S. higher education institutions on Learning Management Systems to 2012 (U.S. \$millions)

2006: \$202.4

2007: \$215.6

2008: \$235.6

2009: \$263.3

2010: \$287.6

2011: \$311.0

2012: \$334.9

CAGR: 9.2%

SOURCE: Datamonitor

From Vision to Reality

The 21st century classroom clearly has myriad benefits both for students and instructors, but some obstacles still remain.

Cost is a significant barrier for many universities. Not only is the cost of the technology itself somewhat prohibitive, but installation costs, along with the expense of retrofitting existing buildings, can be high. Wirelessly enabling campus buildings has gone a long way toward reducing installation and retrofitting costs, as have the student technology fees many universities now charge students each semester.

For some universities, the answer is adopting a slow but steady installation pace. WPI, for example, is committed to outfitting about 100 classrooms a year, and the process is almost complete. Today, about 95 percent of WPI's classrooms are equipped with projector screens, computers and other basics. As the technology replacement cycle is reached, the university slowly replaces older equipment with newer technology.

For Arizona State University, the solution was defining a base set of technologies the university could standardize on for each classroom and committing to finishing that installation before moving on to more ambitious setups.

"We've defined the technologies, through trial and error, that will give the university and our students the best bang for the buck, and we have spent the last two years getting each classroom to that level," says Adrian Sannier, technology officer of Arizona State University. "For us, that means wireless connectivity, a projector and sound system."

Acceptance, along with ease of use, is another barrier, more for instructors than students. It's as much of a technology issue as a cultural

issue; instructors have been teaching the same way for dozens of years and are comfortable with the status quo. The answer is two-fold: making sure technology is as interoperable as possible, and providing adequate training for instructors, says Stephanie Atkinson, principal analyst at Compass Intelligence, a market analytics firm based in Scottsdale, Ariz.

Although interoperability has come a long way — more manufacturers are developing technology that use standards-based protocols and interface devices — there is more work to be done. But it's getting done, in the form of three up-and-coming standards: WiMAX, a broadband wireless access standard; 802.11n, a wireless networking infrastructure standard; and display ports, the next-generation high-definition video port. Display ports will provide commonality between legacy audio-visual devices such as TVs and high-definition video and displays common on PCs, explains Lenovo's Schmedlen.

"Two emerging technologies, DisplayPort and ultra-wide band (UWB), will help enable the advanced learning environments by providing seamless, standard connectivity between audio-visual devices such as projectors, interactive whiteboards and other technology assets in the classroom. Many notebooks now ship standard with these technologies," he says.

Bandwidth can be another barrier; new technology often is bandwidth-intensive, and many campuses are having trouble keeping up. According to Compass Intelligence, many colleges and universities are experiencing a doubling to tripling of bandwidth needs each year.

To keep pace, Atkinson says many higher education institutions will be replacing Wi-Fi technology with WiMAX and LTE, two mobile broadband technologies that offer more campuswide connectivity and can handle higher bandwidth rates.

The Classroom of the Future: Here Today?

Technology continues to move forward, with small but important advances, such as better battery technology and new types of collaborative learning tools.

By the year 2020, it's very likely that the typical college classroom will look nothing like today's. There won't necessarily be a front of the room where the instructor presents information. The norm may be an interactive, touch-sensitive, wireless slate. All information will archive back to central repositories for recall at any time. Conversations across the room will be as simple as conversations with students in other countries.

WPI's Lynch envisions an environment where students can interact even more with content during class or labs. In general, he sees a bigger focus on collaboration, immediate feedback and peer learning. The classroom will be used mainly to experience learning — not take notes, he says. To do that, he expects that many courses will include virtual reality environments.

"A lot of the information push that goes on today inside the classroom will start happening outside the classroom," he says. "Students will learn the fundamentals outside the classroom, through technology like intelligent tutoring software, and save classroom time for more experiential learning."

Mobile technology and video also will take a larger role, Atkinson believes. Students may use smartphones with targeted educational applications. Students may be able to sit at their desks looking at course material, text the professor questions, and access a social network to discuss the topic with other students.

The influence of YouTube and the Internet in general will make streaming video more important. As bandwidth becomes easier to come by, professors will take advantage by relying more on podcasts and videocasts, she predicts.

Much of this will be possible because the rate of change is likely to escalate, Datamonitor's Engelbert says. "We're seeing more interesting partnerships between vendors, as well as more service offerings that are bringing down cost barriers for collaboration. All of this will get things moving faster in general."

Funding Tech Infusions

Since 1997, Louisiana State University in Baton Rouge has charged students a \$5 technology fee per credit hour, up to \$75 a semester. In 2007, it collected almost \$4 million. While other schools do the same, at LSU, the student technology fee oversight committee decides how to spend it.

The LSU committee is composed of 10 people. Six are students who either belong to or are appointed by the student government association and graduate student association. The others include the school's vice chancellor of finance and administrative services, vice provost of academic affairs, vice chancellor of information technology and a faculty member who's appointed by the faculty senate.

