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CAMPUS TECHNOLOGY

Empowering the World of Higher Education

February 2012

THE NEW NORMAL

In an era of budget cuts, CIOs must reset expectations of what IT can handle—and rebrand IT as an efficiency expert. p. 30

+ TAKING HOMEGROWN PRODUCTS OPEN SOURCE AND BEYOND

3D, OR NOT TO BE?

SMARTPHONES: TEACHING TOOL OR BRAIN CANDY?

campustechnology.com Volume 25 Number 6

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Cover illustration by Alison Seiffer

Features

Enter by Feb. 15: Campus Technology Innovators Awards. See page 29.

Groundhog Day

When it comes to IT budgets, the "new normal" is looking a lot like the "same old, same old."

The sound of wailing and the gnashing of teeth mean it's budget time again. For many CIOs, it's like a scene out of *Groundhog Day*, where Bill Murray wakes each morning to find that he is stuck in the same day. Budgets have declined or been flat for four years. And Casey Green, director of the Campus Computing Project, doesn't expect improvement this year either. It's enough to make the strongest CIO follow Punxsutawney Phil's lead and hibernate for six more weeks.

Lying low is the wrong approach, though. In fact, the budget crisis rocking higher ed is the perfect time for IT executives to raise their visibility on campus and reposition their organization. As Dian Schaffhauser details in our cover story, "Succeeding in the New Normal," enterprising IT execs are shifting the conversation away from IT as a cost center to a new perception of the organization as a money-saving efficiency expert.

Departments in every corner of higher ed institutions are under the cosh to trim budgets, and IT is perfectly positioned to provide them with tech solutions that can both save money and increase productivity. Budget pressures are convincing even the most die-hard traditionalists that it's time to try something new.

Cocooned in our tech community, we forget just how rooted employees can be in processes that date back decades. A friend of mine recently joined an educational institution to help with payroll. Her supervisor still maintains her contacts on a Rolodex and prints every e-mail for her files.

While today's current budget woes may make such employees more receptive to change, it's probably not enough to clinch the deal. To succeed, IT leaders need to build a *quantifiable* track record that can convince naysayers and make supporters of top administrators on campus. And then they need to broadcast their successes from the rooftops. Nothing is more persuasive than success.

CIOs are obviously looking at improving the efficiency of their own organizations, too. How many IT groups today have lost employees? In the same cover story, Tim Chester, CIO of the University of Georgia, gives some good advice: "The most important decisions that IT leaders make in this day and age are what you choose not to do." Trimming IT's catalog of services is a first step in dealing with anemic operational budgets.

But IT shops are also coming up with innovative ways to secure additional resources. In "Means of Production," David Raths explores the possibilities of distributing homegrown products—commercially or via open source. By going open source, under-resourced IT groups can gain access to a broad development community to help improve their product. By going the commercial route, universities can raise sorely needed revenues. Either way, IT groups are showing that it doesn't have to be the "same old, same old." From the winter of our discontent come the first signs of spring. Just ask Phil. CT

—Andrew Barbour, executive editor
abarbour@1105media.com

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Community Colleges and STEM Education: A National Mandate
What community college students need to know as they prepare for careers in science, technology, engineering, or math.

Discover What's Possible: Universal LMS Integration of McGraw-Hill Digital Resources
What the **SUNY system** did to provide its students with an expanded library of teaching and learning resources.

Trending Articles on *CT*

- **Higher Ed Tech Trends for 2012**
  campustechnology.com/0112_techtrends
- **California Wants to Legislate Use of Digital College Textbooks**
  campustechnology.com/1212_etext
- **6 Ingredients for the 21st Century Classroom**
  campustechnology.com/0112_ingredients

Features

Rethinking the Community College Classroom Experience
Funded by a $2 million grant, a digital learning studio at **Santa Monica College** (CA) is engaging students in new ways. The goal is to strengthen the school's minorities program through the use of experimental technologies.
campustechnology.com/0112_community

For Mobile Strategies, Open Source Offers Flexibility
A desire for flexibility—as well as cost-savings—is prompting more and more higher ed institutions to consider open source for their mobile strategies.
campustechnology.com/0112_openmobile

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Events Calendar

Feb 12 - 17
The Data Warehousing Institute
World Conference: Data Strategy for Your Enterprise
tdwi.org
Las Vegas

Mar 4 - 7
League for Innovation in the Community College
Innovations 2012
league.org/innovations
Philadelphia

Mar 12 - 15
SANS
Mobile Device Security Summit 2012
sans.org/info/94399
Nashville

Mar 28 - 29
Customer Engagement Technology World
cetworld.com
San Francisco

Apr. 30 - May 2
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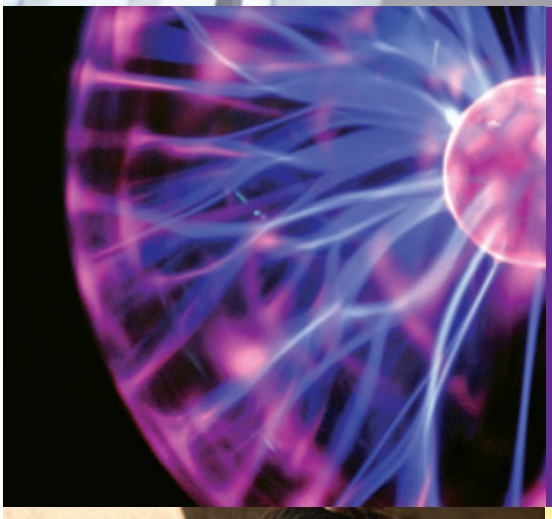

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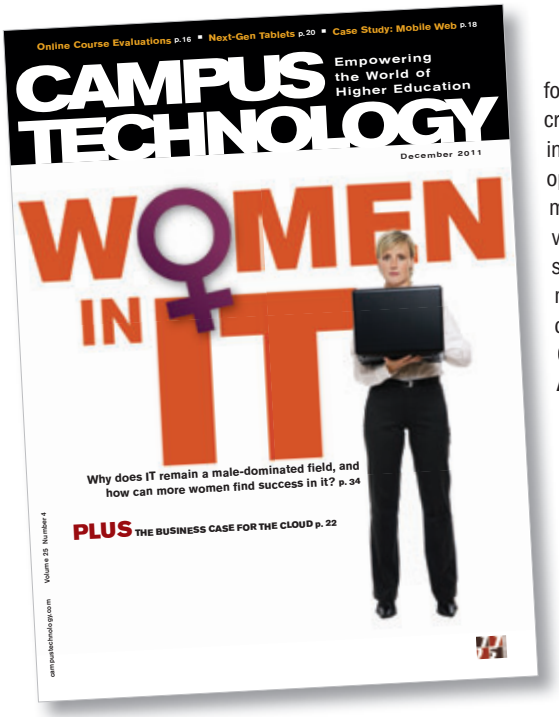

Women in IT

CT's December feature "Women in IT" and the accompanying online story "Women CIOs: Will Their Numbers Soon Decline?" explored what it's like to be a woman in IT in higher ed and why the number of women CIOs may decline over time.

It's frustrating. Not only are women's careers derailed in young adulthood by children, but women also typically become more responsible for supporting aging parents. This could explain the interest in exiting the career earlier, and avoiding positions that require 150 percent effort during what can be a tricky stage of life. Thanks for the article!

Anonymous
Comment posted on *campustechnology.com*

This discussion parallels a wonderful book, *Damned If She Does, Damned If She Doesn't,* by Lynn Cronin and Howard Fine [Prometheus Books, 2010]. While it focuses on women in business, I find many similarities with women in IT because business and IT are merging. Gender limitations continue to be lived in IT. Yes, women have opportunity and access, but perhaps, as Cronin and Fine state, there are protocols embedded in business that can derail women: "These basic, respected rules of business work well for men but can inadvertently create paradoxes that put women in no-win situations and limit their opportunity to succeed in a manner comparable to men." The vast creativity of women in leadership is yet untapped and tragically may be lost. Good timing for discussion. I highly recommend Cronin and Fine's book.

Anonymous
Comment posted on *campustechnology.com*

I guess I don't get it. I am a woman, and I have always believed that I can have any career I want. I don't care if it's predominantly men in the field or not. I don't have trouble promoting my own successes or asking for the resources I need. Could it be that it is less of a gender issue and more of a generational issue?

Anonymous
Comment posted on *campustechnology.com*

Does App Make Sense?

In a December online article, "U Wisconsin-Milwaukee Rolls out Mobile App Built on Open Source Platform," writer Tim Sohn reported on a popular campus app built using a free, open source platform.

In a university system already strapped for funding, it's more important to consider the cost of ongoing operations and maintenance than the initial startup cost. But the real issue is this: Is there any value in being able to locate a class with GPS after the first time? Or in duplicating capabilities (like contacting faculty or students) that are offered on other platforms that are already accessible by mobile devices? Sure, an app is cool, but the university must have better things to spend its money on.

Jerry
Wisconsin
Comment posted on *campustechnology.com*

Legislating E-Text

In an online article, "California Wants to Legislate Use of Digital College Textbooks," CT reported on a proposed bill that would set aside $25 million to pay for the development of 50 open source digital textbooks to be made available free to students.

As a college student myself, the concept of e-books is entertaining, and someday they may have uses. In reality, the only people who consider e-books as an alternate to printed texts are not students but those who can make money on them. How do you write notes next to an important paragraph, how do you underline, and how do you jump quickly to a section when the battery is dead? What about when the professor asks you to print out the material and bring it to class (Oh my God, we just killed a tree)? Have you ever checked out an e-book from your college library? I tried today and failed. I got the same book in print in about four minutes, and it works all the time regardless of power. Yes, there are some valid uses for e-books such as user manuals, but even those have flaws. Let's move on and worry about something more important.

Michael
Santa Clara, CA
Comment posted on *campustechnology.com*

Does anyone else see a problem with this? It's bad enough that government—federal and state—has prescribed what can be taught in the classroom. Now the state wants to supply the textbooks. This will turn into political correctness on steroids, heaped on top of every extreme environmental, climate change, and affirmative action agenda out there. Truth will be the first casualty of state-authored textbooks. The second is the students coming out of college with skulls full of mush.

Anonymous
Comment posted on *campustechnology.com*

In reference to the above comment, the state is not supplying the textbooks: "The legislation would create a request for a proposal process inviting faculty, publishers, and others to develop digital open source textbooks and related courseware." The state is not dictating any changes to the content beyond what current textbooks already contain. Evidently, you disagree with the current content, which is a separate issue. If you have a problem with trying to cut down the costs for students, then you must not be

or never have been a college student, nor have any kids that are college students.
Anonymous
Comment posted on *campustechnology.com*

To infer that the state of California would mandate the use of these textbooks or dictate who the authors might be is to misinterpret the legislation. This innovation would not replace the current options for textbook adoption, but would provide other options that could save students money. To the commenter who complained about digital books, if you don't like the interface for highlighting and notating e-books, and don't appreciate the opportunity to exchange comments online with others in your class, just buy the print version. Write with a pencil or pen all you want. Why deny others a different way of highlighting and annotating?
Student Advocate
Comment posted on *campustechnology.com*

The article speaks of a mandate to produce 50 "textbooks," but I would be surprised if electronic teaching material is formatted as course-long textbooks in the future. One approach is a collection of modules focused around a given course. For an example, see the *Principles of Biology* e-text, from Nature Publishing.
Larry Press
Comment posted on *campustechnology.com*

While I generally agree that the cost of a single book has gone through the roof, using $25 million of taxpayer funds to subsidize books doesn't seem right either. Why do we continue to see examples of courses/instructors who adopt a $160 text, but then use only a portion of it? Whose fault is that? It's certainly not the publisher's or students'.
Chris
Comment posted on *campustechnology.com*

Online Learning Challenges

In an online story from May, "Managing Students Virtually," writer Bridget McCrea looked at the challenge of managing online students effectively.

I am an online learner at **Capella University** working toward my Ph.D. in leadership for higher education. Having completed undergraduate and graduate degrees at a traditional bricks-and-mortar institution, I have to admit that I was a bit skeptical at first of any online environment. However, I was pleasantly surprised at how robust Capella's online learning environment was. I initially started courses at Capella to earn a post-master's certificate. Once in the program, though, I decided to continue with my Ph.D. Not only does Capella offer a user-friendly, resource-rich learning environment, but the rigor of each course is on par with—and, in most cases, exceeds—the level found at any traditional university. The new portal referenced in the article is very easy to navigate: It features social-networking modules, clear topical menus that make it easy to find resources, as well as a very comprehensive search engine.
Michelle Searer
Chicago
Comment posted on *campustechnology.com*

Why do we continue to see examples of courses/instructors who adopt a $160 text, but then use only a portion of it?

Mission Impossible?

In the January issue of CT, *"Mission Support" detailed how the IT department at* ***Harvard Business School*** *(MA) developed a new learning ecosystem to support a changing vision for the school's first-year MBA program.*

As a current second-year HBS graduate student, this monograph is hilarious. The rollout of the LMS has been an almost unmitigated failure from the perspective of students, faculty, and support staff. The system appears to have been designed with absolutely no input from anyone who would ever have to use it, a trait that was highlighted in the school's weekly newspaper. All attempts that I know of to provide feedback to IT staff during the rollout of the system were met with silence. The system's poor design and persistent unreliability have not improved since it went into use. Most professors have resorted to weekly e-mails to their class sections to distribute supplementary materials and make announcements. I've worked in the private sector as a software developer and a product manager, so it was incredibly frustrating but also incredibly informative to be on the user end of this project. For me, this experience highlighted the worst-case scenario in trying to build a complex, custom software solution in-house (versus contracting out or buying a shrink-wrapped product).
CSB
Boston
Comment posted on *campustechnology.com*

E-mail us at *editors@campustechnology.com*, or join the conversation on the web at *campustechnology.com*. Letters are edited for length and clarity.

Campus+Industry

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NEWS

CAMPUS TECHNOLOGY innovators AWARDS 2012

CALL FOR ENTRIES. The 2012 Campus Technology Innovators call for entries is now open! We seek innovative colleges and universities that have deployed extraordinary technology solutions to campus challenges. Go to *campustechnology.com/innovators* to enter by Feb. 15.

IT PROJECT MANAGEMENT. **Ferris State University** (MI), which has more than 15,000 students across 19 satellite locations, has implemented Innotas' Project Portfolio Management (PPM) solution to manage its IT projects. Innotas PPM streamlines the process for requesting projects, enabling the university to prioritize IT projects and resources to align with its strategic direction. "With all our project information in one place, managers now know who's working on what, enabling senior management more visibility," say Jim Cook, FSU's project manager. "Additionally, it is a huge benefit to be able to produce reports on-demand for senior management, instead of having to go through e-mails to find the necessary information."

MORE FREE MIT. The **Massachusetts Institute of Technology**, which opened up OpenCourseWare (OCW) in 2002, recently announced plans to develop the temporarily named MITx, a program to share some MIT courses freely through an online interactive learning platform. The new initiative, which is slated to launch this spring, is expected eventually to host "a virtual community of millions of learners around the world." According to the school, the learning platform will be used among its own students and be made available to other schools—both higher ed and K-12. The program will include online laboratories, course notes made available through OCW, online tutors, crowd-sourced grading of programs, automatic transcription, and student-to-student communication. Non-MIT students who demonstrate mastery of subjects will be able to earn a certificate of completion from MIT. Read more at *campustechnology.com/articles/2012/01/03/mit-building-free-open-source-online-course-platform.aspx*.

SECURITY MOBILE APP. To help protect 13,000 students at three campuses, **Northeastern State University** (OK) has launched a customized version of a mobile security app that allows students to notify campus police of their whereabouts. MacroSolve Guardian runs on both Apple iPhone and Google Android devices and features three modes. The "danger" mode requests an emergency response from campus police, sending the phone's GPS coordinates and tracking the device until it's deactivated by a pass code. The "follow me" mode is useful when students feel they are in an uncomfortable environment; when activated, it notifies campus dispatch and tracks the phone using GPS for a period. (The user may also request an officer to provide an escort.) "Check-in" mode allows users to notify campus dispatch where they're headed and when they expect to arrive. If they're late, designated contacts are alerted. Read more at *campustechnology.com/articles/2012/01/06/northeastern-state-adds-gps-savvy-security-mobile-app.aspx*.

MACROSOLVE Guardian allows students to ask campus security to track their location in dangerous or uncomfortable situations.

3D ARCHITECTURE LAB. The **University of Missouri** has created an $85,000 immersive lab to allow undergraduate architectural students to visualize what their buildings and rooms will look like when they're actually built. The Immersive Visualization Lab (iLab) has three large high-definition projection screens sitting side by side to create one continuous, horizontal viewing screen. Wearing special glasses, students can view their computer-generated drawings in 3D. The immersive effect of the continuous screen gives students the sense that they're standing inside the buildings they designed. Read more at *campustechnology.com/articles/2012/01/03/undergrad-architecture-students-get-immersive-lab-at-u-missouri.aspx*.

ENERGY-SAVING PARTNERSHIP. A utility company has teamed up with a "cleantech" development firm to provide a system that integrates energy-load response with energy-usage monitoring. Constellation Energy and Lucid will market the new system to colleges and universities, with both companies claiming that it will have no "out-of-pocket cost" associated with it. Savings generated in one building can be applied toward the installation of Lucid's Building Dashboard software and Constellation's VirtuWatt energy-management system in other buildings. Lucid's Building Dashboard notifies users of their energy and water usage, encouraging them to take steps to reduce consumption. Constellation's VirtuWatt integrates with existing building-automation systems to track

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NEW EMERGENCY SYSTEM.

Southern California's **Marymount College** has replaced its legacy emergency-notification system with a cloud-based one. According to information released by the college, the decision to overhaul its system came when its emergency-notification system failed to function during a tsunami scare in March 2011, and campus administrators were unable to get timely assistance from the system's provider. For the new system, the institution, located just six miles from the Port of Los Angeles, decided to go with e2Campus from Omnilert. "We liked the simplicity [from an administrator's point of view], we liked the price, we liked the flexibility of the pricing structure, and the ability to add and subtract users," says Denise Fessenbecker, director of general services at Marymount. Read more at *campustechnology.com/articles/2012/01/04/california-college-overhauls-emergency-messaging.aspx.*

BRANDEIS MOBILE APP.

Students who own iPhones at **Brandeis University** (MA) can now access campus information quickly from anywhere thanks to the launch of a free app, dubbed Brandeis Mobile. Developed by the university and California-based EZ Axess, the app features links to blogs, including that of the university president; an interactive campus map, which identifies a user's location and allows users to search for parking and buildings; videos available on the university's YouTube channel; sports, including team information, stories, photos, scores, and schedules; phone numbers for on- and off-campus emergencies; and access to the university's library catalog. The university plans to add an events calendar soon. In addition, Brandeis has created a mobile-optimized website that provides the same functionality. Read more at *campustechnology.com/articles/2012/01/03/brandeis-university-deploys-mobile-campus-life-app-for-ios.aspx.*

SOLAR INSTALLATION.

Yuma-based **Arizona Western College** has begun generating its own electrical power through a solar installation that uses five different technologies. The school recently flipped the switch on a 5-megawatt system that takes advantage of a climate that gets more sunshine than any other city in the country. The college, which serves 13,344 students on a 23-acre campus, will use the installation to generate electricity for all its daytime needs and to help with its solar-related education and workforce-training goals. The five solar technologies include concentrator photovoltaic systems with dual-axis trackers from SolFocus and GreenVolts, thin film from Sharp, single-axis trackers from SunEdison, and SolarWorld monocrystalline and Suntech polycrystalline solar panels. The installation includes demonstration systems of each technology for education, business, and government use. The college has been expanding its solar-related curriculum to encompass solar technician certificates and renewable-energy degree programs. The institution expects to save $3.5 million over the next 10 years in utility bills. Read more at *campustechnology.com/articles/2011/12/15/arizona-western-college-goes-for-variety-in-solar-installation.aspx.*

CPV SYSTEMS with dual-axis trackers are one of five solar technologies in use at Arizona Western College.

STATE NETWORK UPGRADE.

Washington state's K-20 Education Network recently completed an upgrade of its network infrastructure to encompass annual bandwidth growth that had reached 40 to 50 percent. The 15-year-old organization runs a wide area network (WAN) that links 498 locations at public schools, two-year colleges, and four-year colleges in the state. K-20 deployed MX480 3D Universal Edge Routers from Juniper Networks. According to Tom Carroll, K-20's service manager, basic internet access on the network has given way to more demand for support of online business applications and high-definition videoconferencing. In addition, the new network is supporting applications for enterprise resource planning, time and attendance, payroll, and learning management. A major driver for the latest upgrade was to accommodate greater demand for increased bandwidth—to 10Gbps capacity—without a concomitant increase in service charges. The total cost of the project was under a million dollars, an expense incurred by K-20's members. Read more at *campustechnology.com/articles/2012/01/03/washington-upgrades-state-network-with-juniper-gear.aspx.* CT

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To Catch a Thief

To reduce the illegal downloading of copyrighted material via their networks, colleges are relying on a mix of technology, education, and punishment.

WHEN IT COMES TO THE theft of copyrighted material, the crime spree may be over, but it's not exactly Mayberry out there. Illegal file sharing of copyrighted material peaked about four years ago before high-profile legal battles by the Recording Industry Association of America and the Motion Picture Association of America. But it remains a significant problem.

"A year ago it was movies. This year, it is reverting back to music," says Duane Woerman, manager of the university technology office at **Arizona State University**. "Last year, we had about 9,000 cases we had to respond to."

Numbers like that translate into a significant headache for colleges and universities, particularly in the wake of the 2008 reauthorization of the Higher Education Opportunity Act (HEOA), which requires institutions to take active steps to prevent unauthorized distribution of copyrighted materials on their networks.

"It costs the recording industry a loss in its revenue stream," Woerman points out. "And for us it's a manpower issue because we have to respond to all these incidents."

As the operator of the network, it is the university that receives Digital Millennium Copyright Act (DMCA) takedown notices sent by aggrieved copyright holders. And it is the university that has to track and respond to violations. The costs to the institution don't end there, however. Illegal peer-to-peer (P2P) file sharing hogs network bandwidth, and often leads to increased malware infections.

In some ways, the prevalence of illegal file sharing is the result of both improving technology and changing cultural norms. "The networks are extremely fast, which means movies, albums, and TV shows can be downloaded at record speed," explains Justin Webb, security analyst with **Marquette University** (WI). "Also, most incoming students have always had the internet and have inevitably been exposed to nonlegal methods of obtaining artistic material."

To fight the scourge, colleges and universities are trying a cocktail of three remedies in line with HEOA mandates: education, technology, and punishment.

Education

In Webb's eyes, there's a misapprehension among students that, because there isn't a physical theft, no harm is done.

His theory—that students don't believe they are stealing—makes sense. Today's college students are used to sharing everything online and having their entertainment available at the click of a mouse. And even though most students are heavy tech users, many don't understand what constitutes acceptable, legal behavior online. It's in the university's interests to educate them on these finer points.

"We give annual notices to students informing them that downloading of copyrighted material is illegal, and we offer

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a website that gives alternative—and often free—options to allow students to obtain content legally," explains Webb.

Other schools turn to student leaders for help. The **University of Houston** (TX), for example, has an extensive awareness program that was designed in part by students to educate fellow students on a variety of technology security topics. Included in this program are details about what constitutes illegal downloading, as well as information about where students can download material legally.

There's a misapprehension among students that, because there isn't a physical theft, no harm is done.

"Our awareness program utilizes an innovative e-book format, complete with interactive games and videos designed to engage students' attention and encourage information retention," explains Mary Dickerson, Houston's chief information security officer. "The truth is, if you are downloading without the copyright owner's consent, it is stealing. All you need to do is keep reminding your users that it is just that simple."

Technology

If educational efforts fall on deaf ears, technology offers ways to discourage illegal file sharing—and to catch the perpetrators. However, there are significant differences among institutions in how willing they are to interfere with students' ability to share P2P files.

Marquette, for example, does not block P2P file sharing. "But," says Webb, "we do throttle that traffic using a packet shaper on our student network, which reduces its load on our bandwidth."

It's a similar scenario at **Washington State University**. To discourage P2P file sharing, IT administrators set it as a low priority on the network, slowing downloads of potentially copyrighted content. "Not all P2P is illegal, but a whole lot of it is," says Craig Howard, director of administrative services information systems.

For its part, Arizona State tried a number of different third-party products. One program stopped file transfers, but not until after the download had started. "The technology allowed us to stop the activity, but there was no reduction in [industry] complaints," says Woerman, who explains that it still constituted a violation in the eyes of the recording industry.

The vendor he uses now, Palo Alto Networks, blocks all P2P file transfers on the campus wireless network and in the dorm buildings. In the year since the new system was implemented, Arizona State has seen the number of violations drop from 9,000 to 2,000.

Obviously, some students continue to find ways to carry out P2P transfers. According to Woerman, "they go to the computer labs," which are not blocked by the Palo Alto Networks firewall. The labs and other unprotected areas of campus are expected to have protection in 2012.

The other half of the technology solution involves tracking down and identifying the culprits. When Arizona State receives a DMCA takedown notice, says Woerman, "we use ForeScout Network Access Control to help identify where the violation originated, and our Cisco network infrastructure to pinpoint the offender's location."

At **Wiregrass Georgia Technical College**, CIO Amos Terrell uses a Microsoft Access directory to track what students do online and what they download. Students have to log on to the network, and everything they download goes into their own folders. Terrell can monitor what kinds of files (including their size) are being downloaded, which makes it much easier to identify potential problems—and violators.

At Houston, Integrity monitoring software from Red Lambda tracks the protocol used for downloading. "The software correlates complaints received from the copyright holders and publishers against our system logs and data to identify the person downloading the material," explains Dickerson.

Punishment

Short of blocking all P2P traffic, though, there is no surefire way to halt illegal downloading. Ultimately, it is the threat of being caught—along with the penalties for infractions—that dissuades the majority of students from engaging in the practice. Most universities publicize these penalties in the materials that are sent to students as part of their awareness programs.

At the **University of California, Santa Barbara**, a student's first DMCA violation results in a 30-day disconnection from the residential network. A second violation leads to the loss of internet access for as long as the student remains in a residence hall. In addition, the case is referred to a campus judicial officer, and the student might lose his eligibility for university housing.

Appalachian State University (NC) takes a less punitive approach for the first couple of offenses—the first results in a warning, the second in the loss of internet access for 10 academic days. For the third offense, though, the school throws the book at violators: the loss of internet access for 75 academic days, and academic probation. Simply put, three strikes and you're out. **CT**

RESOURCES

For links to the schools, products, and vendors mentioned in this article, please visit *campustechnology.com/ 0212_illegal-downloads*.

__Sue Marquette Poremba__ is a central Pennsylvania-based writer who specializes in security and technology.

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Sitting on Cloud Mine

In a mobile world, cloud-based personal-storage services make it easier to manage documents across devices, and to collaborate with peers and students.

IF YOUR POCKETS ARE SO STUFFED with student thumb drives that they bulge like a squirrel's cheeks…you know it's time for a change. If the presentation on your desktop bears little resemblance to the version on your laptop…you know it's time for a change. It sounds like the lead-in to a comedy routine, but it's no laughing matter when you realize you've been working on an outdated file for hours. Fortunately, like a good punch line, the answer to the problem is short and sweet: personal cloud storage.

Personal cloud storage or—more specifically—backup and sync services give users the ability to access the latest version of their files from any device with an internet connection, and, in some cases, the ability to share specific files or folders with collaborators, so they too are always working with the most current version. No more thumb drives. No more e-mailing large files as attachments.

Faculty are finding these cloud-storage services useful not only to manage their own work, but also as a collaborative classroom tool. "There are four computer devices I use throughout the day," says David Parry, assistant professor of emerging media at the **University of Texas at Dallas**, who uses a backup and sync service provided by SpiderOak. He ticks off a list of devices that includes his cell phone, a work laptop, a home desktop machine, and a tablet. "Anytime, anywhere, as long as I have a device with me, I can get my syllabus. All the files I'm working on for the current semester are stored in the cloud and I can just get them from a device, even if I don't have my own device."

A multitude of cloud-based, personal-storage companies have popped up in recent years. No two are alike, but most offer some storage for free, with additional storage available for a fee. SpiderOak, for example, gives users 2 GB free. Choosing among the various cloud-storage options can be tricky, especially since it's a rapidly changing industry sector.

Founded in 2007, Dropbox is probably the granddaddy of backup and sync services, and holds a significant market share. Users download the application for free to each of their devices. Any file stored in a user's Dropbox folder is then accessible, online or offline, on any of those devices, as well as being stored by Dropbox on Amazon's Simple Storage Service (S3). Each time a user hits "save," Dropbox updates the versions on the Amazon servers and on all the other devices. In addition, users can share files with other contributors or team members.

AJ Ostrow, a first-year student in the computer-engineering program at **McGill University** in Montreal, relies on Dropbox for team- and partner-based projects. During a recent code jam—a 48-hour programming competition—

Mick Wiggins

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Ostrow and his partner needed to program in parallel to finish their project in time.

"My partner and I were considering ways to sync our files and share them while we were programming. In the end, we decided Dropbox would be the easiest, especially to get the files onto our virtual machine," explains Ostrow. "It replaced a USB drive or subversioning (version control), which would have taken too long. We shared files with code over Dropbox and updated them in real time."

While Ostrow submits most of his schoolwork via McGill's Blackboard system, he uses Dropbox regularly for programming side projects and to share business plans. "Basically, anything that needs a USB or to be e-mailed as an attachment is easier to handle with Dropbox," he adds.

SpiderOak, SugarSync, Syncplicity, and Wuala are among other storage and sync services that operate in much the same way as Dropbox, including the ability to share files with collaborators. Many of these companies differentiate themselves from Dropbox by emphasizing their security cred, an area where Dropbox is perceived—rightly or wrongly—to be vulnerable.

Security Approaches

Dropbox stores user files in encrypted form, but the encryption takes place only after the user sends the files to the company. "They have the keys," complains Parry. "Theoretically, people at their company have the ability to unlock your file and view the contents."

With some of Dropbox's competitors, on the other hand, files are encrypted on the user's side before being sent. "If somebody on their side gets access to my files, they have meaningless data," explains Parry about his use of SpiderOak. This makes syncing files a little slower and, Parry says, you're out of luck if you forget your password. But it's a trade-off he's willing to make. He uses SpiderOak for files containing information about his students, such as grades and letters of recommendation.

Parry now uses Dropbox only for sharing files with students or when he's working in groups to coauthor papers: "We'll create a group folder and then we'll share those documents, which means we can all edit them."

For its part, Dropbox defends its security setup. In addition to Dropbox's own security—which includes the use of Secure Sockets Layer and Advanced Encryption Standard 256-bit encryption—files are protected by Amazon's security policies. For users who share Parry's concern about Dropbox employees accessing their data, the company recommends using TrueCrypt, free software that enables users to encrypt their files before they upload them.

Ostrow at McGill is not worried about security with Dropbox, because he believes cloud systems in general are actually very secure. "It's not like I have a lot of sensitive information to protect," he says. "If Amazon can save millions of credit cards, then they can hold onto my homework."

Gorillas in Their Midst

Encryption debates aside, these backup and sync services take essentially the same approach, with variations in pricing and storage allowances. Looking ahead, the biggest competitive threat may not come from each other, but from some of the 800-pound gorillas that are elbowing into the space. Apple's iCloud, Amazon's Cloud Drive, Microsoft's SkyDrive, and Google's User Managed Storage all have the potential to supersede or eclipse the established sync services. Some of them offer suites of services, ranging from e-mail to calendars, that could make them attractive one-stop sync shops. With iCloud built into every new product, for instance, Apple has made syncing and backup automatic and largely invisible.

There are some drawbacks to each of these heavyweight contenders, however, that may make users pause. ICloud, for example, doesn't mix apples and oranges: It's a product for Apple users and doesn't do collaboration. Google's solution, on the other hand, is high on sharing—a dispersed team can work on Google Docs files simultaneously—but it requires everyone to have a Google account. And to work offline, you have to download the document and then reupload it to refresh the shared document.

In deciding what type of product to use, perhaps the biggest advantage of the specialized backup and sync services is a trinity of features: They are platform agnostic, they don't require sign-in, and they allow collaborators to share documents quickly and easily. In higher education, these are powerful attributes that, for now anyway, eclipse some of their more vaunted competitors. Whether this will hold true down the road remains to be seen. **CT**

RESOURCES

For links to the vendors and products mentioned in this article, please visit *campustechnology.com/0212_sync.*

"Anything that needs a USB or to be e-mailed as an attachment is easier to handle with Dropbox."

—AJ Ostrow, McGill University

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Smartphones: Teaching Tool or Brain Candy?

As smartphones become ubiquitous, educators debate how to take advantage of their unique strengths for learning while minimizing their disruptive influence.

LET'S GET ONE THING STRAIGHT. Smartphones are a permanent feature of college classrooms, whether you like it or not. Most students already have them, and it's just a matter of time before the rest follow suit. From ordering a late-night pizza to posting pictures on Facebook of their roommates eating it, students rely on their phones for *everything*.

Yet students' attachment to these devices is not necessarily a bad thing. Like any internet-connected computer, smartphones can play a valuable—even exciting—role in teaching and learning. What better way to reach students than via a device they treat like their significant other? At the same time, smartphones do have a dark side. They are the ultimate opiate of today's students—a wonderland of games, friends, apps, and YouTube videos. Does the bored kid in the back row really need such easy diversions? As educators work to come to terms with these devices, the challenge will be to find ways to accentuate the positives while minimizing the distractions.

Smartphone as Learning Tool

Today's smartphones have the computing power of a mid-1990s personal computer. They *are* computers, and it's time we started thinking of them as such. What's more, they come with the added benefit of being constantly connected to the internet.

What makes them different, obviously, are their tiny size and weight. An iPhone weighs less than 5 ounces and fits in your pocket. Unlike a laptop, it's truly portable. If you don't buy into that, try sprinting to class with a 7-pound laptop smacking you in the kidneys.

Portability is what makes the smartphone such a powerful learning tool. As the concept of the walled classroom breaks down, the smartphone is perfectly suited to support the untethered world of teaching and learning. Students in the field can use the camera to take pictures or videos, the built-in microphone to record interviews, the Qik app to broadcast live video, the browser to perform research, and the keyboard to jot down their notes—anytime, anywhere.

The smartphone's potential as a learning tool is rapidly being discovered by faculty. Paul Wallace, assistant professor of instructional technology at **Appalachian State University** (NC), taught students to use Scvngr as a way to apply their classroom knowledge to benefit the local community. Students partnered with Watauga River Conservation Partners, a local organization, to create mobile scavenger hunts to help the community learn about

wetlands and conservation. Not only did students learn to use mobile technology, they were also able to apply their classroom knowledge in the field.

Another demonstration of smartphone-enabled learning is Project Noah, which is based on the premise that students can create and share knowledge using their mobile devices. Students use the app (iPhone or Android) to document and take photos of sighted insects, birds, and bushes, and then share their findings with an online community.

Within the confines of a classroom, the smartphone's advantages are obviously more limited. Some instructors are using polling applications such as Poll Everywhere to ask students if they read a particular chapter, or what they found most compelling about it. Instead of raising their hands, students respond by anonymous text message, with their answers appearing on a screen for all to see.

LEARNING ABOUT MOBILE

How can you to stay up-to-date or get new ideas? Check out Gizmodo to learn about the toys, Mashable to learn about the technology, and the Centre for Learning & Performance Technologies to learn about teaching with new technology.

Smartphones also allow students to Google information that can add to class discussions. Gone are the days of frantically flipping through a textbook to find the answers. In addition, in lieu of old-fashioned study guides, students can make their own electronic flash cards using applications such as FlashCards++, Quizlet, or CoboCards.

Instructors have to understand the technology's limitations, however. In many ways, the smartphone is the fast-food restaurant of technology. It's where you go for simple, quick information when you're on the road. When you need something more substantial—data analysis, multimedia editing tools, or software development, for example—it helps to have a more powerful computer, with a full keyboard and large screen.

And what of the frivolous flip side of smartphone use? For generations, disengaged students have amused themselves in class with everything from magazines to doodling to full-blown siestas. Compared with the capabilities of the smartphone, though, these are all small ball. The smartphone is the *world* at their fingertips. As exciting and useful as this may be for a motivated student, the smartphone is also the ultimate digital diversion for the disengaged. Among this group, Economics 101 is always going to lose to Angry Birds.

Is there anything lecturers can do to counter the tendency among certain students to zone out with their smartphones? Or is it even the lecturer's responsibility? These are, after all, voting-age adults. They either do the work and succeed, or they goof off and fail.

RESOURCES

For links to the products, vendors, and organizations mentioned in this article, visit *campustechnology.com/0212_smartphones.*

Even if you take this Darwinian approach, no teacher likes to be ignored, and faculty on campuses nationwide have tried a variety of tactics to control smartphone use in class. One of the most successful is *not* to ask students to put their phones away, but simply to leave them visible on their desks. This discourages students from holding the devices on their laps while they text and tweet away. Indeed, classroom instructors might want to take a page from the airlines, asking students to power off their electronic devices for the duration of the flight.

It would be a mistake, though, to try to close smartphones down altogether. An increasing number of apps—available free or for a nominal price—are being written for educational purposes. Students can learn everything from mathematics to science, history, and geography. Teaching statistics? There's an app for that.

Nevertheless, instructors should probably avoid using smartphones in each and every class session. The novelty will wear off with overuse, especially if the use is not intuitive. Think about how you already use your smartphone and how those tasks might translate to a classroom setting. If you're comfortable with the technology, the applications will follow. **CT**

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DON'T MAKE ME TALK TO YOUR MAMA

WHEN IN DOUBT, bring in mother. It's a strategy for combating cell phone use that has worked well for faculty members at various institutions. Warn students that if their phones ring in class, you will answer it for them. Chances are it will be Mom on the other end of the line, and you can go for the double play: old-fashioned guilt trip and an appeal to the fiscal worrywart within.

Time is money, you explain, and then break down the financial ramifications of students receiving phone calls during class. With tuition hovering at $35,000 per year, for instance, each hour of class costs approximately $80. Mom's short phone call is costing each student in the class—not just her son—$5.

Then, take her side. Reassure her that she couldn't possibly be aware of her child's class schedule, and that it's her child's responsibility to turn the phone off before class. Now you've set the hook. Needless to say, if you can get Mom to stop apologizing, the student's phone will never be on during class again.

Universities are wrestling with the possibilities and pitfalls of making homegrown IT products available beyond their campuses. *CT* examines the benefits of the two major options: open source or a commercialized venture. By David Raths

means of production

No one who's worked in higher education will ever confuse the experience with working in the corporate sector. Colleges and universities are simply not geared for the business of manufacturing or marketing products. The focus—as it should be—is on teaching and research. Given the wealth of talent among IT staff and faculty, however, higher ed institutions do develop cutting-edge IT solutions to in-house problems. In many cases, these same solutions could help other institutions. Are there benefits to distributing these products to a wider audience? What's in it for the institution itself? And how does a school even go about it? ▸

Jon Reinfurt

Adapting an in-house product for use by outside customers makes sense only under certain circumstances. In these constrained times, few CIOs are likely to throw their support behind a project if the only return is a sense of self-worth and a lighter wallet. And if the first attempt at such a project doesn't succeed, don't expect a second chance anytime soon.

"A first success is huge," says Patty Gertz, executive director of Jasig, an open source consortium that started out as a special-interest group of Educause and is now in the process of merging with the Sakai Foundation. "You *have* to convince a CIO that this is worth doing," she says, "and then convince new CIOs all over again when there is change at the top."

Broader Research Community

Among institutions seeking to distribute homegrown products more widely, the main motivation is usually to improve the product while reducing demands on the school's own resources. This usually means going open source. The concept is simple: The more developers and schools that work on a product, the faster its quality improves at a lower cost per participant. It's a collaborative approach that works well in an environment where most schools face resource constraints.

Six years ago at the **University of Wisconsin-Madison**, for example, IT leaders decided to go the open source route on the school's portal platform, because they thought they would have more control over how the product was developed and could collaborate with colleagues on improving it. "Wisconsin has added capabilities and donated them back to the community," notes Jim Helwig, project manager for the portal infrastructure team at the university. "And the great thing is that the community helps you maintain those enhancements. You are not just on your own."

In 2007, the **University of California, Berkeley** took a similar approach when it decided to make its Berkeley Continuity Planning Tool open source. The hope was that others would pick it up and help its development with more resources than Berkeley's IT group had internally.

In the first 18 months, there were 100 downloads of the source code, and a number of UC campuses were among those early downloaders. Berkeley officials met with the central office of risk management for UC schools and proposed offering the software as a service called UC Ready to all UC campuses. "The central risk management office ended up underwriting the cost once we showed them it would reduce insurance rates," recalls Shel Waggener, Berkeley's chief information officer.

RESOURCES

For links to the open source consortia and vendors mentioned in this article, please visit *campustechnology.com/0212_product development.*

Making the decision to go open source, however, does not guarantee a bevy of collaborators. Waggener learned that getting other schools to download the source code isn't enough. You need to build an active development community around the product. It's a viewpoint shared by the IT department at Wisconsin. "Open-sourcing a project really takes a lot more than just zipping up your code and hosting it on a website," explains Nicholas Blair, a senior information-processing consultant at the school. "Sure, anyone can download your code, but without help understanding it, it's not really going to go far."

"Open-sourcing a project really takes a lot more than just zipping up your code and hosting it on a website."

—Nicholas Blair, UW-Madison

That's why many initiatives get funneled through open source consortia, such as Kuali, Jasig, and the Sakai Foundation. Two years after launching UC Ready, for example, Waggener decided that the project would benefit from additional sponsors. "In 2009, we took it to Kuali with the model of an ongoing community project, and they were interested," he recalls. Now a group of 10 private schools, community colleges, and research universities is partnering on Kuali Ready.

Waggener says the transition to a Kuali team effort has made it a sustainable program, with partners who are engaged and contributing. "If a risk manager working with developers in Indiana comes up with a good idea, it is instantly deployed," he says. "So development happens faster and at lower cost."

Building a Support Network

It's difficult to overstate the importance of building a support network. Indeed, three years ago Jasig changed its modus operandi specifically to address the issue, creating the Incubation Working Group to nurture fledgling initiatives. "It usually starts with a university recognizing that its wants something it has developed to flourish," explains Susan Bramhall, a senior systems specialist at **Yale University** (CT) who heads the Incubation Working Group. "It realizes that the project requires more long-term resources to make it sustainable than are available at any one school."

An in-house scheduling assistant from Wisconsin is one of approximately 20 projects currently undergoing an incubation process. "Jasig provides the help to properly license your software, set up project governance and direction, and complete a well-rounded public profile," says Blair, who authored the original scheduling assistant. "It provides infrastructure like site hosting, e-mail lists, and a task tracker, but more than anything it's the talented and engaged individuals in the community who are able to help." ▸

TAKING HOMEGROWN PRODUCTS TO MARKET

PURDUE UNIVERSITY *(IN) has partnered with SunGard Higher Education to commercialize Signals, a student-retention application developed on campus in 2005. The product won a Campus Technology Innovators award in 2011 (see page 29 for this year's Innovators awards program).* Campus Technology *spoke with John Campbell, associate vice president for academic technologies and Signals' chief architect, about Purdue's decision to choose a commercial partnership over an open source approach.*

JOHN CAMPBELL

Campus Technology: Why did Purdue decide to commercialize Signals?

JOHN CAMPBELL: We were content with the progress we were making with the project on the Purdue campus. Then, about three years ago, NBC News did a story about Signals. All of a sudden we had many schools contacting us, asking if we could give Signals to them or if we could help them develop something similar. We did not have enough resources to support all these schools, nor was it something we were interested in pursuing. The code is written very specifically for our institution, pulling data from specific applications. So we were faced with pursuing options that could make Signals applicable to other campuses for predictive modeling.

CT: Did you consider making it available under an open source license?

CAMPBELL: First, you have to ask yourself if your project is a viable open source effort. Is there a high level of interest among institutions? Is there a development community available? Does the project have a long life, so the community can develop over time? When we initially developed Signals, analytics was still in its early stages. At that point, I felt it would be a stretch to get enough people together in the open source community to create viable code. The decision might be different if it were made today. Sakai is starting to build an open source analytics component that will probably be ready in a few years and the nature of the decision will change.

CT: What was attractive about the idea of working with SunGard?

CAMPBELL: A university has to realize its limitations. Most institutions do not have unlimited funds to support adding new innovations all the time. SunGard was prepared to be a full partner and develop the system to accommodate multiple student information systems and course management systems. SunGard is also well positioned to stay on top of those systems as they change. There's no way we would have the resources to do that.

CT: What were some of the issues that had to be negotiated?

CAMPBELL: When you work with an outside entity, you define the box in which the collaborative work will take place, and then you find how things might work inside that box. For Signals, we created a partnership that allows SunGard to develop a product for many types of institutions. We also retained our ability to continue our research and efforts based on Signals. If we find new models, SunGard has the right of first refusal to new features/approaches. We worked with our Office of Technology Transfer to define the nature of our collaboration. Because I was the inventor on this project, I was not involved in the negotiations with SunGard. The lead role for our department was our CIO, Gerry McCartney, who is fabulous at developing collaborative partnerships.

CT: Does Purdue have other products that went open source?

CAMPBELL: We have HUBzero, a platform for scientific virtual organizations to share data and run simulations. One example involving nanotechnology is *nanohub.org*, which has 200,000 members and is completely open source. We are seeing growth in the use of these hubs.

CT: Is Purdue working on anything else that has potential for commercialization?

CAMPBELL: Right now we are working on five teaching and learning applications and talking to different groups about commercializing them or putting them in a consortium model *(see www.itap.purdue.edu/studio).*

CT: Do you have any advice for universities looking to develop open source software for wider distribution?

CAMPBELL: Be aware of what other technology you will be integrating with. For instance, don't get hung up by requiring others to license a scientific library to make it work, because that limits your options. Be aware of your own institutional policy for releasing an open source product. Universities are becoming more realistic, I think, than they were 15 or 20 years ago, when they thought everything might be the next Netscape. They now realize that everything developed on campus is not going to produce significant revenue. But they also realize that innovation, development, and support cost money. Each institution will need to weigh the benefits and the risks. We have a fairly succinct process at Purdue involving Office of Technology Commercialization approval if you want to take something open source. You explain how it is used, how you see it in a larger context, and which Creative Commons license you would use. The office examines all the factors and makes the best decision.

Industry & Open Source
In funding software research at universities, large technology companies are increasingly embracing an open source approach. The rationale is familiar: to create a broader research community. In an online exclusive, *CT* examines the trends and the possibilities. Visit ***campustechnology.com/0212_industryopensource.***

Eleven projects have "graduated" from the incubator and are now self-sustaining. A few others were shut down because they didn't gain traction. "The fact that some were terminated just validates the process," says Jasig's Gertz. "We apply our criteria and if long-term sustainability won't be there, we don't continue."

Revenue is generally not one of the criteria used to evaluate an open source project. Schools participating in the Kuali Ready project will pay Kuali an annual licensing fee of $8,000-$11,000, but that money does not come back to Berkeley.

"The potential for the university to make a fortune from this is zero," Waggener notes. "It is cost avoidance. It is reducing my risk. Of all the initiatives we have done at UC, this migration into a community source is the most cost-effective."

Generating Revenue

But generating revenue from homegrown products is possible, as several universities have proved. **Purdue University** (IN) is the leading exemplar of the trend, with CIO Gerry McCartney carrying the standard for a new approach focused on innovation. "If we are only consumers of products, we are in a weak, weak position," he said during a keynote speech at Campus Technology 2011. "For us, 'hybrid' surely must mean that somehow we figure out how to be *producers* of products. We need to explore, not only how to create products, but how to bring them to market."

The school has had success with its stated goal. Recently, Purdue signed a deal with SunGard Higher Education to commercialize its Signals student-retention product and is working on five more teaching and learning products (for more details, read "Taking Homegrown Products to Market" on page 27).

The decision to partner with a company to commercialize a product is not to be taken lightly. Beyond the question of revenue sharing comes a whole raft of issues, including governance, development, marketing, sales, and liability. The Signals agreement, for example, places responsibility for software development, marketing, sales, and support with SunGard, while Purdue continues to contribute work on the underlying risk algorithm.

When pressed about how much revenue Purdue generates from the partnership, John Campbell, associate vice president for academic technologies, remains coy. "I would say that my motivation is to have ongoing funds to continue the innovation," he explains. "This in turn will benefit the teaching and research missions of the institution."

Purdue's current success in this area, however, is no guarantee that gold lies in them thar hills. Yale's Bramhall, for example, did not find advantage in pursuing the revenue route. "Prior to our days with open source software, we did disseminate some software for revenue," she recalls. "In my opinion, managing the distribution and income was as costly—but less beneficial than—the current gain from open source."

At the same time, it's important to realize that open source initiatives also come with their own management demands. Looking back over the first year of Kuali Ready development, Waggener says that the group should have hired a full-time communications person on the first day to answer questions, manage demand, and get the word out.

"The individual members are all answering questions, but it would increase efficiency if one person could answer the basic 80 percent of those questions," he says. "We have done no outreach. Community source has no marketing or sales team." CT

David Raths is a freelance writer based in Philadelphia.

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NOT ALL HOMEGROWN SOLUTIONS are developed from the ground up like the Berkeley Continuity Planning Tool. Some are in-house add-ons for core systems developed by third-party vendors, which can complicate distribution efforts. Fortunately, some software vendors are developing their own version of openness. For instance, SunGard Higher Education has built a Community Source Initiative around its Banner enterprise resource planning system.

"We have an institution-led board that reviews customer modifications to Banner," explains Tom Wagner, SunGard HE's product manager for retention and student success. "If the board votes that the modification is of significant value, it is added to baseline Banner, and the school no longer has to take responsibility for supporting that modification. If modifications don't make it into baseline, there is a code repository that allows schools to share them." (SunGard has also forged for-profit partnerships to market products developed by higher ed institutions. See "Taking Homegrown Products to Market" on page 27.)

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If CIOs are going to succeed in this era of belt-tightening, they need to change campus expectations about what IT can realistically achieve and, just as important, alter the conversation about IT as a cost center.

Succeeding in the New Normal

By Dian Schaffhauser

BEING A COLLEGE CIO these days must feel a bit like juggling chain saws with one hand while holding a donation cup in the other. It's unlikely to end well, yet it represents the new normal in IT. While campus clients—from administrators to faculty and students—expect the usual raft of tech services, the IT budget simply can't deliver.

Alison Seiffer

LOUISE FINN, CIO of Loyola University Maryland, introduced the Paperless University.

The analogy is something that Tim Chester can probably relate to. A month after he joined the **University of Georgia** as CIO, the school suffered a major data breach. Mop-up efforts involved communicating with nearly 19,000 affected people, forensic testing to evaluate the extent of the problem, and mitigation to reduce the likelihood of a future breach, all of which cost money that was not part of the 2011 budget.

To pay for these unexpected costs, Chester was forced to juggle. For starters, he imposed a soft hiring freeze. "We've slowed down the pace at which we're replacing people who depart," he explains. "If somebody leaves and the salary is $3,000 a month, instead of hiring somebody next month, we'll hire in four or six months. That translates into $18,000 in one-time money that we can spend on something else."

Chester also pulled the lion's share of his application-development staff into a special project to eradicate the legacy use of Social Security numbers in reports and elsewhere. That came at the expense of performing updates to the university's custom-developed ERP applications. And that particular juggle, notes Chester, has "caused some grumblings."

So goes IT management in today's harsh economic climate. But Chester made one other key decision: He's going to put some of the chain saws down. "The most important decisions that IT leaders make in this day and age are what you choose not to do," he says. "We lose control when we say, 'We're responsible for A-Z and now we have to figure out how to do that 10 percent cheaper.' That's debilitating."

A better approach, he recommends, is to use governance, consensus, relationships, and influence to come up with a set of activities that IT can deliver. "If you take that approach—and that's a hard approach—you actually find that you have a lot more control in this environment than you thought."

As IT administrators struggle to come to terms with the new normal, one truth is becoming clear: CIOs need to change the conversation about IT on campus. First, instead of driving their beleaguered IT staffs ever harder while service levels drop, they need to reset campus expectations about what IT can realistically achieve. Second, CIOs must rebrand their own organization. They need to start taking credit for how IT saves their institutions money. In the eyes of the university, IT has to go from cost center to efficiency expert.

In deciding what not to do, IT groups face three choices: Outsource, curtail some services, or end some services outright. But the ultimate decision comes down to just one key tenet: Which course of action will make the organization more efficient on a per-dollar basis?

A budget crisis is actually a great environment in which to introduce operational efficiencies. At no other time are people more likely to change their work processes or be willing to get by with less.

The key is to root decisions in cold, hard data. Such an approach will win support from top-level administrators, and steal the wind from those who favor the status quo. **Loyola University Maryland**, for example, looked at usage data patterns to determine which applications could be retired. The Listserv server is the most recent system that the university has removed from service.

According to CIO Louise Finn, retiring such applications saves money in software-licensing costs and in engineering time. "My server engineers are my most constrained resource," explains Finn, "so freeing them up to do other things was really key."

Even if you have all your ducks in a row, such changes are never going to be easy. Finn recalls that there were vocal diehards who didn't want to move to newer systems or change the way they operated. But she had laid the groundwork and had the deans' support, so IT was able to work through those obstacles.

Another data-driven cutback at Loyola involved the help desk. The school had been using regular IT staff to run its help desk from 9 a.m. to 5 p.m. on weekends. But an examination of hourly statistics showed this to be wasteful overkill. Now the help desk relies on student workers and shorter weekend hours—it's open only Sunday from noon to 4. This cutback alone has saved $35,000 annually.

In the eyes of the university, IT has to go from cost center to efficiency expert.

Pushing for Efficiency

By taking the time to figure out what IT won't do, CIOs can stay within their new-normal budgets and often improve service levels. But there's one other advantage: By freeing up capacity, IT can take on projects that will result in more efficient workflow and cost savings for other departments. In this period of intense fiscal pressure, there is tremendous value in being the efficiency expert on campus.

A great example of this is Loyola's Paperless University, an IT project

intended to streamline document management and workflow across campus. As with any initiative that would require significant changes in how university staff do their work, the first step was to develop a watertight business case. In putting it together, Finn's group realized that the human resources and admissions offices would benefit most from the new system.

According to their analysis, the project would reduce usage of energy, paper, and ink, but the real benefits would accrue in staff time savings—something that couldn't happen soon enough. The undergraduate admissions office was six to eight weeks behind in opening envelopes and matching documents to applications. "We would have applicants calling and saying to us, 'I mailed my paperwork in three weeks ago and I haven't heard anything. What else do you need?'" recalls Finn. "And it would still be sitting in a mail bin."

Finn found the funds to pay for the project by juggling, naturally. Nortel, the university's network vendor, had gone into Chapter 11, so Finn repurposed some of the capital funds that she had been saving for a network refresh, directing them to the Paperless University and other strategic initiatives.

The school contracted with DataBank to handle the scanning of paper documents that would be stored in Perceptive Software's ImageNow document-management software. ImageNow is integrated with Loyola's implementations of Datatel Recruiter and Colleague to eliminate duplicate data entry and reduce information-retrieval times.

The undergraduate admissions office signed up for Enrollment Manager, a web-based admissions-management service from Admissions Lab that makes the entire application process electronic, creating student records that can then be transferred to downstream offices.

A process that used to take six to eight weeks is now handled in 48 hours. Rather than "chasing paper around from one desk to the other," Finn says, staff can work on functions that are more "customer facing—able to take the phone calls, the walk-in traffic, and just provide better customer service."

The paperless initiative permeates HR, which is now—proudly—paperless. The staff even tout the department's new status on a web page that explains the process for requesting sabbatical leave: "Please note, as part of the Paperless University initiative, no paper copies are due."

"The most important decisions that IT leaders make in this day and age are what you choose not to do."

—Tim Chester, University of Georgia

Quantify the Savings

To ensure that IT is recognized as the source of such cost-saving efficiencies, though, it's vital that CIOs also find a way to quantify their successes.

It's an approach that is working for Bill Carter, vice chancellor of IT at **Houston Community College** (TX), a 75,000-student school spread across six colleges and 23 campuses. More accurately, it *started* to work when the economy fell apart. A few years ago, when Carter would share with his college board how much it could save through tech-based efficiencies, the members would respond, "Big deal." Now, their response is more likely to be, "What's the efficiency of investment?" a phrase he taught them himself.

Efficiency of investment refers to how much money can be saved over current spending levels by investing in a more efficient work process. In the case of HCC, the costs savings since 2007-2008 are $25 million and counting.

It wasn't always like this. Carter is painfully aware of how IT was originally viewed on campus. "The cost of instructional departments is justified by the revenues they generate from student tuition and state reimbursements," he notes. "Me, I'm a cost center. They dump money into IT. In the past, they've seen very little coming out of it."

THE IT DEPARTMENT at Houston Community College (TX) calculates that it has saved the 23-campus school $25 million and counting since 2007-2008.

No more. During this school year, Carter expects to cover 77 percent of his total IT budget in efficiencies of investment. He has set a personal goal that, within two years, all of his IT costs will be covered, making the organization cost-neutral. Savings totaled $9 million last year, $8 million the year before, $4 million the year before that, and $2.9 million in 2007-2008.

And Carter is using these numbers to help reposition IT as an efficiency expert. As a result, the tune of board meetings has changed from, "'There he goes again,'" says Carter, to "'OK, he's doing this for a reason. We need to understand the reason.'"

For every IT project, Carter finds ways to quantify how it will impact the institution—and the bottom line. Consider IT's automation of the HCC time sheet system in 2009. Prior to that, each employee would submit a written time sheet to a department secretary, who would validate it, get a supervisor signature, and manually enter the data. Each of those manual touches cost money, however: In a college system with about 4,900 employees, the costs rapidly added up. With two pay periods a month, that's 117,600 time sheets in a year.

In seeking a way to calculate the true cost of the system, Carter drew on a widely disseminated statistic from Coopers & Lybrand (which became PricewaterhouseCoopers in 1998) that estimates companies spend $20 in labor to file a document, $120 to find a misfiled document, and $220 to reproduce a lost document. Erring on the conservative side, Carter estimates HCC's manual handling costs at $15 per sheet of paper.

As a result, when IT replaced all those manual steps with a workflow in PeopleSoft's ERP application, Carter was in a position to calculate the impact to the institution. The result? A cool $2.3 million in savings during the first two years.

The savings have been even more dramatic in the area of student payments and refunds. The original system was completely manual and onerous, particularly on the refund side. Staff would print checks, stuff them into envelopes, hand them out to students, file the checks after they were cashed, deal with incorrectly addressed checks, store all the paperwork, and later destroy it.

In fall 2008, HCC implemented CashNet, a service from Higher One for handling student payments online. Then, in fall 2009, the college contracted with Higher One for its student refunds and financial aid disbursement service, OneDisburse.

By handing those operations over to a service provider, the college eliminated staff and handling costs; reduced the cost of supplies, such as paper, ink, toner cartridges, and printer drums; and reduced power usage. Carter estimates that HCC has saved about $500,000 for each year that the CashNet system has been in place. The OneDisburse program saved $1.3 million in its first year and $1.4 million in its second year.

But Carter is nothing if not relentless in calculating what he considers the true savings. For example, the college has experienced tremendous growth in recent years, with student enrollment rising from 53,097 in 2005 to 75,600 in 2011. How many additional employees, Carter asked the head of financial aid, would have been needed to keep up with this surge? The response: another 10 people on top of the 15 or 20 he already had in his department. "Right there, that's $500,000," declares Carter.

RESOURCES

For links to the schools, products, and vendors mentioned in this article, please visit *campustechnology.com/0212_newnormal.*

Publicize Your Success

Success breeds success. "When you do this over long periods of time, all of a sudden people start paying attention," Carter explains. "They start going, 'Wow. I want to get on that bandwagon. I want to think about how IT can help me.'"

At Loyola, Finn realized that the Paperless University was a hit when a famously reluctant faculty group expressed interest in the project. "If I had gone to them two years ago and said, 'We're going to take this process paperless,' they would have run for the hills," notes Finn. "Now, they want to get on the bandwagon."

For that to happen, though, CIOs have to get the word out about their successes. They have to toot IT's horn. To ensure that all of IT's cost-saving initiatives receive publicity, for example, Carter maintains a spreadsheet of all the projects on HCC's sustainability website.

"Technology people are inherently working to make things more efficient," Carter points out. "But they do a lousy job of publicizing their results. They do a lousy job of measuring them. As we get more and more into things like performance funding, accreditation, and accountability, what you're going to find is that IT leaders are going to have to figure out a way to justify their existence, or they're going to end up out of a job." CT

"Technology people do a lousy job of publicizing their results. They do a lousy job of measuring them."

—Bill Carter, Houston Community College

With budget planning in full swing on campuses, *CT* offers 10 tips for controlling costs and increasing efficiency, from renegotiating software contracts to implementing zero-based budgeting.

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Dian Schaffhauser is a senior contributing editor of Campus Technology.

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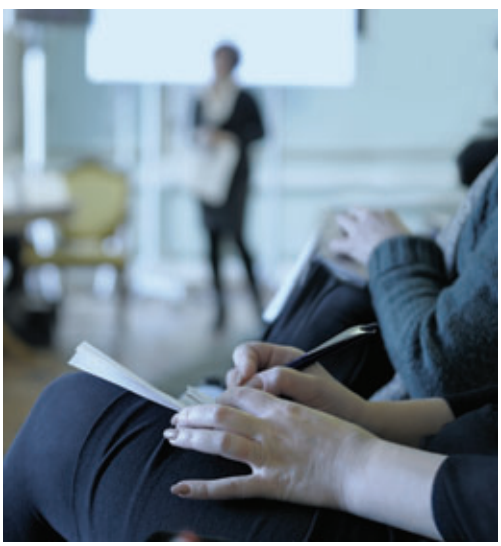

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3D technology is here and showing good results in some classrooms. The challenge lies in finding sufficient content to make the investment worthwhile.

BY KEITH NORBURY

3D, OR NOT TO BE?

IT MAY BE TOO SOON for students to be showing up for class with popcorn and gummy bears, but technology similar to that behind the 3D blockbuster movie *Avatar* is slowly finding its way into college classrooms. 3D classroom projectors are taking students on fantastic voyages inside the human body, to the ruins of ancient Greece—even to faraway galaxies.

A watershed moment in 3D-projector technology came in 2009, when Texas Instruments (TI) released a firmware upgrade that enabled newer DLP (Digital Light Processing) projectors to accommodate 3D. Since then, the cost of 3D projectors has dropped to where some manufacturers, such as BenQ, offer a 3D-ready projector for as little as $599.

Even so, colleges and universities have been slower to jump on the 3D-projector bandwagon than K-12 schools, says Chris Chinnock, founder and president of consulting firm Insight Media. This is probably due to the fact that more 3D content is currently available for the K-12 market. Chinnock expects the rate of adoption in higher ed to pick up as more college content is created and more studies demonstrate its value.

So far, much of the research into 3D learning has been sponsored by the manufacturers themselves, including a six-month study conducted in Europe in 2011 that compared the performance of students in classes using 2D and 3D imagery. Underwritten by TI, the "Learning in Future Education 1" study found the test scores of students in the 3D classes improved by 17 percent over their pre-course test scores, compared with an 8 percent improvement among students in the 2D classes.

Until independent studies can evaluate the impact of 3D content in education, however, it would be premature to rely on any statistical learning claims for the technology. Even then, it seems likely that any gains will be highly dependent on the quality of the content itself. That certainly seems to be the message from faculty who have used 3D content in their classrooms.

Lonnie Busch

Faculty Experiences

At the Carver College of Medicine at the **University of Iowa**, lecturer Darren Hoffmann has been using 3D projectors for two years to teach anatomy to groups of eight to 20 students. "The product itself is fascinating," says Hoffman, who also serves as a consultant for Cyber-Anatomy, the creator of the 3D cadaver software. "There are things I can teach faster with a 3D visualization than with flat PowerPoint slides."

Columbus State Community College (OH) developed its own 3D content for a distance-learning course on mythology. Lita Tzortzopoulou-Gregory, who is an instructor at the college, and her husband, Timothy Gregory, a professor at **Ohio State University**, shot video and still photos last summer with Fuji 3D cameras. They then shared the images remotely with the college through Dropbox.

"The reaction was interesting—it was split," says Jason LaMar, a multimedia web developer at the college. "I think it mirrors society's general reaction to 3D stuff. Some people love it. For some people, it gives them a headache."

Those who loved it, though, were enthralled, he adds. "It's one thing to see a flat photo of the Parthenon in Greece, but it's an entirely different experience in 3D. You feel as if you could walk between the columns."

Meanwhile, an effort at **Purdue University** (IN) to model Earth's galactic neighbors in 3D fell short of expectations, according to Laura Cayón, a research associate professor in the physics department. The school installed a stereoscopic 3D system in an astronomy classroom capable of seating about 60 students. Unfortunately, the 3D experience didn't enhance students' appreciation of astronomical scales any better than viewing flat-panel representations did.

"Distances are so huge that it's hard to visualize 3D in the enormous empty spaces between galaxies," notes Cayón. "We came to the conclusion that a better option—at least for our project—was to have individual screens rather than [one large one]. Students become more immersed because it's their own screen—it's not so far away."

Darton College (GA) also experienced growing pains with its 3D software. The school obtained 3D anatomy models that were then animated by Andrew Lenard, a web designer at the college who helped build the 3D system.

The heart model looked great, except for one problem, recalls Darryn Ostrander, who was then director of instructional technology and distance learning: "The first thing a doctor said was, 'That person's going to die—he's got arrhythmia. The heart's not beating properly.'" Lenard, who's not a doctor, had incorrectly animated how the heart beats. Nevertheless the demonstration impressed physicians, who told Ostrander that it was better than dissection.

RESOURCES

For links to the consultants, studies, and vendors mentioned in this article, visit *campustechnology.com/0212_3d.*

Lack of 3D Content

Without doubt, the biggest barrier to wider adoption of 3D projectors in the classroom is the dearth of quality instructional content. "There are a lot of 3D projectors in place, but we are waiting for the content and whole 3D ecosystem to catch up," says Michael Abramson, vice president of research for Pacific Media Associates, which covers the projector market.

It's a viewpoint shared by Insight Media's Chinnock. "In order for this to really move forward, you have to have the hardware/software solution," he notes. "The hardware is certainly there. The software, partly being the curriculum, that's getting there."

For content companies playing in the 3D space, though, it's a classic chicken-and-egg scenario. Why would a university buy a 3D-projection system for just one or two software titles? Conversely, why would a company develop a host of expensive titles to serve what is, after all, a relatively small market right now?

"For us, it would be great if there were 30 companies like ours," says Rich Lineback, president of Cyber-Anatomy. In addition to Cyber-Science software for

SIZING UP 3D GLASSES

A MAJOR CONSIDERATION with 3D projection is the choice of stereoscopic glasses required to create the 3D effects. Active-shutter glasses can view an image projected on any flat surface, while passive glasses require a silver screen as well as either dual projectors or a polarizing filter to create the 3D effects.

While passive glasses cost only a few dollars each, the active-shutter versions can cost upward of $100 each. Vendors offer volume discounts, however, which can reduce the cost to about $50 a pair.

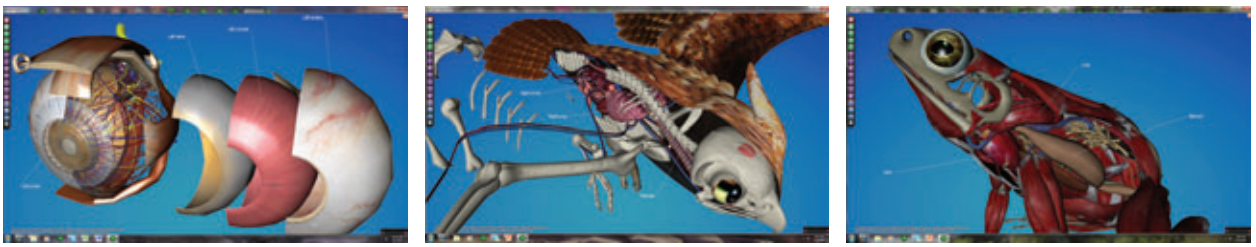
Regardless of the type of 3D glasses, their use does appear to have an unexpected, positive side effect: keeping students focused on the 3D content rather than fiddling with their smartphones or tablets, says Jaime Beringer, customer marketing manager for Texas Instruments' DLP. "Glasses almost become like little radar-focused tools."

On the flip side, Darren Hoffmann, a lecturer in the Carver College of Medicine at the **University of Iowa**, complains that they prevent eye contact with the instructor.

"I can't see people's lightbulbs going off," he says. "If I could remove the glasses and still have the engaging visuals, I think I'd probably be more satisfied as an instructor." One other irritant: Distributing and collecting glasses can be a pain, especially for larger classes.

The holy grail of 3D-projector technology—a glasses-free version—is still several years from being ready for prime time. The problem is that glasses-free 3D requires at least eight viewing zones. To achieve this either greatly reduces resolution or requires far more computing power, which boosts the cost.

"I'm hoping in the next two years that the holy grail is developed," says Jim Mayrose, an associate professor at **Buffalo State College** (NY). "If not, we will be going with the DLP 3D projectors with stereo glasses."



CYBER-ANATOMY'S CYBER-SCIENCE 3D package offers students a way to do virtual dissections.

high schools and junior colleges, Cyber-Anatomy offers a more sophisticated 3D package for medical schools.

Founded by Karim Abdel-Malek, a professor of biomedical and mechanical engineering at the **University of Iowa**, the company discovered its first big market in the Middle East, where the Islamic requirement that a body be buried soon after death has led to a shortage of cadavers to train doctors. "Also, they don't have enough anatomy instructors," adds Lineback.

An interesting newcomer to the 3D-content scene is ViziTech USA, founded two years ago in Atlanta by retired Brig. Gen. Stewart Rodeheaver. While in the military, Rodeheaver was tasked with finding a better way to teach new soldiers. He soon realized that today's youth, whom he dubbed "screenagers," are visual learners.

"I think it's absolutely the wave of the future," he says of 3D. "I think that the more virtual, the more visual, and the more experienced-based you can make it, the better off we're going to be."

ViziTech USA uses 3D AVRovers as the platform for proprietary 3D content sold to institutions such as **Moultrie Technical College** (GA) and **Savannah Technical College** (GA). Moultrie bought three units in early 2011 for its healthcare programs, while Savannah recently signed a deal to use ViziTech USA 3D for its machine shop, aviation mechanics, and automotive-technician programs, says Rodeheaver.

His company invented "gesture manipulation," which enables a student to move 3D objects, such as machinery, by hand without having to use a mouse. ViziTech USA is currently working on a content portal to provide certified, curriculum-specific 3D imagery that can be downloaded by educational institutions.

A final hurdle to broader implementation of 3D projectors in higher education is one with which educators are all too familiar: budget issues. In these difficult economic times, it's tough to justify spending money on perceived frills. "That's a real issue," says Lineback. While 3D-ready projectors are not significantly more expensive than traditional projectors, many schools are likely to phase them in only gradually, as part of their normal equipment-replacement cycle. Even so, additional money is required to purchase auxiliary 3D equipment, including screens and glasses (see "3D Equipment Options" below).

One way around that, says Hoffmann, is to find money in a school's outreach or recruitment budget. He tosses the Cyber-Anatomy box in the back of his car and takes it around to high schools to promote Iowa's medical school. But it can also be used to dazzle alumni and other potential donors.

"Because it is so visually interesting, you get that automatic buy-in from anybody who just wants to see what it looks like," Hoffmann says. CT

__Keith Norbury__ is a freelance writer based in Victoria, British Columbia.

3D EQUIPMENT OPTIONS

SCHOOLS HAVE A VARIETY of options for setting up a classroom 3D-projection system, with a broad range of prices.

"In terms of full classroom 3D with a projector, DLP is the solution for today," says Chris Chinnock, founder and president of consulting firm Insight Media, of the Digital Light Processing projectors powered by technology from Texas Instruments (TI). "However, Epson has just announced a number of new 3D projectors based on their LCD technology."

A third technology is LCOS, which stands for liquid crystal on silicon. It is reflective like DLP but uses a liquid crystal like LCD.

According to Jaime Beringer, customer marketing manager for TI's DLP, a basic DLP 3D projection system can now be put together for as little as $1,500 to $2,000, while Chinnock estimates it would cost about $5,000 to equip a classroom for 3D.

Some of the same companies peddling 3D content also offer turnkey hardware solutions as part of an effort to jump-start the industry. For example, Cyber-Anatomy provided the Carver Medical College at the University of Iowa with a turnkey system that includes a 3D projector, 3D-capable computer, and 3D glasses. The 35-pound equipment package sets up on a table to project 3D images on any surface. According to Rich Lineback, president of Cyber-Anatomy, a hardware package typically adds up to about $10,000.

A similar system is in place at **Columbus State Community College** (OH), except the college's technical crew assembled the components itself. That system, which cost about $5,000, includes a Sharp 3D DLP projector, a Dell laptop with an Nvidia Quadro graphics card, and 40 pairs of XpanD active-shutter 3D glasses, says Jason LaMar, a multimedia web developer at the college.

Also offering a turnkey 3D solution is AVRover. Its 3D projector package includes the projector, computer, and glasses on a rolling cart for under $10,000, says Doug Smith, AVRover's president. "We found that there were a lot of people trying to put carts together," Smith says. "They'd have 3D glasses and everything, but it was difficult to get it to work."

CT Solutions

The latest releases, services, and new product versions

Indoor/Outdoor Wireless Mounts

Peerless-AV has launched a line of indoor and outdoor wireless mounts that enable streaming of full HD 1080p images over a distance of up to 131 feet. The new plug-and-play *PeerAir Wireless Mounting Solutions* include indoor and outdoor wireless articulating arms and tilt wall mounts, a mobile cart, and a wireless projector mount. Power and cabling provisions—including short-length HDMI cables—also come with the system. Additional features include reverse IR, multicasting for up to four displays from a single transmitter, and WPA2 security. Contact vendor for pricing. *peerlessmounts.com*

Lecture Capture Goes Mobile

Sonic Foundry has released a version of its lecture capture software that allows users to view presentations on their mobile devices. Version 6 of *Mediasite*, released in December, features the ability to stream presentations live or on-demand to iPad, iPhone, iPod, BlackBerry, and Android devices supporting HTML5 and H.264. The software detects what type of device is in use in order to optimize playback, and uses native touch-friendly controls and navigation gestures. *sonicfoundry.com/mediasite*

Lamp-Free Projector Revamp

Casio is revamping its lineup of highly mobile projectors that use a hybrid light source based on lasers and LEDs. The company will release six new models in the DLP-based *Slim* line, whose models weigh in at 5 pounds and measure 1.7 inches in height. The lamp-free, hybrid LED/laser light source has an expected life of 20,000 hours. The new models—which will include the XJ-A141, XJ-A146, XJ-A241, XJ-A246, XJ-A251, and XJ-A256—will offer enhancements such as a built-in light sensor, continuous automated brightness control, and an economy mode. Other features include 2x optical zoom; an integrated 1-watt speaker; and MobiShow, a wireless presentation tool compatible with iOS, Windows Mobile, and Android operating systems. Pricing for the new models will range from $1,000 to $1,500, and will include a three-year parts and labor warranty and a three-year/6,000-hour warranty on the light source. No shipping date has been announced.

casioprojector.com/products/Slim_Projectors CT

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C-Level View

Grading OERs for Class

Social-networking tools and learning analytics can help educators evaluate OERs.
By Mary Grush

A vast amount of open content is now accessible to educators online, but there's not much evaluation data or guidelines on how to use it. *Campus Technology* asked Michael Cottam, associate dean of instructional design and new program development at **Rio Salado College** (AZ), how higher ed could better evaluate open education resources (OERs) and help course designers leverage them more appropriately.

CAMPUS TECHNOLOGY: There's such a wealth of material online under Creative Commons licensing. How can course developers determine the potential effectiveness of an OER for their course?

MICHAEL COTTAM: For an instructional designer, it's a matter of curating it and gathering it into something that will make sense for your particular learners in your particular class. Part of what an instructional designer has to do now is to find the best resources and fit them together in a way that allows learners to meet their objectives in a class.


COTTAM

CT: Is the role of instructional designers not only to guide faculty in how to use technology effectively, but also how to identify and use OERs?

COTTAM: I think it's both now. The skill set around using technology for instruction is certainly still required, but instructional designers also have to be very aware of the OERs that already exist, and guide faculty to use them in an effective way. To do that, we need to be able to evaluate OERs. I think that's a direction the OER community needs to take.

CT: How do you see this happening?

COTTAM: The first thing is online feedback. As a consumer, when you investigate any product or service online, it's increasingly common to see other people's reviews of the product right there. Can we do the same thing with OER? To some extent, people have already been peer evaluating OER content. For example, MERLOT has been facilitating peer reviews for years. But we need to leverage social-networking tools more widely. The peer evaluation that happens naturally in an online social environment could inform instructional designers and faculty as they build courses. In a sense, it's the collision of OERs with social networking online that's going to make this work.

Part of the allure of the social web is that you can interact with anybody, anytime. As an academic, you may get feedback from many different perspectives—from swirling students, from practitioners in the professions, as well as from other academics. In a way, the chaos of the web can be informative and beneficial to us as designers and educators.

CT: What else will help evaluate OERs?

COTTAM: The other very exciting piece that ties in with evaluating OERs is learning analytics. With learning analytics, I hope we can look more deeply into the effectiveness of specific learning designs and online learning materials—especially OERs—in our classes. Then we can make data-based decisions to improve our courses.

If there are OER learning objects on the web with common assessments, and we are able to gather data on their effectiveness for a large number of learners and institutions, the impact of design improvements can extend beyond a single class or section. Shared data and transparency about learning design and outcomes have the potential to change the way we approach student success.

Analytics have been used in the corporate sector for many years. The impact of analytics can be as great in education as it has been in business and marketing. By pairing learning analytics with a strong methodology, we will know that the results are valid and reliable. If those results are then broadly shared among institutions, they have the potential to effect widespread change in the acceptance and use of OERs. **CT**

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