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# CLASSROOM TECHNOLOGY

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Upgrading campus technology to support today's teaching and learning approaches

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For more information on classroom technology, visit [CDWG.com/hiedsolutions](http://CDWG.com/hiedsolutions)

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# NEW INSTRUCTIONAL MODELS

Technology is driving change in the way teaching and learning happen in the classroom.



**C**lassrooms in the 21st century are undergoing a rapid transformation into new learning environments that are highly flexible, configurable and collaborative. Large lecture halls with sloped floors and fixed seats and classrooms with immovable podiums and tablet-arm chairs are going the way of the mimeograph as colleges and universities redesign learning spaces to accommodate new instructional models. This is a change driven by a generation of students who grew up in the digital age and who now expect interactive, learner-centered instruction.

By their very presence, new classroom technologies are changing the way professors teach and measure student outcomes. For example, adding network access and digital projectors to classrooms encourages the use of interactive content. More important, new technologies provide the means through which new instructional models take hold and flourish.

Classrooms rich with interactive

whiteboards, document cameras and lecture capture systems support active-learning environments. Telepresence systems, along with video and web conferencing, expand classroom walls to include participants from anywhere in the world.

Students, equipped with notebooks, tablets and smartphones, can learn at their own pace in classroom extensions that can be accessed at any time, from any place. IT leaders can better prepare for future classroom (and campus) needs – and meet current demands – by designing agile and secure networks and planning future budgets strategically.

While the lecture – with an instructor standing at the front of a roomful of students, imparting his or her knowledge – remains the norm, new instructional models are evolving, shifting the focus to a student- or learner-centered environment.

## The Changing Instructor Role

Nowhere is that shift more apparent than in the evolving role of the professor,



from a “sage on the stage” to a “guide on the side,” based on distinct theories about how students learn.

The sage-on-the-stage model is unidirectional and relies on an all-knowing instructor to impart wisdom to a group of students who are empty vessels, waiting to absorb information. The guide-on-the-side model suggests that students learn best by interaction, engaging with and creating content. In this approach, the instructor serves as a mentor to students, who direct their own learning experiences.

A third model, a hybrid of the two approaches, is commonly referred to as the “sage on the side.” It is, perhaps, the most accurate reflection of the balanced role the instructor plays in today’s classrooms – as a subject matter expert, facilitator and student guide.

No matter which model is applied, there is no question that institutions have moved beyond the idea that learning is, or should be, a passive activity. Information dissemination will always play a part in a student’s education. But with the proliferation of information and widespread access to it via the Internet, *information literacy* – defined by the National Forum on Information Literacy as the

ability to “identify, locate, evaluate, and effectively use” information for problem solving – is at least equally important, and can only be achieved through active participation in learning.

Instructional models designed to foster active participation are known by many names, from problem- or challenge-based learning to collaborative or team-based learning. But they all have one thing in common: The responsibility for learning is shifted to the learner.

Although they are receiving a lot more attention today, such models aren’t necessarily new. What is new, especially in higher education, is their more widespread adoption and inclusion in the “traditional” classroom environment.

**Active learning** | This is a broad category of instruction that encompasses many of the other models detailed in this guide. This term, popularized in the 1980s and 1990s, refers simply to any learning in which students engage with class material through summarization, discussion, exercises or activities. Active learning often involves peer-to-peer work, and may take the form of role-playing or simulations, class discussion or group projects.

**Problem-based learning** | PBL is a form of active learning in which groups of students tackle a problem in order to gain both subject matter knowledge and critical-thinking skills. As part of a PBL exercise, students identify the information they have as well as the information they need, then determine the best way to find the information required to solve a problem. Challenge-based learning (CBL) is an extension of PBL: Students not only identify how to solve a problem, but also identify the problem (challenge) itself.

**Collaborative and team-based learning** | These are instructional models in which students work in pairs

or in teams to complete assignments, solve problems or deliver projects. Teams, teamwork and team building characterize the workplace. It’s likely that all students will be expected to work collaboratively one day, in both their professional and personal lives.

Social learning, which suggests that learning is acquired through interactions with others, provides the context for collaborative, team-based learning approaches. Thanks to available technology, social learning can now take place through face-to-face, virtual and global social interaction.

**Competency-based learning** | This approach focuses on what (as opposed to how) a student learns, and when. A student progresses to the next content area only after demonstrating competency (or mastery) in a particular set of knowledge or subject matter. Competency-based learning creates the potential for every student to learn in an individualized and personalized learning environment.

## The Flipped Classroom

The flipped classroom provides the perfect vehicle for introducing active learning and learner-centric instructional models into the physical classroom. At its core, a flipped classroom is an instructional model in which the traditional lecture and homework components are reversed. The lecture – or, the dissemination and acquisition of knowledge – happens outside of class time, while the homework – or, application of knowledge – happens within it.

The flipped classroom concept is by no means a new development. In its earliest form, students were expected to read from their textbooks and come to class prepared to discuss key concepts. But aided by technology, the flipped classroom approach becomes a rich, multimedia experience.

AT ITS CORE,  
A FLIPPED  
CLASSROOM IS AN  
INSTRUCTIONAL  
MODEL IN WHICH  
THE TRADITIONAL  
LECTURE AND  
HOMEWORK  
COMPONENTS  
ARE REVERSED.



Students may be asked to read preparatory content, listen to audio lectures and view podcasts in advance of the actual class. Professors may create their own content through the help of lecture capture or video recording software applications. Or they may curate content from an ever-growing pool of resources provided by textbook publishers, multimedia content producers, education startups, other colleges and universities or individual experts from around the world.

In the flipped classroom, students take on more responsibility for acquiring core or “base” concepts, but they also have more control over their own education. While faculty members teach at their own pace in traditional lecture settings, in a flipped environment lectures can be stopped, started, rewind, paused and viewed again and again until students fully understand the content. Students determine when and where they would like to view lectures, and tackle subjects at their own pace.

Content delivered outside of the classroom often is interspersed with quizzes or activities to ensure students truly understand the concepts being explained – and, occasionally, to ensure that students actually complete out-of-class assignments. Activities provide students with instant feedback, and nicely support the competency-based learning model.

Such forms of assessment also help instructors to determine where to focus valuable classroom time if it becomes clear that students are struggling with specific concepts. With more dissemination of information happening outside of the classroom, class time is applied to active-learning activities that focus on inquiry and interaction (both student-to-teacher and student-to-student), as well as application of the knowledge gained.

## Virtual Learning

If the flipped classroom is changing the nature of what happens within classroom walls, new models for course delivery are breaking down those walls altogether. Virtual environments, from blended classes offered by a university to its enrolled students, to massively open online courses (MOOCs) offered for free by universities around the world to any student, have dominated recent conversation, and student interest and enrollment in them is only expected to grow.

According to one Pew Research Center survey, 50 percent of college presidents expect that within 10 years, a majority of students will be taking at least some of their classes online. Already, nearly a third of college students have taken at least one class completely online according to the *ECAR Study of Undergraduate Students and Information Technology* (2012), from the Educause Center for Applied Research.

MOOCs and other, more traditional but fully online courses are designed to enable instructors and students to interact virtually. Often, the courses are delivered through a unique platform or learning management system (LMS) that supports basic classroom functions such as lecture posting and file sharing, group discussions, work submission, and quizzes or other assessments. In some cases, the LMS facilitates real-time interactions such as chat, desktop sharing, collaborative whiteboard space and web conferencing.

Online courses are touted for their convenience because of their asynchronous delivery, allowing students to learn and interact with content according to their own schedule, instead of within a fixed class time. Such courses also allow students and faculty to participate from any location. While online courses frequently are structured much like onsite classes, with content



## LEARN NOW, LECTURE LATER

CDW•G surveyed 1,015 students, faculty and IT staff about their instructional preferences for the 2012 *Learn Now, Lecture Later* report.

The survey found that faculty members are moving away from the traditional lecture model: Just under half of those surveyed already have made the shift. Another 20 percent reported that they are considering a change.

### Which instructional delivery methods have you used more frequently during the past two years?

- 59%** Leading hands-on projects with students
- 51%** Guiding students on group projects
- 31%** Guiding independent research/study or self-paced study
- 37%** Distance/virtual learning
- 13%** One-on-one tutoring with students

Source: CDW•G's 2012 *Learn Now, Lecture Later* report



released and covered only in a specific time period, they also lend themselves well to competency-based learning.

A major complaint about online courses is that they lack face-to-face interaction, which can present a challenge for some students. In response, many institutions now offer “blended” courses, providing synchronous and asynchronous opportunities with both onsite and online components. The flipped classroom is an example of a blended class in its simplest form. However, the online component of a blended course often reduces the amount of in-class time.

For example, students might participate in person only one or two days per week, and complete the balance of class time online. Another variant of the blended learning model, called “HyFlex,” provides both online and in-person class tracks and allows students to participate entirely in one or the other, or in both, switching back and forth between the options based on their comprehension of

the material and other needs.

With the advent of so many new technologies, the benefits of virtual learning can be combined with the value of face-to-face interaction in ways never possible before. Online courses can be made more personal, and physical classrooms can be transformed into a global stage.

Web and video conferencing and telepresence systems provide the means for face-to-face interactions in both physical and virtual environments. Online classes can be augmented with virtual office hours, in which faculty members meet face-to-face with students via Skype or other web conferencing technologies. Online students can form study groups or work on group projects in real time using web and video conferencing and collaboration tools.

The potential of these technologies to transform the physical classroom space is even more compelling. The high-definition audio and video capabilities of telepresence systems make it possible to bring faculty and students into the traditional classroom

from hundreds or thousands of miles away, with near lifelike precision.

An expert doing fieldwork in Africa can guest lecture to students in Boston. A professor can hold class simultaneously in three different counties in Minnesota – a particularly useful tool for institutions with satellite campuses and highly specialized course content. Similarly, a student who needs a class not offered locally can join a classroom thousands of miles from home, with all the benefits of taking the course in person.

### **BYOD**

The bring-your-own-device movement is not an instructional model, but no technology trend has done more to transform the physical classroom or enable new teaching models than BYOD. A fundamental shift in higher education technology thinking is occurring, not just because of the presence of personal devices in a university's technology mix and on the network (both of which historically have been closed systems), but also because of how these devices

are being used in the classroom.

In a traditional, lecture-style course, classroom interactions almost exclusively are one-way, with a faculty member lecturing and students taking notes. Even with the introduction of classroom technology, most commonly a computer and projector, information and content is pushed to students with little engagement. Newer technologies, such as interactive whiteboards, are engaging students more fully with course content, but generally their use is limited to one or two students at a time.

With the widespread inclusion of personal devices (notebook computers, smartphones, tablet devices, e-readers and more), students are taking a more active role in the classroom and engaging more deeply with content. Most students now arrive at college equipped with several devices (more than three devices per student, on average, according to some reports), and they expect to be able to connect them to their institution's network and use them everywhere.

In addition to having communication and entertainment value, the devices also are effective learning tools. However, at some institutions they have been (and in some cases, still are) banned from classrooms out of concern that they serve only as distractions.

Individual instructors and colleges that see beyond the distraction potential are realizing the tremendous benefits of allowing students to bring their own devices into the classroom, particularly in support of active learning and other new instructional models. Students are able to take and share notes with new software and mobile applications on their notebooks, tablets and smartphones. Should a student forget an important concept, he or she can easily access archived lectures, e-textbooks and other online reference materials – content that's virtually

available to anyone with a computing device and an Internet connection.

Students' devices can extend an institution's technology capabilities and do much to create technology-rich learning environments. Through BYOD, students can interact with course content and demonstrate comprehension by using their devices as student response systems.

Students engaged in problem- or challenge-based learning can conduct research and collaborate on electronic documents without setting foot in the library. With technology readily at hand, students engage with course content, and each other, in a multitude of ways – finding, curating, creating and collaborating – without ever leaving the classroom. ■

# MIXING IT UP

Students surveyed in the *Learn Now, Lecture Later* report want a greater mix of instructional models.

## HOW WE LEARN vs. HOW WE WANT TO LEARN:

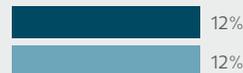
### TRADITIONAL LECTURE MODEL



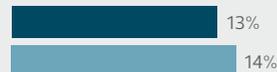
### HANDS-ON PROJECTS



### GROUP PROJECTS



### INDEPENDENT STUDY



### DISTANCE/VIRTUAL LEARNING



### ONE-ON-ONE TUTORING



■ HOW WE LEARN  
■ HOW WE WANT TO LEARN

The full *Learn Now, Lecture Later* report can be viewed online at: [CDWG.com/lnll](http://CDWG.com/lnll)

# RETOOLING THE CLASSROOM

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A fresh perspective and the right tech tools are needed to facilitate today's learning and teaching styles.

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**A**s new instructional models grow in popularity, students and faculty are asking to have more technology integrated into their classes and classrooms.

Learning spaces must be redesigned from the ground up to meet today's student and faculty needs.

## Reimagining Learning Spaces

The intended use of an architectural space and the entirety of the physical space – from furniture and lighting to acoustics and electricity – must be considered to maximize the effectiveness of modern instructional models and the technologies that support them. Designers must carefully consider the mix of space available and the different types of instruction each room can support.

When rethinking learning space, many institutions find it difficult to dedicate rooms to specific instructional styles. Instead, they opt for flexible classroom spaces that can support a variety of pedagogical styles and class

structures, and that can be adapted as styles and needs change. Such classrooms require more square feet per person than traditional classroom designs to provide sufficient room for a variety of class configurations.

Furniture must be easily moved and configurable, and provide adequate surface space to balance student technology – notebooks, tablets, smartphones and e-readers – as well as books, papers and group work. Tables and chairs might be on casters or easily folded and stacked. Tables might also be in a variety of shapes that lend themselves to different configurations for individual or group work.

Multiple writing surfaces and display areas, whether low-tech portable whiteboards or high-tech interactive whiteboards, can be included, alongside group tables with one flat-panel display each or a main presentation area with at least two screens for displaying both static and interactive content simultaneously.

Zone lighting systems and window

shades help provide optimal conditions for viewing content from a digital projector. The size of a space as well as its acoustic qualities (from the types of flooring and ceiling materials to ambient noise from an HVAC system) should be considered to determine whether a microphone and speakers are necessary.

A solid infrastructure must be in place to support technology-enabled learning. While there may be specific requirements for server and storage infrastructure depending on the particular technologies deployed, the presence of end-user computing devices in the classroom elevates the importance of both network and power (see Chapter 4 for more on this topic).

### Personal Computing Hardware

According to CDW•G's *Learn Now, Lecture Later* report, notebooks and netbooks are the prevailing classroom technology, with nearly three-quarters of student and faculty groups reportedly using the devices. Fifty percent of students and 36 percent of faculty also use smartphones; 26 percent of students and 34 percent of faculty use tablet devices; and 19 and 17 percent of students and faculty, respectively, use e-readers.

While some faculty may fear that personal devices in the classroom will distract students, many recognize the potential of technology-rich environments to support active learning. With access to a personal device and the Internet, students not only can consume content, but also produce it during class time.

E-textbooks and an LMS enable students to quickly review key subject matter, recall and replay the instructor's latest lecture, or submit an assignment before the end of class. Research and collaboration also can be done in real time. With audio and video capabilities built into many personal devices, students

can generate multimedia content to demonstrate mastery of a subject and assist others in developing the same.

Schools are faced with myriad options when evaluating hardware, and also must decide whether to permanently equip classrooms; deliver devices via a mobile lab, one-to-one or loaner program; or simply allow any and all devices through a BYOD initiative. Each approach has its pros and cons.

Institutions that provide devices (either through fixed or mobile labs or one-to-one programs) control the hardware and software, ensuring that all students are on a level playing field with access to the same tools. However, these devices must be maintained and refreshed, at a cost.

A BYOD strategy can mitigate the time and expense of hardware maintenance, but students will use a variety of devices, platforms and software tools (and some students will have no device at all). What follows are the current options available for personal computing, however it is approached.

**Desktop computers** | Once the workhorse of institutional hardware, desktops today are found primarily in instructional or open-access computing labs, as well as on instructor podiums. Deploying desktops is a good way to ensure hardware and software consistency, and they often are the most robust choice, with excellent memory and processing power. Their size and cost, regular imaging requirements and three- to five-year lifecycle make them less desirable to some.

**Thin clients** | Virtual desktops and thin clients are a good choice for universities that want to provide a desktop computing environment in the lab without imaging. A desktop can be delivered to an end user, but the actual applications, operating systems (OSs) and computing are located on a server and delivered over a network,

which requires a robust network, server and storage infrastructure.

The underlying virtual desktop infrastructure (VDI) adds value to a BYOD initiative, letting students access a consistent desktop and institutional software from their own notebooks, tablets or smartphones.

**Notebook and netbook computers** | The notebook and netbook's small size, weight and portability make it the most requested instructional tool by faculty and the second most requested by students, according to CDW•G's *Learn Now, Lecture Later* report. Notebooks can provide almost the same computing power as desktops, and lend themselves well to flexible learning environments, but they are resource-intensive. Readily available power – both in classrooms and at charging stations – is essential.

Netbooks bridge the size and capability gap between notebooks and tablets. While netbooks can run software locally and perform basic office functions, they are best deployed where Internet access is the primary need. A newer breed of netbooks running Google's Chrome operating system offer a lower-cost, application-based computer that runs virtually everything off of the Internet. >



**Tablet devices** | The convenience of tablets has propelled them swiftly into classrooms. Their popularity can be attributed to small size and weight; long battery life; and versatility, with applications for browsing, email, e-textbooks, note taking, photos and video creation, flash cards, educational games and more.

Some institutions are experimenting with tablet devices as a replacement for notebooks, but they do have limitations, including lack of an integrated keyboard and reliance on applications. When such devices are delivered as part of a mobile lab, it can be difficult for students to take full advantage of applications requiring user-specific settings because of required institutional settings that lock them down.

**E-readers** | E-readers are tablet-like devices designed specifically for reading digital books. An early benefit of the devices was their “E Ink” technology, which produces a paper-like image and reduces eyestrain. Some e-readers now feature LCD screens, similar to notebooks and smartphones.

The popularity of e-books is rising, but the value of e-readers themselves remains unclear. E-books often are provided in proprietary formats. And while some e-readers are compatible with multiple formats, others require conversion or support only their own format. The rise of tablet devices, with a similar form factor and ability to utilize apps to read different types of e-books, may lessen the appeal of e-readers.

**Smartphones** | While not typically provided by an institution, smartphones bear mentioning because of their increasing use in the classroom. Half of students and more than a third of faculty said they use their smartphones in the classroom as a learning tool, according to CDW•G’s *Learn Now, Lecture Later* report. Smartphones can be used in web- or application-based student response systems and for research and access to the LMS.

No matter how complex a room’s systems are, the control panel must be simple to use and should be consistent across classrooms. Management software can be deployed to remotely monitor and support systems and submit help requests directly from the control. What follows are several technology options to consider for outfitting classrooms.

**Projectors** | Digital projectors, both LCD and DLP, are the primary presentation tools in many higher education classrooms. LCD projectors tend to have better color saturation and are brighter than DLP projectors at the same lumens, making them well suited to rooms with a lot of ambient light. DLP projectors tend to be smaller and have higher contrast ratios and deeper blacks, making them well suited for video.

When considering projectors, look for models that can display content in the same aspect ratio (4 to 3, 16 to 9, 16 to 10) and display resolution (SVGA, XGA, 720p, 1080p) as the input device. The brightness (lumens) of the projector also should be considered in relation to the room’s size and lighting. Typical classrooms might require a 3,000- to 4,000-lumen projector, with higher lumens needed in larger or better lit spaces.

Maintenance is important to consider as well, including the time needed to clean and replace filters (some projectors are filterless). Nearly all projectors require bulb replacement every 2,000 to 3,000 hours. New hybrid laser and LED “lampless” DLP projectors can dramatically reduce the cost of ownership, with predicted bulb lives of 10,000 to 20,000 hours. These projectors power up quickly at full brightness, reducing class wait time, and are more energy-efficient than LCD projectors.

To create more flexibility in the classroom, wireless projection capabilities also should be considered.



## CASE STUDY

# FLIPPING THE CLASSROOM

Read how several institutions are retooling their approach to classroom learning:

[CDWG.com/hiedclassroom1](http://CDWG.com/hiedclassroom1)

## Presentation and Collaboration Tools

Colleges have many choices when it comes to classroom presentation and collaboration tools. Some provide instructors with only a projector and a screen. Others create experimental classrooms equipped with interactive whiteboards, document cameras, lecture capture and digital conferencing systems.

At the heart of any classroom is an automated control system that provides a single user interface for managing all of the audio-video equipment in a room, as well as classroom lighting and environmental systems.



Some projectors have built-in functionality, and there are a number of devices that can be used to wirelessly connect to a notebook or tablet.

**Interactive whiteboards** | These tools – large display boards connected to a computer and projector – support many learning styles and encourage students to interact with content. Whiteboards allow faculty to mark up content, then save their work for viewing later via the LMS.

Their size, screen area and interactive elements make whiteboards suitable for small classrooms and class sizes. The boards can be fragile, both because the whiteboard material itself can be delicate and because untrained users may use inappropriate writing materials with it. Some whiteboards can accommodate traditional dry erase markers, but most require the user to write with a finger or specialized pen.

Interactive whiteboards often come with their own software and educational toolset, typically geared toward K–12.

The time required to learn the system and design lesson plans that take advantage of the technology may hinder higher education faculty adoption.

Newer technologies that provide interactive whiteboard capabilities through a traditional projector environment, such as interactive pen devices (requiring proprietary hardware and software) or software that can be used on computers and tablet devices to write notes and mark up content, may provide the best of both worlds for higher education faculty.

Interactive content can be displayed through a standard projector on a larger screen (useful for large class sizes). This allows for greater mobility because students and instructors can interact with content from anywhere in the classroom.

**Student response systems** | Commonly referred to as “clickers,” these tools allow faculty to engage students in the classroom and assess comprehension of class material on the

fly. Student response systems work best in large classrooms where it is difficult to interact with all students directly, and with true/false or multiple-choice questions. The tools traditionally operate with proprietary hardware, which can be costly.

Several vendors offer the systems, and they are not compatible. Without clear cross-departmental communication and institutional standardization, students could be required to purchase multiple clickers for use in different classes.

Some institutions are moving toward software- or web-based systems that allow responses through any Internet-connected device – notebook, tablet or smartphone. But this requires a solid wireless network and good classroom coverage.

**Digital conferencing** | Conferencing systems that connect students to the global community while minimizing costs can create a diverse learning environment. This broad class of



technology includes web and video conferencing, telepresence and unified communications. Guest lecturers or expert faculty can teach from anywhere, students studying abroad can participate in on-campus courses and classes can take field trips to remote locations.

Web conferencing is the simplest of these systems, requiring only a webcam and microphone to interact in an online environment. Collaboration tools allow participants to chat or screen share over a digital whiteboard.

Software-based systems, requiring little more than an Internet connection, work well for pushing content to large, remote groups. They also work well for small groups or one-on-one sessions, such as study groups or virtual office hours.

Video conferencing often requires dedicated equipment at each end of the conferencing session, although it also can work across IP networks. These systems tend to feature higher quality audio and video than web conferencing systems. Telepresence systems use ultra-high-definition video, spatial audio and life-size images to create an environment in which remote participants feel as though they are in the same room.



**INSTRUCTORS CAN RECORD CLASS SESSIONS – INCLUDING AUDIO, VIDEO AND SCREEN ACTIVITY – USING A WEBCAM, MICROPHONE AND LECTURE CAPTURE SYSTEM.**

## INCREASING COLLABORATION

The use of web conferencing, video conferencing and telepresence technologies is on the rise at higher education institutions:

**33%** Number of students who have used these technologies in their classrooms

**31%** Number of faculty who have used these technologies in their classrooms



Source: CDW-G 2012 *Learn Now, Lecture Later* report



**Lecture capture** | Instructors can record class sessions – including audio, video and screen activity – using a webcam, microphone and lecture capture system. This technology comes in all shapes and sizes.

Some are hardware or appliance-based, and may be set up permanently in a specially designed classroom or put on mobile carts that can be wheeled from room to room. Software-based systems can be hosted by an institution or in the cloud, installed on a podium computer or notebook, and used in any classroom where the software is installed. Originally designed to archive class sessions for future viewing, some systems now support simultaneous webcasting for real-time viewing and recording.

Systems can be integrated with a classroom's automated control system so that recording is easily started and stopped, or even scheduled in advance, with no user interaction required. Recorded content can be published automatically through a variety of media, integrated into an LMS and

viewed from practically any device.

Reporting is an integral component, and instructors who want to know what content is being watched, and how frequently, can use system data to identify specific areas where students may be struggling. Some systems also allow students to submit or respond to questions or take notes on content.

**Document cameras** | Like overhead projectors, document cameras project images for classroom viewing. Cameras can be used to display two-dimensional content, such as print advertisements in a marketing class or maps in a geography class, or 3D content, such as a dissected frog in biology or clay objects in art class.

Document cameras can be used to take pictures of content to be integrated into course material, posted to the LMS or used in an exam. Many double as webcams, and some offer video recording capabilities, making them useful for lecture capture and video conferencing applications as well as content display. ■

# Get Help

## Finding Funding Opportunities.

**With over \$1 billion in grants, GetEdFunding is a free, grant-finding resource.**

Designed for K-12 and higher education institutions, the site is dedicated to helping educators identify the funding that's needed to take learning to the next level.



Find the funding you need at **[GetEdFunding.com](https://www.getedfunding.com)**

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-  Research funding options
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-  Create a profile and receive alerts for new opportunities as soon as they become available



Asynchronous Learning  
The New Learning Ecosystem  
Learning Management Systems  
Mobile Applications  
Social Media  
Electronic Portfolios  
Digital Content

# LEARNING BEYOND THE CLASSROOM

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The opportunities offered by today's new learning ecosystem are almost limitless.

.....



.....

**T**echnology-enabled teaching and learning tools not only advance classroom design and usher in new instructional models, they also extend learning beyond classroom walls.

Nearly all classes today, even those that take place in an actual classroom, include asynchronous learning components – information sharing that is not limited by time or place.

## **Asynchronous Learning**

Once thought the purview of online and distance learning only, asynchronous learning is possible through the use of an LMS, mobile applications, social media and other institutionally hosted or cloud-based presentation, collaboration and communication tools. As a result, a class that takes place, for example, between 10:00 and 10:50 a.m. on Mondays, Wednesdays and Fridays can now also occur at 1 a.m. Saturday in the dormitory on a student's notebook computer; at 9 a.m. Tuesday in the library on an institution-provided

thin client; and at 5 p.m. Thursday in the dining hall on a smartphone.

This shift to anytime, anywhere learning, through any device, is enabled by in-classroom technologies such as lecture capture systems, and also by the LMS, which provides a central venue for posting class materials and assignments, archiving lectures and hosting discussion on course topics. The proliferation of mobile devices and the consumerization of IT are also primary drivers of this change in where (and how) learning occurs.

These broad trends are expanding the list of acceptable tools and blurring the lines between education, work or school-specific software and consumer applications. Students and faculty, once restricted to using only software provided by their universities, now can choose among hundreds of free or low-cost, mobile- or web-enabled software applications to support everything from individual note-taking and studying to group collaboration and communication.



Still others are using a best-of-breed approach, combining elements of the traditional LMS with Web 2.0 technologies through a service-oriented architecture and federated identity management. Those universities have created portals that use web services, application programming interfaces and the new Learning Tools Interoperability (LTI) standard to provide access to any number of applications to support teaching and learning.

While it presents an appealing ideal, developing an institutional platform that supports PLNs and the wide array of applications in the new learning ecosystem is no trivial task. Institutions must have adequate technical staff to develop and maintain the environment and train and support end users who may find the many available options overwhelming. In addition, the common challenges associated with the public toolsets – for instance, reliability and security – do not go away.

The LMS still provides a number of advantages for many colleges. As more move toward open-source or cloud-hosted platforms, the LMS provides a relatively low-cost, comprehensive environment for facilitating class activities and interaction.

Most feature an ever-increasing, robust set of tools that can be tightly integrated. For example, completion of an assignment is automatically noted in the grade book. As management systems, they are designed to be integrated with student information systems and provide a wealth of data – all in one place – that can be leveraged for learning analytics.

### **Mobile Applications**

Under BYOD initiatives, students are bringing personal devices into the classroom in droves. They expect to have easy access to institutional resources, from registering for classes to participating via the LMS, using

those same devices. This makes mobile strategies key to institutional success.

The question for institutions is not if they want to provide mobile access to the classroom, but how they will do so. Will they buy or build to meet mobile needs? Should they create a platform-independent mobile website or an OS-specific mobile application? Some commercial LMSs are packaged with a mobile interface, and institutions must decide whether to provide it as a stand-alone offering or integrate it into an institutional mobile presence.

### **Social Media**

Despite being created for personal use, social networking tools and websites are quickly being adopted by faculty as a means to support student learning. In some instances, such sites provide a far more natural design and method of interaction than that provided by an LMS. Given that students spend so much time engaged in social media, social media platforms are a natural choice for bringing learning opportunities directly to students in their preferred habitat, rather than having students to come to a physical learning setting.

Instructors use sites such as Facebook and Twitter to post class announcements, link to additional resources and encourage student discussion, often in class. But not all faculty and students like the idea of merging school and personal content.

Some institutions have implemented private social networking sites restricted to students, faculty and staff. While such sites address privacy concerns and the blurring of public-private lines, they create yet another interface that students must visit and contribute to, often without the value provided by readily available commercial platforms.

### **Electronic Portfolios**

For many years, portfolios have been integral in certain disciplines, particularly teacher education and art. Frequently,

e-portfolios are hosted by institutions, enabling students to present themselves and their work in an online forum. A number of commercially available software products support the creation and management of e-portfolios, some under a software as a service (SaaS) model. Others are open-source, and some can be integrated into an LMS.

Given how much time students spend online (and recognizing how the lines have blurred between what's public and what's personal), institutions are seeking ways to help students understand, build and manage their overall online presence. With so many tools to choose from, the approach is often taken that the tool itself may not matter.

Helping students learn to navigate their options and develop a professional online presence, no matter which tool is used, should be the goal. Some institutions now offer students their own blogs, websites, web hosting or personal domain names to support this online presence and branding.

### **Digital Content**

At the core of any enabling technology, from LMS to social media, is content. Digital content is one of the most highly used tools in today's classroom, and students want more of it: 48 percent of students surveyed said they want more digital content to be incorporated in their classes, according to the *Learn Now, Lecture Later* report.

Digital content takes many forms, from text-based documents and presentations to audio- and video-enabled podcasts and lectures. Faculty can create their own content, or choose from an array of content available from textbook publishers, educational websites and other educators. Content may be available through subscription or purchase, or through a Creative Commons license for specified use. Or, it may be unrestricted and released as an open educational resource (OER).



## SOFTWARE AS A SERVICE

The software as a service (SaaS) model is one of the main forces behind the explosion of tools now available to students and faculty. Software delivered under the SaaS model is installed and hosted remotely – in the cloud – and provided to users via a web browser or mobile application. Data used by the software also is stored in the cloud.

SaaS is an optimal solution because it enables users to access the features and functionality they want, at limited expense. Typically, a user pays only for access to the software under a monthly or annual subscription fee, and some software is free. The SaaS model also enables access from any Internet-connected device, at any time.

Traditionally, higher education institutions have provided software either by developing it themselves, or by purchasing commercial software and hosting it. In such cases, the software

generally is available only over the university's network, and the institution is responsible for maintaining the underlying hardware systems that support it. The college also must maintain, upgrade and enhance (in the case of internally developed systems) the software itself.

Under the SaaS model, universities no longer must build and maintain a robust hardware infrastructure for hosting software, nor do they need to manage, maintain or upgrade the software itself. Cost-conscious institutions, or those requiring specialized, expensive software for limited use, frequently choose SaaS because it enables them to pay only for the number of users or amount of usage, rather than buy a software package outright. Deployment of new software under SaaS is fast and easy – all a college needs to do is sign up.

The choices can be overwhelming.

For faculty or students who seek to develop their own content, there is no shortage of content creation options available. Documents can be created with traditional software packages or through newer online document creation and collaboration sites such as Office 365, Google Docs/Drive or Zoho.

Similarly, text-based presentations can be developed using PowerPoint or Keynote, or the online presentation software, Prezi. Faculty can choose from myriad tools to create audio and video lectures in support of a flipped classroom.

A software- or hardware-based lecture capture system can be used to record lectures, as can locally installed or cloud-based software. And new mobile applications can capture audio, video or screen activity. Truly ambitious

faculty can even design and create their own interactive textbooks using online interactive magazine/book applications or software that comes standard with some computer operating systems.

Not all content must be created.

By utilizing content from other resources, faculty can take a best-of-breed approach, culling great reading materials, video tutorials and other supporting materials.

Many textbook publishers provide interactive digital content to complement printed texts, although some of that content can be accessed only through a publisher's proprietary system and is not easily integrated into an LMS. A significant amount of free content also is available through sites that specifically create or cultivate video content targeted to the education market (YouTube EDU,

TED-Ed and Khan Academy).

Once created or found, digital content can be distributed in a number of ways. When selecting a tool, instructors should consider how students will access the content, because some tools create content only for specific platforms.

Text and video content can be distributed via the LMS, through online channels such as iTunes U or YouTube, or through content-sharing sites used personally by the instructor, such as SlideShare, Vimeo or VoiceThread. Found content also can be collected and displayed using online curation tools such as Pinterest, Scoop.it or eduClipper. ■

# TECHNOLOGY POWERS ACADEMIC SUCCESS



**54%**  
OF STUDENTS  
SAY THEY ARE  
MORE ACTIVELY  
INVOLVED IN  
COURSES THAT  
USE TECHNOLOGY.

Source: ECAR report, *ECAR Study of Undergraduate Students and Information Technology*, 2012

**A**s CDW-G's recently released **Learn Now, Lecture Later** report confirms, the idea of a teacher serving as a "sage on the stage" is slowly giving way to an alternate approach, one in which the teacher functions a "guide on the side" so that students can steward their own learning experience. Based on a spring 2012 survey of 1,015 high school and college students, faculty and IT professionals, the report found that 47 percent of teachers have shifted away from the lecture-only model of teaching and another 20 percent of them are considering using different instructional methods.

While traditional lectures are standard, many teachers believe the approach is far less effective for today's students, who are fully immersed in technology when they aren't in school. The report bears this out, finding that the most satisfied students listen to fewer lectures and use more technology in their classes. Although 38 percent of student respondents say they want to learn via lectures, the remaining 62 percent prefer more variety, including hands-on group projects, independent study, distance or virtual learning and one-to-one tutoring.

Interactive whiteboards combine the simplicity of traditional whiteboards with interactive performance – without

cords, cables or costly installation. Combined with learning response systems and visual presenters, they bring next-generation classrooms to life, allowing teachers to engage their students' interest and make learning more interactive.

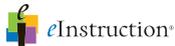
Along with notebook computers, classrooms are being equipped with technologies that are intended to engage and immerse students in a more collaborative and participatory learning environment. And with these types of technologies in the classroom, students have increasingly more options to attain and maintain the skills they need to achieve their future goals.

## **We Get Next-Gen Education**

For years, CDW-G has been helping educational institutions provide a better learning environment for students. We'll take you beyond basic technology and show you how to incorporate the skills and knowledge that today's students require to learn and live in an increasingly digital society. We can also train professors on how to use the technology effectively. From pre-configuration, installation, implementation and ongoing support, we're here to help both in and out of the classroom.



**Steelcase brings learning to life by engaging today's teachers and students with simple, sustainable, evolving solutions** – transforming education into inspired teaching and learning experiences. Our unique solutions include interactive whiteboards, slates, software and accessories that are easier to use and work with any software.



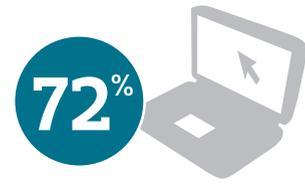
**Create an interactive and engaging learning environment with eInstruction's interactive whiteboards.** Interactive whiteboards integrate with other technology for a seamless and fully interactive classroom so students are always involved in lessons to help drive greater achievement.



**Affordable short-throw projectors with premium audio and connectivity.** These budget-friendly short-throw projectors minimize shadow interference and glare, to ensure optimum viewing of your presentations. Using a built-in short-throw lens, they enable you to project an 80-inch image from just 2.7–2.9 feet away. The 425W/435W units boast a 16:10 widescreen aspect ratio that's ideal for displaying high-definition content and content from widescreen computers. All projectors are equipped with a microphone input and a premium 16W speaker to enhance any lesson with captivating audio. HDMI digital connectivity and advanced networking capabilities offer even more flexibility for today and in the future.



**HP's full line of portable notebooks offers great screen clarity under a wide variety of conditions, making it easy for students to learn where they want.** In addition, the HP ElitePad 900 comes with durable materials like Corning Gorilla Glass 2 and machined aluminum. This tablet only feels lightweight. It's built to last and designed to look great and work dependably everywhere from the classroom to lecture hall.



**PERCENTAGE OF UNIVERSITY I.T. STAFF WHO BELIEVE THAT VIRTUAL LEARNING IS ESSENTIAL TO A 21ST CENTURY CLASSROOM.**

Source: CDW-G 2011 21st Century Campus Report

**GET AN EDGE WITH HELP FROM PEOPLE WHO GET IT**

Take higher education to the next level with the right interactive classroom technology. Discover how our audio/visual, collaboration and digital signage solutions can help boost teaching abilities and learning outcomes to give your institution an academic advantage.



**LEARN MORE AT CDWG.COM/HIEDSOLUTIONS**

# VIRTUAL LEARNING IN HIGHER EDUCATION



**74%**  
**OF STUDENTS  
SAY THEY HAVE  
TAKEN AT LEAST  
ONE COURSE THAT  
INCLUDES ONLINE  
COMPONENTS.**

Source: ECAR report, *ECAR Study of Undergraduate Students and Information Technology*, 2012

**Once viewed as an add-on to traditional instruction, virtual learning has become an essential component of higher education.**

Online elements and digital content are now integral parts of college classes in all fields. Many institutions also offer an increasing number of courses entirely online.

Virtual-learning programs are efficient and cost-effective, which are important factors at a time when higher education and student budgets are tight.

The proliferation of mobile devices and students' expectations that they can work anytime, anywhere are pushing virtual learning programs to offer mobile versions of their applications and make infrastructure upgrades to ensure high availability.

Because they serve a generation connected by Facebook, Twitter and other social networking technologies, effective virtual-learning programs include multiple communication channels, such as chat, blogs and wikis – vehicles that allow for student-to-instructor and student-to-student interaction.

The trend toward using digital content

and online elements to enhance traditional courses in all fields is also strengthening. An increasing number of institutions now offer a blend of virtual and in-person classroom learning, with some components available in person in the classroom and other pieces available online.

The aim is to combine the best aspects of each approach. Ideally, classroom time is devoted to advanced interactive experiences with the instructor and other students, while the virtual portion of the class adds the flexibility and independence of self-paced learning. At the University of Central Florida in Orlando, for example, more than half the 56,000 students already take at least one of the university's 2,500 online or blended courses.

A growing virtual-learning environment makes heavy demands on the IT infrastructure, which must maintain high availability for all applications and resources. CDW-G can help you build a robust infrastructure that meets the demands of today's digital learning environments.



CDWG.com/samsung

**Samsung provides innovative products, dedicated support and sustainable programs. From breakthrough picture quality to virtually seamless video walls, Samsung LED commercial displays are exceptional attention grabbers.**

Samsung's commercial LCDs allow you to deliver crystal-clear images in any setting. Look your best with Full HD 1080p resolution, optional TV tuners, full networking capabilities, speedy response times and a wide range of connectivity options. With amazing picture quality, increased connectivity and networking capabilities, Samsung's line of large-format displays are what you've been waiting for. Some include a built-in PC, which comes loaded with Samsung MagicInfo software, allowing you to manage multiple Samsung LFD displays from anywhere.



**LifeSize**  
A Division of Logitech

CDWG.com/lifesize

**Today's higher education institutions are challenged to prepare students for a future in a truly global economy.** Competition is fierce and expectations of students and educators are enormous. Education also demands a cost-effective and environmentally friendly approach to bridging the distance between metropolitan campuses and institutions spread across continents. High definition (HD) video conferencing has become a mainstream communication tool, encouraging new levels of face-to-face collaboration. From large lecture halls to state-of-the-art learning centers, HD makes the whole experience perfectly natural for education.



CDWG.com/adobe

**With Adobe Connect, you can captivate your audience with rich, engaging, and interactive experiences and make them available to virtually anyone, anywhere, on virtually any device, with just the click of a button.** Adobe Connect allows invitees to easily attend your meetings from the desktop without requiring a client download, and offers complete mobile-to-mobile collaboration capabilities to address the realities of today's competitive environments, where people are on the move worldwide.



**50%**  
**THE PERCENTAGE OF COLLEGE STUDENTS WHO CHECK THEIR MOBILE DEVICES AT LEAST EVERY HALF HOUR.**

Source: Wakefield Research, June 2012

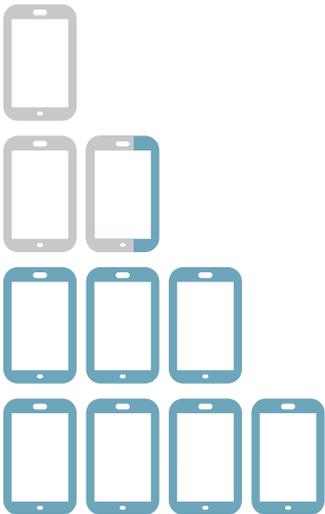
## NEXT-GENERATION LEARNING ENVIRONMENTS

For years, CDW-G has been helping educational institutions provide a better learning environment for students. We'll take you beyond basic technology and show you how to incorporate the skills and knowledge that today's students require to learn and live in an increasingly digital society. We can also train professors on how to use the technology effectively. From pre-configuration, installation, implementation and ongoing support, we're here to help, both in and out of the classroom.



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CDWG.COM/HIEDSOLUTIONS**

# BETTER BYOD SECURITY



**83%**  
THE PERCENTAGE  
OF ORGANIZATIONS  
THAT SUPPORT  
A BYOD POLICY.

Source: CITE Conference to Tackle BYOD Issues, Lucas Mearian; Computerworld.com

**D**istrict IT managers often express concerns about the new security challenges that arise when students, teachers and staff bring their own devices to school. Here are five BYOD security best practices from consultancy IT-Harvest that can help you keep security concerns in check.

**1. Keep tabs on potential malware and viruses.** Maintain and regularly update a registry of risky apps or programs that you don't want people to use. Make the registry open for viewing by everyone participating in the BYOD program who uses their personal devices for school or work.

**2. Educate the user base.** Encourage users to quickly report lost or stolen devices, and respond proactively with a remote lock or wipe. Always ensure that passwords are enforced on any BYOD device.

**3. Protect organizational data.** Insist on the ability to perform selective wipes that will target only district data stored on a personal device. This must be done tactfully, because you don't

want to antagonize students, staff or teachers by wiping personal data.

**4. Authenticate and encrypt.** Have users authenticate all personal data and encrypt district data.

**5. Seek legal advice.** Consult an attorney to determine the district's liability for having students, teachers and staff use their own devices and set policies accordingly.

At CDW·G, we understand that security is a top concern at educational institutions where hacking can impact grades and other private records. It's why we have the technology you need to optimize your infrastructure and keep your network safe.

Backed by a team of experts, your dedicated CDW·G account manager can work with you to assess your infrastructure, find ways to fill holes in your security strategy and ensure you have the processing power and connectivity to support your growing student body and their growing wireless demands.



CDWG.com/cisco

**Cisco WLAN controllers are responsible for systemwide wireless LAN functions, such as security policies, intrusion prevention, RF management, quality of service (QoS) and mobility.** They work in conjunction with Cisco access points and the Cisco wireless control system to support mission-critical wireless applications. From voice and data services to location tracking, Cisco WLAN controllers provide the control, scalability, security and reliability that network managers need to build secure, enterprise-scale wireless networks – from branch offices to main campuses.



CDWG.com/symantec

**From primary and secondary school districts to higher educational institutions, schools are facing numerous IT challenges.** These range from protecting confidential information on student's notebooks, mobile devices and desktops to providing network access control and storage options. In addition, institutions require a cost-effective and secure approach to migrations and distance learning. Symantec's comprehensive portfolio of solutions allows for a safe and managed learning environment.



**AirWatch's Mobile Device Management (MDM) solution enables you to manage deployments of mobile devices.** The solution provides the ability to quickly enroll devices in your environment, configure and update device settings over-the-air, enforce security policies and compliance, secure mobile access to your organization's resources, and remotely lock and wipe managed devices.



**17% PERCENTAGE OF I.T. MANAGERS WHO SAY THE INTRODUCTION OF BYOD POLICIES MAKES SECURITY MANAGEMENT MORE CHALLENGING AT THEIR ORGANIZATIONS.**

Source: *Study Management and Operations*, Enterprise Strategy Group, 2012

## WE GET MOBILE SECURITY

BYOD programs can present a number of challenges for IT administrators. A mobile device management (MDM) solution can help protect your school's valuable assets. At CDWG, we take the guesswork out of buying MDM systems by pretesting best-of-breed solutions to match any budget. Our solutions include the most commonly deployed products on the market and accommodate a wide range of technical requirements and budget constraints.



**LEARN MORE AT  
CDWG.COM/SECURITY**

# BE CONFIDENT IN YOUR INFRASTRUCTURE



**3X**  
IN 2016, THE NUMBER OF DEVICES CONNECTED TO IP NETWORKS WILL BE LARGER THAN THE GLOBAL POPULATION BY ALMOST THREE TIMES.

Source: Cisco Visual networking Index: Forecast and Methodology, 2011–2016, Cisco, May 2012

## **M**ore and more is being expected from your IT infrastructure.

Speed. Agility. Efficiency. You need a strategy that can help you optimize your existing resources and better enables you to meet the demands of today's students.

CDW-G can help you fortify your IT core with comprehensive infrastructure solutions:

### **Data Center**

**Backup** | Enhance your ability to store, search and restore critical information for high availability in any circumstance.

**Networking** | Minimize complexity and ensure 24/7 access to applications, data and more.

**Power and cooling** | Reduce energy costs and provide backup power planning for uninterrupted data access.

### **Virtualization**

**Client virtualization** | Give end users a secure connection to virtual desktops in the data center.

**Server virtualization** | Run multiple applications/operating systems independently on a single server.

**Storage management and virtualization** | Transform your IT environment by providing flexibility while simplifying your storage systems.

### **Security**

**Mobile security** | Authorize access to your network from mobile devices and ensure data protection.

**Physical security** | Protect people and resources from harm, theft or vandalism.

**Threat prevention** | Form a united front against multiple network and data security threats.

**Data loss prevention** | Identify your most sensitive information, determine who is accessing and using it, and match the DLP solutions to help comply with internal and external security policies.

We understand that you can't operate without a robust, resilient and responsive network. It's why we've got the technology you need to optimize your infrastructure and reduce your stress level. Backed by a team of experts, your dedicated CDW-G account manager can work with you to assess your infrastructure, find ways to reduce latency and ensure you have the processing power and connectivity to support your growing student body and their growing wireless demands. They will also help you weigh the pros and cons of technology, provide you with options, and make sure your investment will support your needs with the least amount of latency possible.



**EMC provides a wide range of solutions for higher education that can help improve operations, increase faculty effectiveness, accelerate student performance, and develop new methods for delivering educational services.**

As an industry leader in storing, managing, sharing and protecting data, EMC has helped colleges and universities across the globe improve their operations so they can turn data into information, and then turn that information into true educational value.

EMC products and solutions have helped higher education institutions leverage next-generation IT in many ways, including:

- EMC Centera storage technology captures, stores, manages and archives data from multiple sources and multiple devices (of various types)
- EMC Avamar deduplicates information before it is transmitted to a central repository, thereby increasing storage capacity and driving further cost savings
- EMC's RSA technology protects student information

Other solutions enable data sharing and project management so that teachers can post lesson plans and share them among themselves for increased efficiency and effectiveness. EMC has helped education institutions of every size, across the globe, to become more efficient and effective in the delivery of higher education.



**HP's extensive portfolio spans printing, computing, software, data storage, networking hardware, services and IT infrastructure.** HP ProLiant servers continue to deliver on their heritage of engineering excellence with increased flexibility and performance, enterprise-class uptime and HP Insight Control manageability.



**Forward-thinking higher education institutions are leveraging innovative technologies to attract the best and brightest students while reducing IT costs.** Virtualization helps academic institutions reduce their capital and operating expenses while improving service delivery and offering more options to connect.

**43%**   
**PERCENTAGE OF HIGHER EDUCATION INSTITUTIONS THAT ADOPTED OR WERE IMPLEMENTING CLOUD SERVICES IN 2012, UP FROM 34% IN 2011.**

Source: CDW-G's 2012 State of the Cloud Report

## OVERCOMING INFRASTRUCTURE INEFFICIENCIES

The Bring-Your-Own-Device (BYOD) trend has seen a surge in the number of mobile devices connecting to the wireless backbone in many organizations and corresponding performance deterioration. Latency-driven applications like voice and video are gobbling up bandwidth and adding to the problem. In order to keep up with today's demands, you need an infrastructure that's optimized for better performance. We get it. And we're here to help.



**LEARN MORE AT  
 CDWG.COM/NETWORK**

# INFRASTRUCTURE AND SECURITY

Technology cannot enhance instruction and learning without the proper foundation and support, including security.



**A solid IT infrastructure is the essential foundation on which secure, reliable services are delivered as part of the new learning ecosystem.** According to the *Learn Now, Lecture Later* report, 87 percent of IT professionals note that their infrastructure will need to be upgraded in order to incorporate more classroom technology.

An investment to support lecture capture or video conferencing would be ill advised without first ensuring that the corresponding server, storage and network infrastructure are adequate – and preferably, scalable to future growth. Expansion of network-based services and the proliferation of mobile devices that access them also heighten security concerns and require institutions to bolster infrastructure to support data integrity, privacy and security.

## Infrastructure

The infrastructure required to support classroom technology ranges from

the locks needed to secure document cameras, projectors and other devices to back-end servers, storage and the network. It also includes facilities-related infrastructure essential to fostering an environment conducive to using technology, such as multizoned lighting, which lets students take notes in a relatively well-lit area of a classroom while the area near the projection screen is darkened.

Easy access to power is critical to encouraging and supporting the use of classroom technology. Power should be readily available at student workstations as well as at presenter stations. Optimally, power is situated in tables and other classroom furniture. Or minimally, it should be in the floor, rather than along a wall, to provide the greatest amount of mobility and flexibility within a learning space.

What follows are some of the key focal areas to carefully consider when crafting a strategy for the university's support infrastructure.

**Devices** | Access to the new

ecosystem begins with the user device. Because applications are often device- or platform-specific, the first decision that institutions must make is whether to provide devices or allow students and faculty to bring their own.

While most institutions mix the two (for example, offering institutionally provided computer labs and faculty desktops while allowing personal devices), some standardize on a platform for student devices. A one-to-one program, in which colleges provide all students with a selected device, ensures that the platform and toolset are consistent for all students. Some institutions may require students to purchase a device, either as part of a campuswide initiative or within specific programs.

A growing number of institutions are implementing VDI. Instead of controlling endpoint devices, VDI enables access from a variety of platforms or devices.

Institutions create consistent (usually Windows-based) virtual desktops for students and faculty, either in a data center or in the cloud. The desktops are loaded with all the university's software and can be delivered to users on a number of platforms. A VDI environment works nicely in support of a BYOD initiative, allowing device choice while ensuring consistent access to applications.

**Applications** | The numerous tools available on campus, combined with the desire to integrate them – or, at a minimum, pass data back and forth between them – means many institutions are shying away from proprietary software systems in favor of open-source software or an open application program interface (API), making it easier for programmers to write code to leverage underlying software in new ways.

When selecting applications or deciding on a platform for in-house application development,

institutions also are using web-based applications and web services that use common protocols – HTTP, XML and Simple Object Access Protocol (SOAP) – enabling applications to “talk” to each other and share data.

Whatever path is chosen, interoperability is key. The ability for systems to work together and share information will be critical as the new learning ecosystem continues to expand and faculty and students explore new ways to use available tools.

To support interoperability among LMSs and other teaching and learning tools, the IMS Global Learning Consortium developed the Learning Tools Interoperability (LTI) standard. Many LMS vendors now conform to LTI, designed to provide a standard and secure way for learning tools to be integrated into an LMS or educational portal without the need to develop custom integrations.

**Identity/access management** | The proliferation of teaching and learning software has resulted in the equally large challenge of managing access to all of those applications. Historically, colleges have turned to identity management systems to manage access within their own networks. While each software application or system may need to be logged into separately, institutions frequently create an environment in which campus constituents can use one set of credentials (user ID and password) to log in to multiple campus systems.

Federated identity management allows users to access systems provided by other institutions or organizations without having to create a separate account with the other provider. Organizations that are part of a group, or federation, agree to use a common identity management framework and authentication/authorization standards such as Security Assertion Markup Language (SAML), OAuth or OpenID to

enable users to log in with one set of credentials from their home institution.

For example, when users log in to new web-based services using only their Facebook or Google credentials, they are using federated ID management. Users need to remember only one set of credentials to access a variety of systems, and security is increased because those credentials are stored in only one place and authenticated by the user's home institution or identity-providing organization.

Account management also is simplified, because service-providing organizations no longer need to manage a large database of user accounts. Universities can easily integrate with other organizations and bring new systems on more quickly when they all conform to the same identity management standards.

Often with federated ID management, however, users still need to log in to separate systems and websites using their primary credentials. Single sign-on is an extended form of identity management that enables users to log in one time, in one place, and use all of the applications and systems they have access to without having to log in to each system.

**Servers and storage** | Institutions must closely examine their server and storage infrastructure to ensure it can handle the load that this growing learning ecosystem demands. When determining which software to include, consider whether it should be purchased and hosted (either in the data center or in the cloud), or procured under a SaaS model.

Institutionally hosted software will require adequate server and storage resources, and some systems can be quite resource intensive. For example, locally hosted lecture capture systems can require a significant amount of storage space (one hour of classroom lecture recorded in standard mode can take up 500 megabytes or more).

&gt;



## THE IMPORTANCE OF SOFTWARE LICENSE MANAGEMENT

Rampant use of personal devices and the rapid shift to virtualized desktop environments mean that software license management is now of critical importance – and incredibly complicated.

Even before these trends emerged, many colleges struggled with how to best maintain an inventory of installed software, ensure compliance with licensing agreements and address audit concerns. A growing mix of license types – to specific users, per seat, concurrent-site licenses, cloud-based licenses, new licensing for software deployed in a virtual environment, and licenses for applications purchased by users in a decentralized institution – all serve to complicate the process.

Universities with an inadequate license management program can face added expenses on two fronts:

increased overall costs from purchasing unnecessary or redundant licenses, and fines incurred from being out of compliance with agreements. A well-designed software asset management (SAM) program helps institutions reduce direct software costs by recapturing unused licenses and negotiating agreements based on actual use. It also mitigates risk by ensuring license compliance.

A SAM program is an ongoing process and can be aided by a variety of asset management tools, from stand-alone applications to those integrated with configuration management, help desk or other IT management suites. Colleges just starting out with license management should take an inventory of the current software environment, review purchased licenses and license types, and reconcile actual software deployed with existing license agreements.

Infrastructure must have sufficient capacity to store the video lectures, but also adequate processing power to recover and replay videos on demand.

Providing virtual desktops to support a BYOD initiative means server and storage infrastructure must be sized appropriately. Persistent and nonpersistent desktops each require a different amount of storage space per desktop, and the type of storage matters when delivering a virtual desktop.

The storage system must be able to deliver a certain number of input/output operations per second (IOPS) for acceptable performance. On the server side, expect to run 50 to 100 desktops per server, depending on the type of server used.

A desktop's usage also plays a role in the server specifications. Desktops

used for geographic information systems (GIS) or other graphic-intensive applications may require different memory or video processing cards to be added to the server.

To extend current server and storage environments, some institutions are turning to the cloud. Cloud computing allows colleges to quickly scale servers and storage up or down to meet changing needs. It provides maximum flexibility and scalability.

However, a cloud provider only hosts the underlying infrastructure. Institutions remain responsible for building, managing and backing up cloud-based servers.

Another option is purchasing software systems provided as cloud-based services, or software as a service. SaaS enables a university to purchase and use software (generally on a subscription or per-user basis)

without the need to build, maintain or manage the underlying server, storage and backup infrastructure.

**Network and bandwidth** | The sheer volume of devices in the classroom and the increasing demand for bandwidth among voice and video applications has taxed many networks, even those with the most up-to-date technologies. With the proliferation of mobile devices and BYOD; the growing expectation of students for anytime, anywhere access to services; and the movement toward interactive, collaborative and flexible classroom environments, an adequate wireless network is critical to overall success, and the success of new instructional models.

Universities are rethinking their network strategies to ensure that all corners of campus, from athletic facilities to residence halls to outdoor spaces, now

have wireless coverage. Spaces that traditionally have had wireless network coverage may also need to be revisited.

Many early wireless installations were designed so that every area of the room received a wireless signal and had adequate signal strength. With the countless users and devices trying to attach to today's wireless network, this old model is proving insufficient. Institutions often find the number of wireless access points must be increased dramatically in classrooms and elsewhere on campus to address the new paradigm of wireless design for density, where the number of devices and users is factored into the design process.

Because the need for access, performance requirements and wireless standards is only going to grow, colleges should consider a modular approach to network design, enabling a network to evolve in the future without requiring heavy-duty replacement. New standards will bring expanded throughput capabilities.

For example, 802.11ac is designed for data transfer speeds ranging from 400 megabits per second to 1 gigabit per second or better, making it feasible to deliver more services over wireless and driving even more users and usage types to the network. The 802.11ac standard is expected to be approved in late 2013, but institutions shouldn't upgrade their entire infrastructure just yet.

This new standard supports only 5 gigahertz devices, while 802.11n supports both 2.4GHz and 5GHz. Because many current consumer devices are still operating at 2.4GHz, universities will have to decide whether to replace an entire system, do an overlay and run 802.11n and 802.11ac in tandem, or selectively deploy 802.11ac in places where there is a strong need for high throughput.

No matter how fast internal network speeds are, network infrastructure

is only half the picture. Institutions also must have adequate bandwidth for campus constituents to be able to interact with off-campus resources, a requirement that becomes even more critical in an environment that leverages a large number of cloud-based services.

Bandwidth needs are driven not only by the number of devices on a network, but also by the types of services being accessed. Unified communications (UC), the addition of video technology in classrooms and increased student access to multimedia content from personal devices can create competition for limited bandwidth.

In addition to developing a long-range bandwidth strategy to address ever-growing needs, colleges will want to employ network management tools to administer quality of service (QoS), traffic shaping and other management techniques. Such tools ensure the most effective use of bandwidth by prioritizing or restricting certain types of network traffic to guarantee no single user consumes too much bandwidth.

## Security

The increase in on- and off-campus classroom technologies also means data privacy and security should be of utmost concern. Federated identity management and single sign-on can enhance security for users accessing myriad applications, and also can simplify account management. In the case of off-campus applications, colleges must look carefully at hosting companies' security practices, where they store data and how closely they adhere to education-specific data standards and laws (such as the Family Educational Rights and Privacy Act, or FERPA).

One of the greatest campus security concerns comes with the increased use of personal devices to access institutional data and services. With BYOD, security concerns are focused on

three areas: the risk of a device infecting the network with a virus, unauthorized user access to institutional resources and exposure of sensitive or confidential data on an unprotected or lost device.

Many institutions use network access control (NAC) to register and authenticate devices on a network and enforce security policies, as well as ensure that a registered device includes up-to-date antivirus software. NAC also can be used to manage user identity and roles, ensuring appropriate levels of access to campus services.

Some institutions lock down their server environments and use virtual LANs or firewalls to create a virtual or physical DMZ for key services. While effective, VLANs in particular may need to be reconsidered, as the rise of wireless projection and other collaborative classroom technologies requires cross-network communication that may be restricted by such network security designs.

Universities that seek to reduce the risk of data loss on mobile devices usually take one of two approaches: secure the device or secure the data. Some implement mobile device management (MDM) systems to better manage and secure mobile devices.

Typically, before a user can access sensitive data from a mobile device, the device must be registered with the MDM, which can enforce security policies, remotely wipe a device and set up access to the institutional virtual private network (VPN). Institutions that choose to secure the data provide access through a virtualized application or desktop. In a virtualized environment, applications and data remain securely in the institutional data center, regardless of which device accesses them, or from where they are accessed. ■

# SETTING UP FOR SUCCESS

Technology training and use policies offer critical support for tech initiatives on campus.



**T**he move to modern learning environments is not an easy process. Eighty-eight percent of faculty surveyed for the *Learn Now, Lecture Later* report indicated they face many challenges – citing budget, class size, lack of time and lack of professional development – in the transition to flipped classrooms and other active learning models.

Those challenges, along with departmental curricula, were the same roadblocks cited by IT professionals. This fact underscores the point that structural obstacles (and not necessarily a lack of willingness on the part of faculty) exist to hinder institutions' ability to move classroom technology forward.

Budgets must be realigned. And IT departments must look for ways to drive down the costs of delivering commodity services so that more resources can be focused on higher-value technologies such as those supporting teaching and learning.

Other structural challenges also

exist, including how faculty workload is assigned, and what mechanisms are used to evaluate effectiveness and promote faculty members. At some colleges, faculty find themselves overtaxed with aggressive course loads and heavy research requirements, in addition to advisory duties and committee assignments.

Add to that the fact that tenure and promotion processes don't reward (and in some cases, may even penalize) the use of technology and experimentation in the classroom. It's easy to understand why even the most willing faculty members may find there's neither time nor incentive to pursue new teaching models.

The saying "if you build it, they will come" will not work when applied to new technologies and learning models. Technology that is put into a classroom without teacher buy-in and appropriate training will sit idle and drain already thin budget resources.

Colleges and IT departments must make a concerted effort to understand

what technologies students and faculty are already using, what they would like to be using and how they would like to learn and teach – then address those needs directly. Access to technologies must be pervasive and robust, and support structures must be in place to ensure not only that the technology itself works well, but also that students and faculty are provided with the knowledge and tools needed to use it successfully.

### Empowering Users

In the *Learn Now, Lecture Later* report, 76 percent of IT professionals reported an increase in faculty requests for help with classroom technologies and instructional models that they support. Over half of the faculty respondents said they want training on specific technologies, and a third said they are seeking training on instructional software, integrating technology into teaching and using technology to teach relevant skills.

However, needs extend far beyond simple training and professional development. In order to operate in today's classroom – with rapidly changing technology, emerging instructional models and students who are digital natives but not necessarily digitally literate – faculty need a support system to help them and their students navigate the wide array of information resources and technology tools available.

Faculty professional development programs must include training on the technology tools themselves, because being able to operate the system is a precursor to its effective use. Development programs must include training and support for course design, or redesign. This way, faculty understand not only how to use the tools but also how to apply appropriate technologies to their curricula to meet learning objectives.

The changing nature of the classroom, with tools being used both in and out of the physical class setting, requires possibly unfamiliar types of interactions. Faculty may benefit from training on how to use technology tools to effectively manage their classrooms, workload and online student communications.

The traditional tools of a university's faculty training program (workshops, tutorials, one-on-one training) may continue to be a part of the professional development offered. But they will no longer be sufficient for meeting all training needs.

Faculty members who not only understand the technology, but also use it in a classroom environment are critical to increasing adoption of technology among their peers and making training more effective. Rather than taking a one-size-fits-all approach, training that focuses on how a tool might be applied to specific disciplines also improves effectiveness.

Faculty must be willing to embrace changes, and that cannot happen through an institutional mandate. Widespread culture change is most effective when it occurs organically, from within. Still, colleges can take steps to foster an environment that is conducive to change.

It is important to empower and support faculty who are interested in experimenting with new technologies – and highlight their work. External professional development funding, which often revolves solely around discipline-specific conferences, should be expanded to include conferences and meetings about teaching with technology. Institutions also can support innovation by providing stipends and grants for faculty to purchase experimental technologies and form learning communities that bring faculty members together to discuss their experiences so they can learn from each other.

### Establishing Policies

Institutional processes and policies can go a long way toward encouraging, or discouraging, innovation and the use of emerging technologies and instructional models. Colleges and universities must decide on their overall position as it relates to incorporating new technologies, and review existing policies to ensure they are consistent with that position. Institutions that want to embrace new modes of communication and collaboration might want to reconsider rules regarding student smartphone use on campus, for example, or employee use of social media during work time.

In addition to reviewing existing policies for consistency, colleges must consider whether policies need to be adjusted or rewritten to address new behaviors made possible by new technologies. Two policy areas in particular, BYOD and social media, are emerging in importance.

Some institutions are creating stand-alone policies to address each, some are creating combined BYOD/social media policies and some are incorporating BYOD and social media themes into existing policies, such as acceptable-use policies. Regardless of the approach, BYOD and social media must be addressed.



**PROFESSIONAL  
DEVELOPMENT  
PROGRAMS MUST  
INCLUDE TRAINING  
AND SUPPORT FOR  
COURSE DESIGN,  
OR REDESIGN.**

There are two types of use to consider when drafting BYOD policy: use by students and faculty in the classroom, and use by employees and administrators to access institutional data and conduct other institutional business. Policies focused on student BYOD initiatives should address where and when devices can be used, as well as security and authentication requirements for accessing institutional resources.

Universities seeking to promote BYOD as a strategic or cost-saving initiative must consider at what level BYOD policy should exist. Should it be at the institutional or academic affairs level, or at the discretion of individual faculty members? Other concerns to address are potential issues of access for students who may not be able to afford the latest devices. Institutions also should consider their role in helping students and faculty understand the safe and ethical use of their devices.

For staff use of personal devices, an entirely different set of factors must be considered. What devices will be allowed, the attributes of those devices (for instance, not jailbroken) and the proper security settings for employee access to institutional data must all be spelled out. Colleges should consider MDM or other management software to enforce security settings (such as password strength) and to provision secure applications and remotely wipe a device should it be necessary (see Chapter 4).

It's also important to consider who owns devices, applications and data, and how each will be supported by the institution. IT departments must decide if (and how) they will support a device's initial connection to the network, as well as configuration and troubleshooting of applications and hardware issues (from "wipe and reconfigure" on the software side to providing loaner equipment in the event of device failure).



## COLLEGES SHOULD CONSIDER MDM OR OTHER MANAGEMENT SOFTWARE TO ENFORCE SECURITY SETTINGS.

Policies can address if (and how) the removal of secure data and applications from a device will be managed in the event a worker leaves the institution, whether the university has the right to wipe a device remotely and how an employee can preserve personal data on such devices.

Where BYOD policies tend to be device- and process-focused, social media policies generally are focused on user behavior and etiquette. Many institutions provide helpful guidelines for staff use of social media, from the process for creating an official institutional account to best practices for being transparent, authentic and respectful in social media communications.

Some colleges require individuals to maintain separate personal and professional accounts, and limit interaction between staff members and students to professional accounts. Still others require disclaimers that indicate the views expressed in social media are those of the author, not the institution.

When and how students use social media also may be considered. The when may be covered by academic policy or by individual faculty policy if its use is to be allowed or prevented during class time. The how may be broadly covered under student conduct policies, which may need to be updated with specific social media guidelines to address unacceptable digital behavior such as cyberbullying, in addition to students' legal and ethical responsibilities.

Whether developing new policies or updating existing ones, it is important to use a transparent process and include a wide range of stakeholders. Both social media and BYOD have the potential for positive educational engagement, and can align with or support new models for teaching and learning. Institutions developing policies to manage those and other emerging technologies or communications channels should create policies that embrace and encourage the many positive benefits while setting appropriate expectations. ■

This glossary serves as a quick reference to some of the essential terms touched on in this guide. Please note that acronyms are commonly used in the IT field and that variations exist.

# Glossary

## **802.11ac**

This is the latest iteration of the 802.11 wireless networking standard. Now under development, it will provide high-throughput wireless for local area networks on the 5 gigahertz band. Devices with the 802.11ac specification are expected to be common by 2015, with an estimated one billion spread throughout the world.

## **Active learning**

This is a broad category of learning encompassing many instructional models, including problem-based learning (PBL) and collaborative or team-based learning. The term, popularized in the 1980s and 1990s, refers simply to any learning in which students engage with class material through summarization, discussion, exercises or activities. Active learning often involves peer-to-peer work, and may take the form of role-playing or simulations, class discussion or group projects.

## **Application programming interface (API)**

API is a protocol intended to be used as an interface by software components to communicate with each other.

## **Asynchronous learning**

In this approach to education, teaching and learning occur separately. Made possible by technology, asynchronous learning involves the learner engaging with the course and content at a time and place of his or her own choosing.

## **Creative Commons**

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## **Demilitarized zone (DMZ)**

A DMZ is a physical or logical subnetwork that contains and exposes an organization's external-facing services to a larger untrusted network, usually the Internet. A DMZ provides an additional layer of security to a local area network (LAN). An external attacker has access only to equipment in the DMZ, not to any other part of the network.

## **Federated identity management**

This term describes the technologies, standards and use cases that enable the portability of identity information across otherwise autonomous security domains. The ultimate goal of identity federation is to enable users of one domain to securely access data or systems of another domain seamlessly, without the need for completely redundant user administration. Federation is enabled through the use of open industry standards and/or openly published specifications, such that multiple parties can achieve interoperability for common use cases. Typical use cases involve things such as cross-domain, web-based single sign-on, cross-domain user account provisioning, cross-domain entitlement management and cross-domain user attribute exchange.

## **Flipped classroom**

This is an instructional model in which the traditional lecture and class homework components are reversed. The lecture happens outside of the classroom, while in-class time is dedicated to traditional homework-type activities, such as exercises or projects.

## **HyFlex**

This term refers to an instructional model derived from the words "hybrid" and "flexible." A HyFlex course includes both online and in-person instruction, and allows students to choose how they wish to participate, in person or online, based on the topic or timeframe.

## **Learning management system (LMS)**

An LMS is a software application for the administration, documentation, tracking, reporting and delivery of education courses or training programs. LMSs range from systems for managing training and educational records to software for distributing online or blended/hybrid college courses over the Internet, with features for online collaboration. Colleges and universities use LMSs to deliver online courses and augment on-campus courses.

## **Learning Tools Interoperability (LTI)**

LTI is a set of standards developed by the IMS Global Learning Consortium to enable communication and integration between a wide variety of learning applications and an LMS or educational portal, without the need for custom integrations.

## **Massive open online course (MOOC)**

A MOOC is an online course characterized by its open access and large scale. Anyone interested in learning the course subject matter may enroll in a MOOC, without paying a course fee or being a student at the institution where the course is produced.

## **Network access control (NAC)**

NAC is a method for managing access to a proprietary network, using software and systems to authenticate users and devices; check for antivirus software and other prerequisites for access; enforce security policies; and manage access, based on user or role, to campus systems and services.

## **Open educational resources (OER)**

OER are freely accessible, openly formatted and openly licensed documents and media that are useful for teaching, learning, assessment and research purposes.

## **Personal learning network (PLN)**

A PLN is a collection of resources, tools and people that a student may connect, engage and collaborate with to support ongoing learning. It is also often referred to as, or used in conjunction with, a personal learning environment (PLE). Because the PLN/PLE is entirely personal, it can be configured to a learner's interests and needs.

## **Software as a Service (SaaS)**

SaaS is a model for delivering software where the software application and associated data are hosted in the cloud and accessed by the user through a web browser or mobile application. With SaaS, users generally pay a subscription fee to access the software, rather than purchasing the software outright.

## **Telepresence**

This term refers to a set of technologies that allow a person to feel as if he or she is present, to give the appearance of being present or to have an effect, via telerobotics, at a place other than the person's true location. It is also a popular application found in telepresence video conferencing, the highest possible level of video telephony. Telepresence via video deploys greater technical sophistication and improved fidelity of both sight and sound than traditional video conferencing.

## **Unified communications (UC)**

UC is the integration of real-time communication services, such as instant messaging (chat), presence information, telephony (including IP telephony), video conferencing, data sharing (including web-connected interactive whiteboards), call control and speech recognition with

non-real-time communication services such as unified messaging (integrated voicemail, email, SMS and fax). UC is not necessarily a single product, but a set of products that provide a consistent unified user interface and user experience across multiple devices and media types.

## **Virtual desktop infrastructure (VDI)**

VDI is a desktop-centric service that hosts users' desktop environments on remote servers and/or blade PCs, which are accessed over a network using a remote display protocol. A connection brokering service is used to connect users to their assigned desktop sessions. Users can access a desktop from any location, without being tied to a single client device. Because resources are centralized, users moving between work locations can access the same desktop environment with the same applications and data. For IT administrators, this means a more centralized, efficient client environment that is easier to maintain and more responsive to the changing needs of users and the organization.

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- Redesigning learning spaces with technology in mind
- Outfitting classrooms with improved technology resources
- Planning infrastructure support for increased wireless traffic



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