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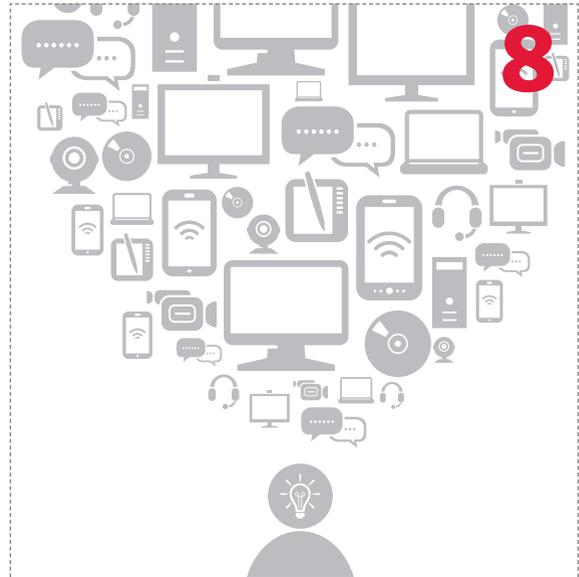
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RETHINKING THE CLASSROOM: DESIGNING A PLACE FOR DOING

THE RIGHT TOOLS MAKE ALL THE DIFFERENCE IN IMPROVED LEARNING OUTCOMES.



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The New Learning Landscape
Change Is the Only Constant
Engaging Instructional Models
The Flipped Classroom
The BYOD Model
Assessing Student Learning

THE CHANGING LEARNING ENVIRONMENT

TECHNOLOGIES
INSIDE AND
OUTSIDE THE
CLASSROOM
ARE CHANGING
HOW LEARNING
HAPPENS.

The past 20 years have brought the introduction of significant technology into schools. As a whole, however, the education industry is only beginning to incorporate technologies that are changing the scholastic landscape in ways that affect the classroom.

This reference guide briefly explores the changes to this landscape and then dives into a practical examination of methods, services and technologies that schools and districts should investigate to help them succeed in this already changed – and continually changing – education environment.

Setting aside the technologies that have been brought into the classroom over the last two decades, three wider advancements that have influenced the world at large have had a significant impact on how education is evolving now: personal computing, the Internet and gaming.

The New Learning Landscape

As personal computing devices have

become more affordable, students have come to expect the power and convenience of a computer in their personal learning experience. Beginning in the early 1990s, schools in Australia and then the United States began providing students with their own notebooks or personal devices as default educational tools.

Well beyond schoolwork though, most of today's students have never known life without access to a computer, even if shared. Students use them regularly for research, writing, media consumption and communication – often without a thought about doing any of these activities without one.

When teachers assign activities without the use of a computer, thought should be given as to why this is the case. Are students being asked to complete the task without a computer because it provides developmental growth that will later help them when they can use a computer? If a pedagogical purpose exists for not allowing the use of computers, it

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should be explained to the students, who are likely approaching the challenge from a different context.

The Internet became commercialized in 1995 and grew rapidly. Many students, even in high school, struggle to differentiate between information that exists on a computer and that which exists on the Internet. Now people can access whole desktop interfaces from the Internet, where every program and all of the data exists via a web page, from nearly any web-accessible device.

This highly enabled Internet, commonly referred to as “the cloud,” provides the power of the PC and adds to it constant availability – and, more important, connection and the ability to collaborate with others. In a simple yet powerful example, multiple students now can work on the same document from their respective homes at the same time. Talking to students around the globe (which used to require extensive coordination and the lag time of international postal systems) is now practically commonplace and possible in real time with video.

The radical change in availability of resources is simply staggering.

**/// GAMES
PROVIDE
INCENTIVES
FOR PEOPLE
TO ENGAGE
IN COGNITIVE
WORK. ///**

Many students have built Google and YouTube searches into the natural pattern of their process of answering questions. And why shouldn't they?

To them, it is not a mark of inferiority that the Internet has more information than they do. Students don't expect their teachers to know the answer to every question as comprehensively as Internet resources they find might – and when they employ proper search techniques, they are correct.

Educators must recognize that excellent resources can be found by teachers and students alike. The days when a teacher was the primary source of course content are over.

Too much information is simply too available for instructors to even pretend to compete with the wider body of knowledge and expertise available via the Internet. Teachers must leverage their knowledge to help students form the questions and strategies they need to find great information themselves and expand the body of information available to the class.

Gaming and brain-based research have always been intertwined. Gaming is fun because it is brain friendly. Both gamers and psychologists have known this for years. Gaming was a \$67 billion industry in 2012. The incentive for games to meet the needs of young minds is huge. As a society, we are beginning to get past the notion that games can't be a part of learning.

The premise is simple: Games provide incentives for people to engage in cognitive work. Education obviously seeks to promote cognitive effort. Thus, it makes sense that educators are beginning to seek links to learning and games that don't call for the graphical blowing up of other digital avatars.

In research, the effectiveness of games in education is well documented. Just as games present challenges in brain friendly ways, research has led

to the use of technology for learning in brain friendly ways. Already, more traditional technology resources, such as Khan Academy videos, are being complemented with gaming components, such as badges received for completing challenges.

Change Is the Only Constant

Confucius is attributed with saying, “I hear and I forget; I see and I remember; I do and I understand.” Despite some radical changes in the learning environment for students, many of the values in education remain timeless. Even in 450 B.C., Confucius recognized what brain research and students report today.

The desired outcomes for schools haven't radically changed. The environment and context in which society seeks these outcomes, however, have changed dramatically; thus, so must the classroom environment.

So how does one contextualize these timeless values and desired outcomes in this new environment? The process involves clarifying the desired outcomes for students in a school or district – first at a high level, then at a more developmentally appropriate one.

Special attention must be paid to developing criteria for each significant term. For example, what does “student-centered” mean? How would one observe “collaboration?” When someone pops his or her head into a classroom and is clearly seeing the right values and learning objectives playing out, what does that look like? What does that person see and hear?

Developing clarity about the desired outcomes is critical. This cannot be done by an individual or small committee. Broader involvement is required not only to get strong buy-in, but also to gain a wide perspective of how the community understands what it seeks.

Organizations such as the

Coalition of Essential Schools, the International Society for Technology in Education and the Partnership for 21st Century Skills can help schools provide a framework for these values. Pedagogical frameworks such as Technological Pedagogical Content Knowledge (TPACK), Understanding by Design and Universal Design for Learning help teachers get on the same page and leverage the work of others to move students more efficiently toward the desired outcome.

Having consensus and a clear understanding of the strategy plays an enormous part in purchasing technology. Larry Cuban's book *Oversold and Underused: Computers in the Classroom*, resonates in the minds of many school board members and taxpayers when bond issues for technology come up. In his book, Cuban argues that the massive investment U.S. schools have made in technology has had little or no

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THE TEACHER BECOMES THE LEARNER

Facilitating a shift in teaching and learning often can seem daunting to teachers and administrators who have developed successful careers as the gatekeepers of knowledge and who themselves were the products of an educational system that viewed the transfer and acquisition of knowledge as its core purpose.

The experience that has best helped educators make such a shift is to engage them in the role of the learner themselves, which is not necessarily a new concept and is quite natural to adult learners.

Malcolm Knowles first developed

the theory of *andragogy* in adult learning, distinguishing its focus on the learner's approach to learning from traditional pedagogy, with its focus on the teacher's approach to delivering information.

Capitalizing on this approach in teachers' professional learning allows them to enjoy the fruits of an individualized professional development experience in which they are the ones who seek information, then hone their own creativity, collaboration, communication and critical-thinking skills in the synthesis of that information and creation of

their own understanding. Their experience then serves as a model for the learner-centered approach they should adopt in the classroom.

Fortunately, ubiquitous computing also affords adults the same kinds of immediate access to information as it does students. Online training, electronic resources and professional learning communities offer such opportunities to educators. Online communities, such as Classroom 2.0, let users both benefit from shared knowledge and resources and also connect with other educators who are integrating technology into classroom instruction.

effect on student performance.

Schools need to know what they intend to do with technology and how they intend to measure its use before the money is spent. Though that can require a lot of work, the good news is that knowing the desired outcome of employing the technology can be enormously instructive in deciding which tools to buy. Without selecting a particular pedagogical framework, this reference guide will take a note from Confucius and assume hands-on, productive student work as the desired outcome, based on the changes in the educational landscape.

Engaging Instructional Models

With the advent of ubiquitous computing in education, the roles of teaching and learning (and even the resources provided by the schools themselves) have undergone a swift shift in focus from a traditional, lecture-based "sage on the stage" approach to more of a coaching, skills-based "guide on the side" approach.

No longer do instructors or school buildings need to serve as storehouses for knowledge in the digital age. With information, resources and training at their fingertips, students can instantly access almost anything about which they hope to learn, from guitar lessons given by professional musicians to online role-playing games that draw upon historical knowledge and military strategy.

What educators and administrators often fail to realize is that this type of information gathering is no longer novel to students. This generation is not only better connected than ever before, but they also have been so most of their lives. Generally, today's students are quite at ease

with the key technologies they use to navigate their social and academic worlds and share that experience eagerly with peers and adults.

As a result, the skills they need to develop in their education have changed. Information is no longer a product they are waiting to consume. Rather, it is raw material with which they are eager to produce something of their own. The Partnership for 21st Century Skills identifies the aptitudes these digital natives need to develop as "21st century skills," which include: critical thinking and problem solving, communication, collaboration, creativity and innovation.

The shift to a skills-focused, student-centered instructional approach is well under way. The CDW-G 2012 report, *Learn Now, Lecture Later*, notes that within "the last two years, just under half of faculty reported a shift away from the traditional lecture model and another 20 percent were considering a change."

The Flipped Classroom

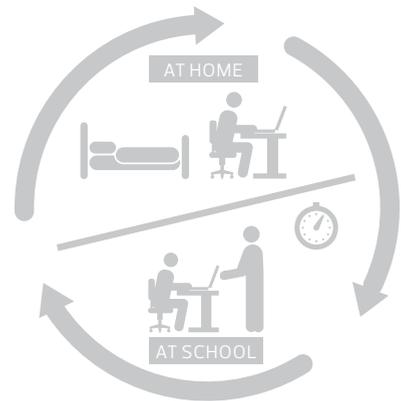
Movement to a more student-centered learning experience, with the emphasis on the instructor in the role of coach rather than information conduit, requires teachers to explore a variety of new instructional styles. One approach gaining popularity in recent years has been the "flipped classroom," in which teachers flip the traditional roles of instruction and homework.

Students access the instructional content (usually through articles or teacher-created videos) for an out-of-class assignment. Then, in class, the teacher is available to coach students as they work on assignments in which they apply their newfound knowledge and skills.

Jonathan Bergmann and Aaron Sams' 2012 publication, *Flip Your Classroom*, explores both the philosophy and

THE FLIPPED CLASSROOM

INSTRUCTIONAL CONTENT FOR ASSIGNMENTS IS VIEWED AT HOME.



TEACHERS COACH STUDENTS ON APPLYING NEW SKILLS AND KNOWLEDGE TO ASSIGNMENTS.



REPORT

LEARN NOW, LECTURE LATER

Learn what surveyed instructors, students and IT staff have to say about where classroom technology is headed:

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approach to implementing a flipped classroom. Bergmann and Sams note that “flipping the classroom is more about a mindset: redirecting attention away from the teacher and putting attention on the learner and the learning.” In describing the instructional approach, the pair emphasizes teachers “are no longer the presenters of information; instead, [they] take on more of a tutorial role.”

The CDW-G *Learn Now, Lecture Later* report identifies a few key areas in which student preference for learning new skills and information is out of sync with the methods used in their classes. Although only 38 percent of students reported wanting a traditional lecture model in their courses, 53 percent noted that it was regularly used as an instructional method. Likewise, only 3 percent enjoyed the benefit of one-on-one tutoring in class, while 8 percent indicated that they preferred it.

By flipping the classroom, instructors are better able to use a variety of teaching approaches while keeping student learning central to the choices made about how to spend class time.

The BYOD Model

One of the top considerations for schools and districts determining which technologies best support their learning goals is whether to use institution-provided devices or let students use hardware of their own choosing. A primary concern when considering a bring-your-own-device (BYOD) approach is security – monitoring student access to and use of online tools.

However, whether using such tools at home or at school, many of today's students are accustomed to having direct access to information when needed through a variety of devices. When school IT teams make end-user

device decisions for their institutions, there should be consideration of the teaching and learning goals and the kinds of activities in which students and instructors will need to engage in to meet those goals.

Even when a school provides devices to its students or allows for limited choice in devices, it is important to recognize that many students will choose to supplement those tools with their own devices as well. For many teachers and administrators, this is a concern with regard to security and monitoring. However, if viewed through the lens of the changing paradigm of information, focusing on information as a raw material rather than as a finished product, student devices can be viewed as an integral part of facilitating student development of 21st century skills.

Regardless of the devices that schools provide or allow students to use, the complementary inclusion of personally owned technology is almost always present. For that reason, this guide will delve into security and infrastructure concerns associated with allowing greater use of personal devices in Chapter 3.

Whatever a school or district's model, it is important to understand that students are already using personal devices in the creation of school content – perhaps just not at school. Therefore, the question is no longer, “Do we allow it?” Today, the question must be, “How do we allow it?”

Assessing Student Learning

In tandem with these technology concerns is the significant concern of implementing the Common Core State Standards, an initiative to align curricula across states, and online standardized testing set to begin in 2014. District technology budgets now need to consider not only

/// BYOD: THE QUESTION IS NO LONGER, “DO WE ALLOW IT?” TODAY, THE QUESTION MUST BE, “HOW DO WE ALLOW IT?” ///

instructional technology, but support for assessment systems (including technicians to support the necessary software and hardware) as well as instruction for teachers and students.

A wise approach to this potential challenge would be to integrate the state assessments in a meaningful way into the goal setting and data collection used to measure the effectiveness of educational technology as well. In outlining technology goals as part of their strategic plans, schools are always encouraged to tie those goals to measurable outcomes that will inform future decisions and purchases.

New online assessment systems already will be an area of focus for technology departments in schools and districts, giving IT teams an opportunity to evaluate how well their programs use data from assessments to measure student learning and the efficacy of the technology used to facilitate that learning. Goal setting and data collection are addressed in more detail in Chapter 5. ■

RETHINKING THE CLASSROOM: DESIGNING A PLACE FOR DOING

THE RIGHT TOOLS
MAKE ALL THE
DIFFERENCE
IN IMPROVED
LEARNING
OUTCOMES.

To serve students well in such dynamic times, schools must be prepared to assess their pedagogical practices and determine how well-suited they are to guide and challenge students in navigating the profound, disruptive change that is now a constant in the living, working and learning aspects of their lives. Because technology has driven or accelerated much of this change, schools can no longer ignore the need for a purposeful plan for technology's role in content area instruction and educational operations.

What schools and districts tend to find when they do this kind of assessment and planning is that they need to place a greater emphasis on collaboration, adaptability, communication, creativity, real-world problem-solving, information literacy, and other skills and concepts that increase student engagement.

Planning also requires redefining traditional notions of classroom design, equipment and organization. Toward that end, this chapter provides snapshot details about

personal computing tools for the classroom, audiovisual technologies to supplement these tools and accompanying software components.

Personal Computing Hardware

For most districts, a mix of devices will continue to be common in schools. But when contemplating classroom technologies, the strategy for acquiring new gear must, as noted already, focus on the desired learning outcome. The investment plan must derive from how devices will be used for instruction – how teachers and students will engage via these tools. There is a wide array of computing hardware options to consider.

Desktop computers | For a roomy hard drive, large display and serious processing horsepower, it's hard to beat a well-equipped desktop computer. Whether an all-in-one unit or a separate CPU and display, these workhorses are stable and sturdy, and generally will provide a longer useful life than most mobile devices. Their challenges include hampering the

ability to easily reconfigure learning spaces because they can be heavy and require a nearby power outlet.

Notebook computers | The processing power and storage capacity of notebook computers has grown significantly in recent years. The best of these can compete well with midrange desktops in terms of performance, but the display is smaller and battery life is still in the four- to five-hour range for most common functions. They are also more costly to support than desktop computers.

Netbooks | These are smaller, lighter versions of notebook computers. The price point is attractive and the performance for web surfing and word processing is adequate for many school uses. These devices' limitations become apparent when multitasking across numerous applications or attempting processor-intensive tasks, such as video editing.

Tablets | The wide variety of tablet systems now available on the market offers the ultimate in mobility. Their light weight, small form factor, astounding array of applications and long battery life make them attractive devices for many schools. They lack the processing power of a notebook and a standard file system. Also, some users find the touch-screen keyboards and printing challenges irksome.

Management of these devices has become significantly easier with the advent of mobile device management (MDM) solutions from companies such as AirWatch and Absolute Software. However, software licensing continues to be an economic disadvantage with these devices for many schools.

Thin client computing | Thin clients are terminals that run all of their applications from a central server. They don't have hard drives or other moving parts. Organizations with a strong infrastructure that are looking to cut desktop purchase and support costs will

find thin clients an attractive option.

One technician can support numerous thin client devices because they are interchangeable and updates are made to the server only. However, these environments can struggle with applications that require localized computing power, such as heavy video and graphics processing.

E-readers | The Kindle, Nook and other e-readers have gained some traction in schools because they can access a Wi-Fi network and provide a utility for downloading books for instruction. Whether there will be much growth in their adoption in schools remains to be seen.

The lines between e-readers and tablets continue to blur. As costs for more fully functional tablets drop, the role of e-readers may shift to libraries, as they offer a clear method for managing digital copies of books.

Chromebooks and Chromebox | A relatively new but rapidly growing player in classroom computing, Chromebooks offer a low-cost notebook and desktop alternative based on Google's Chrome OS. Though these devices offer some offline applications, this environment primarily provides an organized user interface for web-based resources available to any web-accessible device. What's more, these devices offer pricing that rivals e-readers, management costs that rival thin client environments and performance that rivals tablets. This is a category to watch.

Smartphones and other handheld devices | Some school districts with BYOD programs, such as Forsyth County Schools in Georgia or Katy Independent School District in Texas, allow just about any device that can get on a wireless network. As such, these schools find small-form-factor devices satisfactory for their vision of "any device, anywhere, anytime."

Schools should consider all possible

options with an open mind. There are talented people doing interesting things with mobile devices. But there also are support and management issues to consider when embracing mobile devices for instructional use.

AV Equipment

The audiovisual market moves faster than pretty much any other technology market. Therefore, it's wise to stay up to date on what's happening. With more devices going digital and support for legacy analog devices declining, school districts will have to make sure that the decisions they make take into account the number and kind of analog devices they will need to support and for how long.

The AV industry is also wrestling with a convergence with IT. What this means for most K-12 technology leaders is that if AV is not part of their current job, it soon will be.

It also means that the IT team will need to decide how much of a control system it requires to tie together all the components of any given AV setup. The more components in use, the more sense it makes to invest in an integrated setup that provides users with a simple push-button experience – free of the need for multiple remote controls.

/// THE STRATEGY FOR ACQUIRING NEW GEAR MUST FOCUS ON THE DESIRED LEARNING OUTCOMES. ///

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/// 26% OF STUDENTS AND 34% OF FACULTY HAVE USED TABLETS IN THEIR CLASSROOMS. ///

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



Projectors | Prices keep dropping while brightness, features and resolution keep getting better. A new generation of interactive projectors, such as Epson's BrightLink, can make any surface interactive, precluding the need for powered whiteboards for interactivity. Some can stand on end and make floor or table areas interactive spaces.

Most new models now have HDMI inputs and can handle full 1,080-pixel resolution. Most projectors also have installed software so they can be managed centrally over the network. There are also many new

ultra-short-throw projectors that can be mounted on the wall rather than the ceiling, making them easier to install and support. LED projectors have no bulb to replace, but remain a bit pricey for widespread adoption.

Flat-panel displays | Even a very good projector cannot match the image quality of a flat-panel display. Consider a flat-panel display when ambient light cannot be controlled, when the subject matter of a class demands a high-resolution image or when budget or room constraints preclude installing a projector. They also can serve as a quick and

easy video conferencing center when paired with an inexpensive webcam.

There are good deals on plasma displays as manufacturers wind down production. Although very heavy to carry and mount, these displays offer the best picture quality with no restriction on viewing angle. LCDs are much lighter, but the viewing angle can be a problem in rooms wider than they are deep. Sizable LED displays have come down in price and also should be considered.

Interactive whiteboards | Almost every large AV manufacturer now offers an interactive whiteboard solution. Using these devices has as much to do with the software as it does the hardware. Choose the software that best suits the teaching needs and comes with the best support options.

Keep in mind that the market for these products is in a transitional state given the ability of new projectors to provide interactivity without a whiteboard. Remember too that low-cost options such as eBeam and Mimio can make regular whiteboards interactive as well.

Student response systems | Handheld clickers have become popular tools for gathering instant feedback from students. In much the same way that the interactive whiteboard market is in transition, so is the market for proprietary clickers as new apps and web-based services (such as Socrative) can perform similar functions. But many teachers find that using actual devices increases student engagement, provides an avenue for valuable feedback that can help shape a lesson and creates the opportunity for shy students to participate in class.

Document cameras | Nearly every instructor who has used one considers these devices indispensable for sharing student work with the whole class. Connecting them to a projector enables a teacher to display pages from books, objects of all kinds, calculator screens and student papers for review and

discussion. Many document cameras also can record still images or video of what's presented to an SD card or internal hard drive for sharing later.

Voice amplification systems | With increasing emphasis on student learning styles and differentiated instruction, voice amplification systems can be helpful in managing student attention and meeting the needs of children with auditory-processing problems, as well as those with normal hearing.

Significant research exists on the benefit these systems can have in verbal-driven classes. These are simple systems with a wireless transmitter the teacher wears and include two to four speakers that can be placed strategically throughout the classroom.

Web cameras and video conferencing systems | With so many opportunities for online collaboration, every school should have at least a basic setup for video conferencing beyond

a notebook with a camera on it. A decent webcam can cost as little as \$50 and a 50-inch flat-panel display with cart will run about \$1,500.

Of course, it's possible to spend thousands on more advanced video conferencing solutions. A large district with a central IT organization will want to investigate these solutions because it may have enough use for a system to make the outlay worthwhile.

Cameras | Digital still and video

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IN CLASS vs. OUTSIDE OF CLASS: IMPLICATIONS FOR CLASSROOM DESIGN

What does it mean to be "in school" versus "not in school?" As online services and mobile, networked devices proliferate, possibilities for anytime, anywhere learning make this a difficult question to answer.

Schools need to think carefully about which educational experiences make the best use of people being in the same physical space at the same time. What can take place inside a school that can only happen there? What do instructional spaces start to look like when students need to collaborate, communicate, discover, share and process information as members of a learning community, rather than passive recipients of lecture-based instruction?

A body of best practices for this different approach to teaching and learning is emerging as educators tackle the challenge of designing and equipping classrooms today:

- **The process of learning should be visual.** Walls can be painted with whiteboard paint so any surface

can be written on; every wall becoming a "teaching wall." Smaller whiteboards can be hung on rails so group solutions can be easily moved and shared with others. Glass partitions allow groups of students to view others engaged in problem-solving activities.

- **Furniture should be easily reconfigured; common spaces should be designed with teaching in mind.** Desks and chairs can be easily rolled elsewhere and connected to other desks to form tables. Lightweight partitions and screens can be moved to create smaller or larger learning environments. A series of banquettes can accommodate small-group work or be a place for large groups to gather.
- **Floor boxes allow for flexibility in electrical power locations.** Nooks and crannies in corridors and hallways become study carrels or small-group work areas. Stairwells and lobbies are opened up to become impromptu gathering and performance spaces

or galleries for student work.

- **Set up the building itself as a teaching tool.** Floor tiles are purposefully laid in units of measure, in English and metric units of different sizes, to make estimation and measurement easier. Solar panels, environmental probes and digital readouts of smart school systems, detailing energy and water use, allow students to analyze environmental data relevant to their own lives. Green roofs and gardens become biodiversity labs.
- **Technology should play a significant role in supporting learning.** In addition to the traditional means of creating, expressing and sharing knowledge, technology offers a host of other means that students and teachers alike find extremely powerful. Although it can be difficult to know what to choose, it's always best to be clear about what the school or district is trying to do before the IT team starts researching for the right device to do it.



cameras have seen significant price drops, even as their specifications and performance have increased. Classrooms that have these resources available can document daily classroom life in ways that cement students' memories of their time in school and document the things they've learned together. Sharing these moments with parents also helps build a strong learning community in a way that open house nights cannot.

Almost any digital camera will get the job done. With small point-and-shoot video cameras selling for as little as \$130, even young children can become videographers. Smartphones, tablets and other mobile devices with cameras are seriously disrupting the consumer camera market, but in schools the use of stand-alone cameras remains heavy.

Software

There is enough material on software to populate several full-length books on the subject. But here is a brief glance at some software and online service options that can help teachers pull together the way they and their students manage classroom workflow, share content, and save important documents and

projects for future reference.

Web-based productivity software |

By now, most schools are aware of Google Apps for Education, the free suite of online tools for creating and collaborating on all kinds of projects in many different formats. The free and enhanced versions of Microsoft Office 365 provide another viable option.

Both Office 365 and Google Apps give schools domain-level control of the suite. Zoho, an open-source alternative that has been picking up speed in the small business community, also offers directory integration.

Learning management systems |

As teachers and students do more work online, it becomes necessary to create a central repository for course-related materials and online activities. An LMS can serve that purpose.

Choosing the right LMS will depend greatly on a district's particular needs. Adopting one of these systems requires a significant investment of time and money, so the decision should not be taken lightly. But if chosen wisely, an LMS quickly becomes a core service that supports learning in powerful ways.

File sharing and backup | As more students and teachers use multiple devices, access to files across a variety



CASE STUDY

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of platforms becomes increasingly important. Cross-platform systems such as Dropbox, Evernote, Google Drive and SugarSync offer varying degrees of features and space.

Schools should pay attention both to compliance with the Children's Online Privacy Protection Act and to enterprise integration capabilities. Google Drive (if used within Google Apps for Education) and Evernote currently ensure COPPA compliance.

Digital creation software |

Multimedia software is a key component of successful technology integration. Web- or app-based services such as Animoto, Fotobabble, Vimeo, VoiceThread and hundreds of others offer tremendous opportunities for students to express themselves in new ways that can be easily shared. Many of these apps and web tools also contain social media aspects that let others comment on and add to the work. ■

- How BYOD Affects Security
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SECURING THE DIGITAL CLASSROOM

MANY OPTIONS ARE AVAILABLE TO PROTECT STUDENT AND TEACHER COMPUTING ACTIVITY.

An environment in which students are creating extensive content requires increased access to devices, software and storage.

All of this technology, in turn, also must be secured. Additionally, as more students and teachers use their own devices within their school computing environments, schools' IT teams must think about security knowing that consumer devices will be touching data on their networks.

How BYOD Affects Security

The bring-your-own-device trend radically changes standard notions of network security. Traditionally, large networks are highly controlled and monitored. Standardization is key to ensuring timely and low-cost support: The organization's computing device models are often limited and from the same manufacturer, its switches and routers are consistent and remote access is limited and highly secured. BYOD changes all of this.

Smartphones introduced the initial

challenge to standardization. Students and teachers could browse the Internet using their own data plans, completely sidestepping school filtering. Limited remote access drove people to use services such as Dropbox. Google Apps for Education, introduced as a low-cost way to broaden email service, led to the expectation that files, such as those created with Google Docs (now Google Drive), should be accessible on and off the network and from multiple devices.

The increased expectation of services and broader adoption of personal devices soon meant people could do more on their own than with the support of their school technology staff. Suddenly, the standardization that allowed schools to enable the proliferation of technology is now sometimes seen as a limiter and obstacle to the continued use of technology in the classroom.

However, quality technical support and the maintenance of devices and network services at a school are no small tasks. Expecting the same staff

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//// THE PARADIGM MUST SHIFT FROM SECURING THE NETWORK TO SECURING THE DATA. ///

resources in a non-BYOD environment to provide the same service level in a BYOD environment is wishful thinking. Schools have less control over personal devices or what is installed on them and often their staff cannot be certified to perform warranty work. The paradigm must shift from securing the network to securing the data.

Network Access Control

With BYOD and more personal devices coming onto school networks, network access control (NAC) needs to play a strong role in today's network infrastructure. The purpose of NAC systems, such as Aruba ClearPass, Cisco Systems ACS and Bradford, is to manage users and devices that are allowed to connect to the network and the resources they are allowed to use.

The NAC administrator can establish criteria that each user's device must meet before being allowed to join the main network. Criteria for connection can include having up-to-date antivirus software, appropriate patches to the

operating system and specific security policies in place, such as having firewalls turned on. The NAC system will perform a health scan to verify that any computing device seeking to connect wirelessly meets the criteria before allowing access.

Once the NAC has scanned the connecting computer, it can then take prescribed actions. The simplest is to put the device on a safe and limited virtual LAN so it cannot directly access network servers. Typically, this secured VLAN only gives access to the Internet.

NACs also can install antivirus software, apply patches and even install "dissolvable" agents that bring the computer into a healthy status, allow it onto the network and then remove all changes once the computer disconnects. Typically, all of this analysis and remediation takes place in a matter of seconds and gives the administrator control over what is communicated to the user.

NACs can be extremely important tools for organizations that want to allow hundreds or thousands of

devices brought from outside onto the network. Some colleges even use NAC to prevent peer-to-peer transfers, which are a huge bandwidth hog. NAC does an amazing job of preventing or limiting the security holes and virus outbreaks by taking control of who can connect and who cannot – authority that's vital in a BYOD environment.

Single Sign-on

Single sign-on (SSO) capability is becoming increasingly important to network security. As students and teachers use more web-based systems, they must manage multiple password requirements and username conventions. SSO resolves this by allowing a person to use a single authentication service to log on to multiple systems, websites, servers and applications.

The beauty of SSO is that it decreases calls to the help desk, expedites people's use of systems and makes it easier for instructors to integrate web-based systems that require logins into the curriculum.

Few people contest that SSO makes

life easier, but whether it increases or decreases security is up for debate. Though it substantially reduces people's need to keep password Post-It notes, it can compromise accounts if users leave their computer unsecured after logging in.

Once a person has entered the password into an SSO system, any user of that computer has access to all accounts tied to SSO until the computer is locked or someone using the computer logs off. A typical best practice is to exclude extremely sensitive accounts, such as the student information system, from the SSO system.

Remote Access

Access to school systems from off campus used to be reserved for district and building administrators. Now, just as personal tools are expected to be available from anywhere and at any time, so are school resources. Virtual private networks (VPNs) were a popular tool for remote access and are still used today. But it can be cumbersome to manage a VPN when giving broad access. And it really only makes sense with school-issued and -owned devices.

Schools and businesses are demanding something more accessible from any device. Thus, a new class of secure web portals (such as ClassLink and Stoneware) has arrived, offering remote access to files, applications, and desktops in robust and platform-independent ways.

These systems not only give access to files based on logon credentials (which is also done well by Microsoft SharePoint), but they also serve as a single sign-on solution for applications both inside and outside the school network. These systems, similar to Citrix, can track usage and help IT staffs prioritize precious resources

spent on applications and services.

Most important, systems such as Stoneware are device- and cloud-aware, which lets them format their presentation and offer specific services based on the device being used. For example, a file browser will look different on a notebook versus a smartphone.

Another example is that a test being presented through the system may not allow a user to begin testing if the device is not plugged in or has too little battery power. Schools looking to provide the highest level of service to the widest array of devices would be wise to consider this technology approach.

Application-layer Firewalls

Most students and teachers are not malicious users of a school or district network. They just want to use software that helps them do what they want to do. But popular tools such as YouTube, BitTorrent and instant messenger clients can cause distraction and consume bandwidth, making general use of the network difficult for others. This is where an application-level firewall can help.

Many apps are difficult to block with traditional firewalls because they only block ports associated with the apps. If an app is capable of "port hopping," it will simply find an open port despite efforts to block it.

Further, a traditional firewall really only provides the ability to allow or deny access. Schools may want some resources (such as YouTube) to run without using too much bandwidth. Application-layer firewalls let network administrators control the amount of bandwidth available to various apps.

Good application-level firewalls, sometimes referred to as "Layer 7 firewalls" because that's the

THE LAST LINE OF DEFENSE: PEOPLE



As computers take on a greater role in our everyday lives, it is important for people to understand the risks that accompany the many benefits. Good education can lower risks, reduce help desk calls and decrease anxiety within the school district community.

The introduction of malware and viruses often can be radically reduced by teaching people this simple maxim: *If it looks suspicious, don't click on it.* Though it seems so simple, many people don't follow it, thinking they are safe because the network protects them. Helping your community recognize that they are part – a big part – of the solution goes a long way.

Also take time to develop a solid social media policy that explains why certain behaviors are discouraged. Help your community understand that sharing personal information is dangerous because of the risk of identity theft. Help them see how widely shared personal stories actually can be seen if social media settings, such as those on Facebook, are not carefully reviewed. And help students understand the impact that the information and photos on their social media profiles can have later with college applications and job searches.

An educated user community can have a tremendous effect on security. Their knowledge can benefit the security of your school network as well as the personal lives of the members of your community. Few investments will have as significant a return on investment.

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app layer of the Open Systems Interconnection (OSI) model, connect to the network directory and provide the ability to set rules based on network security groups. They also produce graphic reports that allow administrators to obtain granular information about users and resources.

This information can identify trends such as when specific resources are in greatest demand. The school or district can then prioritize certain apps at certain times of the day. As bandwidth demands continue to grow, application-layer firewalls become a critical resource to both monitor and manage how bandwidth is used.

Most new firewalls include intrusion prevention options as well. An intrusion prevention system (IPS) monitors for malicious activity. It looks for unusual behavior on the network, aiming to prevent attacks before they happen.

There are many tricks to exploit vulnerabilities and open holes into a network, and the IPS monitors all traffic that passes through the firewall to prevent and block attackers. An IPS is a security component that should be considered in any large network. Juniper Systems, Meraki, SonicWall and Unitrends provide some of the most popular and feature-rich firewalls.

Content Monitoring and Filtering Software

Almost all schools use content monitoring and filtering. Not only is it universally understood as a best practice, it is required for E-Rate applications. Significant debate exists about how much and what should be filtered. This guide will not delve into that deeply, but it's important to note that a district's policy should relate back to its schools' curricular goals.

Technological literacy, as a goal, may call for allowing students to make more choices and have the ability

to learn from their mistakes online. But even the most open filtering policies make accommodations for students at different developmental levels. Thus, when buying a filtering and monitoring solution, consider its ability to integrate with the directory and provide role-based filtering.

Another significant feature to look for is filtering of phishing, viruses and malware. Web browsing is the most common delivery method of malware. Seek a solution that clearly identifies this as a category and provides frequent updates.

The last major feature to consider is whether the solution is appliance-based or cloud-based. Appliance-based solutions sit inside the network and often cost less over time. Cloud-based solutions provide filtering both on and off campus. This can be beneficial for enforcing policies with school devices that students and staff take home.

Some appliance-based solutions can provide this with proxies, but they tend to be easy to circumvent and can increase calls to the help desk. Popular filtering solutions among schools are Meraki, OpenDNS, Websense and 8e6. ■

FEATURE FOCUS

CONTENT MONITORING & FILTERING SOFTWARE

When comparing solutions, K-12 schools will want to give close consideration to the following feature options:

- ✓ Directory integration or role-based filtering
- ✓ Phishing, virus and malware filtering
- ✓ Application-based vs. cloud-based
- ✓ Custom dashboard and log capabilities
- ✓ Granular social media controls



CASE STUDY

ENSURING MOBILE SECURITY AND NETWORK ACCESS

Read how several school districts are going about securing data and devices:

CDWG.com/classroomtech3

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)

Visit [GetEdFunding.com](https://www.getedfunding.com) to:

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



TURNING THE TRADITIONAL CLASSROOM ON ITS HEAD

66%
OF SURVEYED
TEACHERS
REPORTED THAT
THEIR STUDENTS'
STANDARDIZED
TEST SCORES HAVE
INCREASED SINCE
THEY BEGAN FLIPPED
INSTRUCTION.

Source: *Flipped Classrooms:
Improved Test Scores and Teacher
Satisfaction*, June 27th, 2012

As 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 as 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.

The Flipped Classroom

Many educators are experimenting with the idea of the flipped classroom model. The flipped classroom inverts traditional teaching methods, delivering instruction online outside of class and

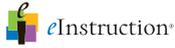
moving "homework" to the classroom. Moving lectures outside of the traditional confines of the classroom allows teachers to spend more one-to-one time with each student. Students have the opportunity to ask questions and work through problems with the guidance of their teachers and the support of their peers – creating a more collaborative learning environment.

Teachers who are eager to transition away from the lecture only model are asking for more technology to facilitate the process. The majority of surveyed students also indicate that they would like even more technology incorporated into their classes as learning tools.

Next-level Classroom Solutions

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. From pre-configuration, installation, implementation and ongoing support, we're here to help, both in and out of the classroom.

/// LEARN MORE AT CDWG.COM/K12SOLUTIONS ///



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.



AVer creates comprehensive solutions to engage and inspire students in your traditional, blended or flipped classroom environments. AVer's broad range of solutions takes the latest in classroom tools and applies them to simple, yet powerful curriculum delivery solutions so your students can experience true engagement, collaboration and interaction both within the classroom and beyond. AVer brings together innovative and comprehensive solutions for virtually every classroom concept, including: iPad and tablet streaming devices, iPad and tablet sync and storage stations, interactive video conferencing, interactive document cameras and curriculum integration software suite.



Enjoy the benefits of technology in the classroom by using DVDs, document cameras, Internet, streaming media and PC applications such as PowerPoint and Excel to present your curriculum. Control the AV equipment, lights, drapes and screens from an intuitive easy-to-use touch panel. Crestron makes using technology simple so you can focus on teaching.



More than simple software for screen recording, Camtasia gives you the tools you need to truly customize and edit your videos. Record on-screen activity, add imported media, create interactive content, and share high-quality, HD videos that your viewers can watch anytime, on nearly any device.

SUBJECTS MOST FREQUENTLY FLIPPED:

46% SCIENCE

32% MATH

12% ENGLISH/LANGUAGE

Source: *Flipped Classrooms: Improved Test Scores and Teacher Satisfaction*, June 27, 2012

EXPERT ADVICE FROM PEOPLE WHO GET IT

CDWG has years of experience working with schools of all shapes and sizes. We carry the technology you need to create more dynamic and engaging learning environments that take education to the next level. With the right technology and solutions, you can help both students and teachers better collaborate, stay engaged and improve the learning experience. Want to learn more about the flipped classroom model? Our experts are on hand to answer your questions and get you started.



LEARN MORE AT
CDWG.COM/K12SOLUTIONS

FINDING THE RIGHT TOOLS FOR YOUR NEEDS

62 %
OF PARENTS
WOULD GIVE THEIR
CHILDREN A MOBILE
DEVICE IF IT WERE
USED IN SCHOOLS
FOR ACADEMIC
PURPOSES.

Source: *Learning in the 21st Century*,
Blackboard and Project Tomorrow, 2012

Whether students are emailing a teacher, researching a project or collaborating with their peers via online group sessions, one thing is clear,

today's students are using mobile computing devices to pursue learning. And with greater opportunities to access information, collaborate with their peers and teachers and create new types of content, students are more engaged in their own education – so putting mobile technology in the classroom makes sense.

But there are many choices in mobile devices, each with its own unique set of capabilities. So how do you decide which ones make the most sense for your school? By carefully considering your organization's goals, student learning styles and abilities, and the way students at different grade levels will be interacting with the technology, you will be better able to determine which devices will enhance the learning experience and educational outcomes seamlessly and cost-effectively.

Notebooks

Today's notebooks offer power, durability and versatility, and are appropriate for students who need heightened content creation and collaboration capabilities. Notebooks support large, complex applications that are designed to run more efficiently on

a local system than over the network, such as video editing software.

Tablets

Designed more for content consumption than content creation, these touch-screen devices – and the apps that bring them to life – are opening up a new world of learning. Educators agree that tablets, when paired with a growing variety of apps, are helping to upend the traditional learning paradigm in which teachers served as conduits of information and students functioned merely as information receptacles.

CDW·G believes that every educational institution should take a strategic approach to the way they purchase and implement technology into their classrooms. This starts with a partner who understands the struggles that you face every day.

At CDW·G, we focus on providing solutions first – products second. This perspective helps ensure that we correctly address what needs to be done and then fit the proper solutions to those requirements. We'll help you find smart, cost-effective ways to incorporate technology into your classrooms.

/// LEARN MORE AT CDWG.COM/K12SOLUTIONS ///



CDWG.com/hp

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, select notebooks offer student-friendly technology including drop-resistant hard drives, strong magnesium alloy frames, splash-resistant keyboards and scratch-resistant surfaces, making learning in the classroom easy and carefree.



CDWG.com/lenovo

Enter Lenovo. The Think brand is world-renowned for its security as well as reliability, durability, mobility and manageability. Lenovo has a full suite of products for the classroom and students of all ages. From affordable notebooks to innovative tablets to enhance the learning experience.



CDWG.com/asus

With over 4 million titles to choose from, the ASUS 7" Portable Google Tablet, Nexus 7, gives you access to a large collection of eBooks. As thin as a paperback book, Nexus 7 is portable enough to fit in back pockets and backpacks, and lets you customize your reading experience by adjusting the font, switching to day or night mode, and much more.



CDWG.com/sony

The amazing Sony VAIO S-series notebook redefines portability. The VAIO S series is slim and compact. Great for students to take to and from class. A tough magnesium alloy body protects the notebook from knocks and shocks as you travel. It provides all the power you need with a long battery life rating and a full-performance Intel Core processor for multitasking or crunching numbers.

4 in 10

STUDENTS BELIEVE INTEGRATING SOCIAL NETWORKS INTO THE CLASSROOM WOULD BENEFIT THEIR EDUCATION.

Source: 50 Education Technology Tools Every Teacher Should Know About, Edudemic.com

DEVELOPING HIGHER-LEVEL SKILLS

Today's students must be taught higher-level skills like creativity, problem solving, communication, and analytical thinking to compete in the global, and increasingly digital, marketplace. Putting the right technology in the hands of your students can bring the classroom to life.



LEARN MORE ABOUT NEXT-LEVEL SOLUTIONS AT CDWG.COM/K12SOLUTIONS

BETTER BYOD SECURITY

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

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

District 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.

/// LEARN MORE AT CDWG.COM/K12SOLUTIONS ///

SOPHOS

Sophos Complete Security Suite gives you the antivirus, endpoint and mobile protection you need with device control, encryption, web and email gateway security you demand. And, because it's all from Sophos, it works better together. It's backed by a vendor you trust. Even better, it's so simple to use you'll actually turn it on – delivering exceptional protection that saves you time and money.



Meraki provides powerful and intuitive centralized management without the cost and complexity of traditional wireless controller hardware. Seamlessly manage campus-wide Wi-Fi deployments and distributed multisite networks with zero-touch AP provisioning, networkwide visibility and control, cloud-based RF optimization, seamless firmware updates and more – without training or dedicated staff.



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 organizational resources, and remotely lock and wipe managed devices.



The MobileIron Mobile IT platform secures and manages apps, docs and devices for global organizations. It supports both organization-liable and individual-liable devices, offering true multi-OS management across the leading mobile OS platforms. MobileIron is available as both an on-premises system through the MobileIron VSP and a cloud service through the MobileIron Connected Cloud.

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

37%
THE PERCENTAGE
OF TEACHERS WHO
SAY THEY PLAN TO
TRANSITION TO ONLY
DIGITAL TEXTBOOKS
WITHIN THE NEXT
ONE TO FIVE YEARS.

Source: ENTERASYS.com/K12

Demands on your network have changed. Driven by a new mobile reality, where the old rules of ports, speeds and wires don't apply. Today your applications and your organization must be on the move in order to keep up.

Infrastructure upgrades make it possible to put modern technology into the hands of students and teachers. In addition, upgrading the infrastructure can help facilitate schools bring-your-own-device (BYOD) programs and one-to-one programs, while also making students more active, engaged learners.

Bill Rust, a research director at research firm Gartner, says three trends are driving districts to upgrade their infrastructures. First, students are demanding that they be allowed to bring their own devices to school. Second, schools are slowly replacing traditional textbooks with digital content, which means every student will eventually need some kind of device. And finally,

states are mandating online testing. When you combine all of these trends, districts really have to make sure they have the right infrastructure in place. That's where CDW·G can help.

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.

/// LEARN MORE AT CDWG.COM/K12SOLUTIONS ///



CDWG.com/hp

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.



CDWG.com/triplite

Tripp Lite offers UPS protection from 300VA – 160kVA, power distribution in a variety of options, and is coming out with even more cooling solutions. Tripp Lite offers a complimentary Power Audit to evaluate your facility to ensure that you're correctly powered, protected and configured and to provide right-sized solutions that meet your system requirements and budgets.

Tripp Lite has power protection, power distribution, rack, cooling, KVM and connectivity solutions.



NetApp

CDWG.com/netapp

NetApp's agile data infrastructure optimizes data management at scale and enables immediate response to education's IT infrastructure needs. With outstanding efficiency and 100% data accessibility, educational institutions can manage data growth, comply with mandates, and meet SLAs – all while lowering total cost of ownership (TCO).



redhat
AUTHORIZED
VOLUME
RESSELLER

CDWG.com/redhat

Red Hat Enterprise Virtualization is a complete virtualization management solution for server and desktop virtualization and a fully open-source virtualization platform. It offers organizations the ideal platform on which to base large-scale virtualization initiatives and internal/private cloud deployments. The solution offers a total cost of ownership (TCO), faster return on investment (ROI), accelerated break-even and freedom from vendor lock-in.

12.8%

DESPITE ALL THE TALK ABOUT THE FLIPPED CLASSROOM, JUST 12.8 PERCENT OF EDUCATORS SAY THEIR SCHOOL'S CURRENT INFORMATION TECHNOLOGY INFRASTRUCTURE IS EQUIPPED TO FULLY ADOPT THE FLIPPED CLASSROOM MODEL.

Source: ENTERASYS.com/K12

OPTIMIZE FOR BETTER PERFORMANCE.

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 a robust infrastructure. We get it. And we're here to help. We can help you assess your needs, evaluate products and vendors and determine the right solution for your needs.



**GET STARTED AT
CDWG.COM/NETWORK**

Robust Bandwidth
Wired & Wireless Infrastructure
Storage Management
Cloud Use in K-12

DIGITAL FOUNDATIONS: INFRASTRUCTURE MATTERS

EDUCATION IN THE CLASSROOMS CAN'T HAPPEN WITHOUT EFFECTIVE INFRASTRUCTURE SUPPORT.

A robust and feature-filled experience in the classroom requires a robust and reliable infrastructure.

While a finely tuned infrastructure is invisible to the classroom, a poor infrastructure is extremely visible. It can make everything else frustrating and ultimately be the key factor in undermining teachers' willingness to put effort into integrating technology into the classroom.

Even having a device for each student will have little effect if logons are slow and Internet service is unreliable. A solid infrastructure is the prerequisite for an excellent K-12 classroom technology experience.

Robust Bandwidth

As more traffic ramps onto the network (especially from video), bandwidth is being taxed like never before. Videos such as those on Sophia, Khan Academy, Atomic Learning and YouTube stream into classrooms regularly. Media-rich interactive websites and cloud-based

services, such as Google Apps, make heavy demands that can be difficult to predict. With all this increased network activity, poor bandwidth can seriously impair the IT team's ability to maintain quality integration of technology in the classroom.

Bandwidth can be managed in a variety of ways. Application-layer firewalls provide a way to manage the traffic that flows across the network's connections. Schools also should predict bandwidth growth when conducting budget planning.

Many technology budgets have benefited from dropping technology costs, which have allowed organizations to increase services without increasing costs. Bandwidth costs are dropping, but in most areas of the country, the demand is increasing faster than the cost is falling. Thus, schools need to look at budgets to find room for more resources for bandwidth. Be aware that the amount of bandwidth a school has may affect the price of firewall licensing.

The reliability of bandwidth is also

critical. Being completely without Internet service is a serious and potentially dangerous situation. Schools should consider a secondary line, which can offload critical services such as email. Appliances from manufacturers such as Sophos and SonicWall can automate this process to minimize, if not eliminate, downtime.

Wired & Wireless Infrastructure

In the recent past, wired networks were the primary networks in schools, and wireless existed simply to extend the resources of the wired network. Now, the expected connection is wireless. Even many desktop systems come with built-in wireless capability. Thus, school wireless networks need to be robust, secure and ubiquitous.

At one time, wireless networks were designed for less than a 1-to-1 device-to-user ratio, because not everyone was using a notebook all the time. However, today's wireless networks are designed for a 3-to-1 ratio to accommodate the increased use of smartphones, tablets and notebooks. This is the new normal, and it demands a great deal from a school's wireless network.

Wireless capacity has grown rapidly over the years. Networks installed even just three years ago may be operating with only the 802.11g standard in place, which has a data rate of 54 megabits per second, but throughput closer to 22Mbps.

The current standard of 802.11n has data rates that range from 54Mbps to 600Mbps and uses multi-input multi-output (MIMO) technology that lets a radio send and receive multiple signals at the same time. The latest standard, which is already beginning to hit the market, is 802.11ac. This standard is expected to reach data rates up to 3.47 gigabits per second.

Wireless capacities of that size bring a new demand to the wired network.

Many switches may not be prepared to take full advantage of this degree of wireless potential. If not already in place, a school's wired switches should support Power over Ethernet (PoE) so there won't be a need to run power to access point locations.

Also, the increasing reach and capacity of access points dictates the need to connect to at least a gigabit or (more likely) a 10-Gigabit Ethernet switch port. Innovation in wireless is occurring at a faster pace than in the wired-switch environment. Therefore, most schools replace their wireless networks more frequently than their wired networks. Be mindful of the rapid innovation in wireless when buying switches. Try to anticipate wireless growth before making a purchase.

The diversity in the wireless marketplace has made purchases significantly more complicated. The first thing districts must consider is the construction materials used in their buildings. If the building is primarily constructed of drywall and allows for the relative easy passage of wireless radio waves (referred to as being "RF friendly"), then consider systems requiring fewer access points that include more radios.

Buildings with heavy and reflective surfaces, such as cinder block and energy-efficient windows, will require more access points and thus can include fewer radios, as they are covering a smaller area. Solutions that work well in RF friendly buildings include Xirrus and Ruckus. Solutions that favor buildings that are less RF friendly include Cisco and Meraki. Most schools have mixed environments though, and most manufacturers, including those listed, offer mixed solutions.

Another significant consideration is how the wireless solution is managed. An unmanaged system

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READY FOR WIRELESS OR FOR A WIRELESS UPGRADE?

Because the wireless marketplace continues to change so quickly, it is important to consider the upgrade path before buying or upgrading a wireless solution. Here are five questions that can help your IT team understand the agility of potential wireless manufacturers.

1. Does the product offer upgrades to the management solution?
2. How are upgrades licensed over time?
3. How frequently does the manufacturer make improvements?
4. What kinds of improvements have been implemented over the last 12 months?
5. What is the roadmap for improvements in the next 12 months?



CASE STUDY WIRELESS UPGRADE TRANSFORMS LEARNING

Read how a network overhaul helped a California district prepare for future growth:

CDWG.com/classroomtech4

would be a cluster of wireless access points that do not talk to one another, such as access points found in most residential homes. This is not an adequate solution for a school.

Managed systems are typically guided by either a controller on the network or hosted in the cloud. Locally managed solutions can provide more control, better speed and reliable accessibility in the case of an Internet outage. But cloud-hosted solutions often offer better redundancy and lower cost. Excellent controller-based solutions include Aruba and Ruckus, while Aerohive and Meraki are excellent cloud-based solutions.



Storage Management

The storage scene has changed significantly in the past five years. With the introduction of serial-attached SCSI and solid-state drives, storage speeds have skyrocketed. Unfortunately, so has the number of files that most organizations want to store. With so much information in a digital format, it's critical to establish best practices for storage management to ensure fast and reliable access to data, including the following:

Data deduplication | This compression technology adds some brains to a school district's storage. The idea behind data dedupe is to eliminate duplicate copies of repetitive data. Doing this can decrease the amount of bandwidth being used on the network and increase the amount of backup that can be kept. This can save a school a large amount of time and money because each backup is much leaner.

No backup system should be considered without some form

of data dedupe. It provides a way to create an efficient backup plan without overspending on storage. The amount of savings depends very much on the exact environment.

Backup | Backup has changed as well. The heyday of Linear Tape-Open technology has likely passed. Today's backup processes often rely on disk-to-disk systems, with some great cloud options available as well.

With the speed and size of hard drives increasing as their prices are decreasing, most IT departments have made the switch from tape to disk, which provides several key advantages. First, the speed and cost of hard drive backup systems are greater than the old tape systems. Finding files to do quick restores is also faster with hard drives. With a tape backup system, the IT team had to locate the tape that held the required backup and manually insert it into the tape loader.

Several backup appliances, including those from Barracuda, SonicWall

and Unitrends, provide all-in-one solutions that run the backup, dedupe the data and then find data as needed.

Some IT departments already have a large amount of storage hardware, so just buying the backup software is also an option. Acronis, ARCserve and Symantec make excellent products to consider.

The newest development in the backup world is cloud storage. This is a very popular option that should be considered as part of a backup plan. These services compress and encrypt the data on the local system or server and then upload the data to the provider's data center in the cloud.

The cloud backup companies usually offer some sort of overnight delivery service in case of a disaster on campus. In such a scenario, the provider would send the school a hard drive with the most recent backup on it.

Given the cost of online storage, IT departments might want to put only

/// A TWO-PART PLAN FOR BOTH ONSITE DISK-TO-DISK AND OFFSITE STORAGE VIA THE CLOUD SHOULD BE CONSIDERED. ///

the most critical data in the cloud. A two-part plan for both onsite disk-to-disk and offsite storage via the cloud should be considered. Whatever the backup strategy, schools should still test backups monthly. An extensive plan is useless if the restore fails.

Virtual storage | Over the past three years, the push to go virtual has been very strong. VMware's technology changed how organizations thought about physical servers. Microsoft Hyper-V brought the cost down for all server virtualization options with its nearly free approach.

A proper virtual setup requires two or more host servers clustered together using a storage area network (SAN) or network-attached storage (NAS) for shared storage. A SAN is the fastest, most sizable, most expensive option and the ideal choice for a virtual project. The idea behind using a SAN in a virtual environment is that each host server will be attached to the SAN either via iSCSI or Fibre Channel.

Once that connection is in place, the host servers will act together in the cluster and share the resources of the SAN simultaneously. This affords the virtual environment flexibility and failover. If a host server dies, its applications and data can be accessed by other host servers in the cluster.

This allows for little or no downtime because a virtual client that might have been running on the now-down host server will be assigned almost instantly to another host server. Such a setup also allows for easy patching and updates of the host servers with no downtime.

Cloud Use in K-12

As it is in almost every aspect of IT, the cloud plays a significant role in infrastructure. Schools can have companies manage their switches, perform their backup, host their servers and provide storage – all via the cloud. Depending on the size of the school or

district, this can help reduce staff, lower costs and allow schools to scale their infrastructure more closely to their need rather than buying for future needs and then growing into the infrastructure.

Storage is one of the most common uses for the cloud in K-12 environments. Many schools and districts encourage students to use Google Drive, Dropbox, Microsoft SkyDrive or Evernote for file storage. Though this use is not considered a best practice for critical infrastructure data, it can relieve the network from one of its greatest stressors: student project data.

These cloud-based storage solutions offer low- or no-cost alternatives. The concern that schools have regarding these kinds of technology tools is

the limited visibility and control they have over them. Enterprise solutions such as Google and Microsoft tend to offer the greatest degree of administrative control and visibility.

Many schools and districts lack the bandwidth to host all of their servers offsite. Those that do typically enjoy tremendous uptime, low staffing demands and granular scalability.

A good example of this in the K-12 space is IlliniCloud, a nonprofit consortium of more 150 school districts that operates infrastructure as a service (IaaS) from three data centers across the state of Illinois. This cloud service lets districts pool their resources and use only the infrastructure they need. ■

MANAGING THE STORAGE PUZZLE



DATA DEDUPLICATION: Eliminate duplicate copies of data for improved bandwidth and increased backup space

ONSITE BACKUP: Onsite disk-to-disk for quick restores

OFFSITE BACKUP: Cloud storage offsite for critical data

VIRTUAL STORAGE: Virtualized servers clustered together using a SAN to share resources and reduce downtime

SUSTAINING SUCCESS: CREATING A CULTURE FOR CHANGE

THE EDUCATIONAL
CULTURE MUST
CHANGE TO MAKE
THE MOST OF
TECHNOLOGY'S
BENEFITS.

Merely purchasing and implementing technology will not transform the classroom experience. Sustained success requires planning, clarity, assessment and communication.

Educational Collaborators, a national consulting organization, refers to this process as creating a culture for change. Implementing the kind of change demanded by the technological innovations in the educational landscape cannot be done with a purchase order.

Schools are seeking to improve the learning experience and performance outcomes of their students. This kind of change is as much cultural as it is instructional. Schools that choose not to assess and address the cultural needs of their communities often experience slower adoption of technology and significantly fewer desired outcomes.

Changing the Conversation

Creating a culture for change requires involving the entire community in the defining and assessment of the desired outcomes. The process begins with a

small group of planners determining the initial desired outcomes of an initiative. The group should include academic administrators, teachers and technology staff. Although logistics often preclude students from being members of the planning group, it is wise to seek their input early in the process.

Perhaps the initial goal is creating classroom environments that promote hands-on student work with current technology tools aimed at improving reading and writing performance. Once the initial goal is created, focus groups are assembled to gather more detailed information before going further.

Focus groups are typically made up of members of the various constituency groups. One or more groups consisting of administrators, faculty, students and parents should be created. Groups can then be asked questions to help clarify the desired outcome.

For example, what does a classroom that promotes hands-on student work focused on creating better reading and writing look like? Beyond test scores,

how would the group define improved reading and writing performance? What are the greatest challenges relative to this desired outcome? What are the school's or district's best assets today as it moves toward this goal?

The purpose of these focus groups is to gain a deeper understanding of the community's perspective around these goals and to help develop a clearer sense of how to assess progress. This is also a critical opportunity for a district to listen (and be seen as listening).

Because this kind of change is as much about culture as it is about instruction, people need to be heard. Even those who disagree with the direction taken will be more open to change if they feel heard. Also, genuinely listening to those who oppose change will provide valuable information about cultural needs that must be addressed.

Assessing the Situation

The focus groups, particularly if assembled well, should give the district a wonderful snapshot of its community. But broader data must be gathered. The data from the focus groups can be used to develop assessments. Some of the assessment data can be simple, such as monitoring change in attendance, behavioral issues or standardized test scores over time.

It is equally important to assess the faculty, as staff members are the primary agents of change in this process. Develop surveys that assess the frequency of their activities to promote hands-on reading and writing and also pay attention to the prerequisites of these activities. Schools need to assess not only the outcomes, but also the process. Assessing the process can provide valuable information about where bottlenecks exist and how to improve more quickly.

The attainment of any goal requires development of some prerequisite attitudes and skills. For instance,

what attitudes must a student have to successfully engage in hands-on learning with technology to improve reading and writing performance? Students must value reading and writing. They must see them as relevant. Be sure to assess this.

And what skills must a teacher have to successfully engage in hands-on learning with technology to improve reading and writing? Teachers must know how to blog, use collaborative writing tools, provide access to differentiated writing assignments and the like. Including assessment criteria for these items will point out where to focus energy if performance objectives aren't being met.

Once assessment tools have been developed, a baseline set of data should be collected. If done before technology is purchased, this can be very instructive in determining what kind of solution is needed. However, even if the purchase decisions have been made, gathering assessment data as early as possible will be valuable.

The data can help define the solution that is best for the school, and it can inform professional development, identify misconceptions and help improve the return on the significant technology investment. These assessments should be deployed and analyzed at least once a year so changes in the program can be made and success can be reported to stakeholders.

Technology Policies

Many schools' acceptable-use policies are merely a collection of policy reactions to bad behavior that has occurred over the years. Any major technology initiative for classrooms represents an opportunity to redesign policies to be proactive rather than reactive, and to focus on outcomes rather than tools.

Goals identified for the initiative should extend from the mission. Any

network and computer policies should extend from that mission as well. Not only does this help develop more long-term policies, but it allows the school to move the discussion past simple fears about new technology tools.

A common practice is to redesign the traditional acceptable-use policy into a responsible-use policy. This change represents a shift from a policy identifying explicitly which specific behavior is allowed or prohibited to one identifying the kinds of behaviors that are consistent with the school district's mission and values.

Because technology evolves so quickly, policies that speak more to the spirit of use provide a broader reach and are more likely inclusive of technologies that have not yet been invented. A thorough discussion and examples of policies can be found on the Consortium for School Networking website.

Service-level agreements also should be evaluated based on the goals and criteria set forth as part of a school initiative. SLAs represent the levels of service a school's IT staff commits to providing its community. These services help the school community know what should be expected, and they provide technology departments with clear goals that give direction regarding how many people should be hired and what caliber of technology should be purchased. >>>

**// PROFESSIONAL
DEVELOPMENT
NEEDS TO MEET
TEACHERS
WHERE THEY
ARE AT IN THEIR
SKILLS AND
KNOWLEDGE
ACQUISITION. //**

Many schools have a significantly smaller IT staff than businesses of comparable size. Though part of this is because of tight budgets, often it is also because school leadership does not understand the demands of technology support. Without a service-level agreement, it is difficult for IT administrators to articulate precisely why more staff is required.

Once classroom expectations are identified and defined, building SLAs becomes much easier to define. Also, an SLA based on classroom expectations is more easily understood by a superintendent and board of education than one designed purely based on technology best practices.

Professional Development

Gathering data about prerequisite

attitudes and skills is a critical component of developing sustainable technology programs. Too often, professional development money is spent either on the use of the tool with little to no attention paid to the desired result of its use, or on training toward a goal that instructors don't support. In either case, the effect of the professional development quickly fizzles and is forgotten.

Professional development needs to meet teachers where they are at in their skills and knowledge acquisition, and that requires the collection of data. It also should always be contextualized against the mission of the school and aimed at the desired outcome.

Technology has been installed in classrooms for years with little professional development, and

subsequently, with little effect on student performance. Professional development must be a part of every technology initiative.

The U.S. Department of Education requires that between 10 percent and 25 percent of many of its grants for educational technology to be spent on technology. With the typical school spending between 1 percent and 3 percent on professional development for their initiatives, it is little surprise that teachers can sometimes feel rudderless with new technology.

When planning a professional development strategy for a technology initiative, remember to include administrators and IT staff. A new initiative also represents a change for IT leaders and their staff. Give them the support they need to succeed as well. ■

THE MANY FACES OF PROFESSIONAL DEVELOPMENT

Professional development can be shared in a variety of formats and venues. Here are a few of the more popular opportunities to gain knowledge and new skills:

WORKSHOPS: Workshops are the most common form of professional development. But be mindful to keep the workshop content focused on specific goals and to require the presenters (whether internal or hired) to contextualize the content for your specific initiative.

Workshops should also have a work component. Participants should be required to actually do something, whether in the workshop or afterward, to demonstrate mastery or practice what they are learning. Lastly, develop a small-group component to every workshop. This increases participation and social accountability.

TRAIN-THE-TRAINER: These programs are popular in large schools and

districts as a means of lowering the cost of professional development. The challenge with this approach is that those undergoing the training often are not also trained to become effective trainers. Seek train-the-trainer solutions that dedicate a component of the instruction time to helping the intended trainers learn how to repackage the material for other instructors.

PROFESSIONAL LEARNING

COMMUNITIES: PLCs are small groups of learners focused on a topic. These groups meet regularly to discuss progress and share experiences. PLCs work well if they have a strong facilitator and a clear topic. Though they require precious time, they can be extremely valuable. These groups can aid in professional development, and they also can build community and help teachers understand that they can learn from their colleagues.

COACHING: Coaching can be helpful for instructors, but it is a particularly

beneficial model for administrators.

This model pairs an administrator with an experienced mentor, and the two work through specific goals for the school together.

The coach and administrator communicate regularly via phone, email or video conference and get together a few times a year to "walk the school" to measure progress. This can be somewhat expensive for a single person, but such leadership training can have an enormous effect on the school and ultimately represent an extremely efficient way to spend professional development dollars.

ONLINE COMMUNITIES: Online professional learning networks provide unprecedented free, high-quality professional development resources. Most online learning communities require a certain degree of personal motivation from participants, but the knowledge they offer can be a rich reward.

Glossary

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.

10-Gigabit Ethernet

A networking standard, defined by the Institute of Electrical and Electronics Engineers (IEEE), for transmitting Ethernet frames at a rate of 10 gigabits per second.

Acceptable use policy (AUP)

An AUP is a policy that stipulates under what circumstances users will be given access to a network.

Andragogy

This term refers to learning strategies and techniques used to teach adults. It is often interpreted as the process of engaging adult learners with the structure of learning.

Application-level firewall

An application-level firewall is a security control that manages access and use from, to or by an application or service.

Bring your own device (BYOD)

BYOD is a technology trend wherein a personally owned mobile device, such as a notebook or smartphone, is used to perform work at school.

Children's Online Privacy Protection Act (COPPA)

This 1998 law sets regulations that website operators, including schools, must meet to protect users 13 years of age or younger.

Cloud computing

Cloud computing refers to a set of virtualized resources that can provide computing power, storage, applications and/or platforms as a pay-as-you-go service.

Common Core State Standards

This is a set of curriculum standards designed to align goals for student performance across states.

Data deduplication

This is a method for minimizing data storage requirements by eliminating redundant instances of data; various dedupe algorithms flag data at the file or block level.

Encryption

Encryption is a technique to protect the confidentiality of data by using a cryptographic algorithm and a secret encryption key to restrict access to only those individuals or devices that possess the secret key.

Fibre Channel

This is a high-speed data network transmission technology typically used within a storage area network that's capable of rates up to 10 gigabits per second.

Flipped classroom

The flipped classroom is an

instructional model in which students consume the initial lecture materials outside the class online and then work interactively during class time.

High-Definition Multimedia Interface (HDMI)

HDMI is a digital interface that integrates audio and video so that a single cable can support almost a dozen AV devices.

Infrastructure as a service (IaaS)

Server, storage, networking and input/output resources that can be provisioned on demand from a third-party cloud provider are referred to as IaaS.

Intrusion detection/prevention system (IDS/IPS)

These are security appliances or installed software that monitor the network to identify potential signs of a breach or malware incursion and then thwart these attacks proactively.

iSCSI

This is an IP-based standard for connecting data storage devices on a network.

Learning Management System (LMS)

An LMS is a program to plan, implement and manage instructional materials, as well as assess student performance in using digital learning resources.

Mobile device management (MDM)

MDM is a class of software used to manage the configuration, including the security setup, of mobile devices such as smartphones and tablets.

Multiple-input multiple-output (MIMO)

MIMO refers to the use of multiple antennas within a wireless network access point to enhance bandwidth performance.

Network access control (NAC)

NAC is a solution that controls access to an organization's networks by examining the security characteristics of a device every time it attempts to connect to the network.

Network-attached storage (NAS)

NAS refers to data storage appliances, designed for use by two or more systems on a common network, that typically house redundant disk arrays.

Open Systems Interconnection (OSI) model

This is a networking framework defined by seven layers: application, presentation, session, transport, network, data link and physical.

Power over Ethernet (PoE)

PoE involves distributing power over an Ethernet cable to a device, alleviating the need to have access to an AC wall outlet – particularly useful for access points in a wireless network.

Role-based filtering

Role-based filtering is a capability that allows the use of policies to define web access use privileges based on the identity of the user.

Service-level agreement (SLA)

An SLA is a contract negotiated between the IT department and a user or vendor that specifies performance parameters for given technology services and that defines repercussions if the agreed upon service levels are not met.

Single sign-on (SSO)

SSO is an authentication program that lets a user log on once to access multiple systems and applications.

Solid-state drive (SSD)

An SSD is a drive that uses solid-state flash memory to provide persistent data storage.

Storage area network (SAN)

A SAN is an array of disks or other data storage devices connected via a network that record data by blocks rather than files.

Virtual LAN (VLAN)

A VLAN is a logical grouping of network resources that mimics a dedicated physical connection between them.

Virtual private network (VPN)

A VPN is a form of network-level traffic encryption that forms essentially a secure wrapper around network traffic – protecting its confidentiality from eavesdroppers.

Virtualization

Virtualization refers to the encapsulation of an application, operating system or memory as a self-contained software use, known as a virtual machine, that can reside with other VMs on a single physical server.

Webcam

A webcam is a video camera – either a stand-alone device or an appliance integrated into a user's computer – to broadcast video via the web.

Wireless access point

This is a communications node on a wireless LAN that connects wireless clients with other networks, including wired networks.

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LOOK INSIDE FOR MORE INFORMATION ON:

- The flipped classroom instructional model
- Choosing the right classroom technology
- Single sign-on and other effective security measures
- Building the infrastructure to support BYOD



SCAN THIS!

Get an up-close look at the next-level classroom technology used at a high school in Rio Rancho, New Mex.

