MAR | 2011

21st CENTURY CLASSROOM

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CDW·G REFERENCE GUIDE

A guide to the latest technology for people who get IT

CDW·G PEOPLE WHO GET IT™

21st CENTURY CLASSROOM REFERENCE GUIDE

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WHAT IS A CDW·G REFERENCE GUIDE?

At CDW·G, we're committed to getting you everything you need to make the right purchasing decisions — from products and services to information about the latest technology.

Our Reference Guides are designed to provide you with an in-depth look at topics that relate directly to the IT challenges you face. Consider them an extension of your account manager's knowledge and expertise. We hope you find this guide to be a useful resource.

THE VALUE OF 21st CENTURY CLASSROOM TECHNOLOGY

Updated classrooms yield teaching and learning value

To understand the value of investing in — and supporting — technology in 21st century classrooms, it's important to first understand 21st century learners and the characteristics they bring to the classroom. Collectively, they've been called everything from "Gen Y'ers" to "Millennials" to "digital natives," but none of these labels truly captures the inherent nature of modern students.

Today's students are embedded in digital culture, but upon more careful study it's clear they may not be as knowledgeable as we think about how this culture works, or about how to use its tools to be successful in today's working world. Although young people come to school with certain characteristics and abilities — not to mention plenty of preconceived notions about the world around them — they are students first and foremost. It's the educator's job to prepare them for what comes next. But how?

If you were to ask someone to describe today's children, you likely would hear that they're easily distracted and often off task; they don't read; they have short attention spans and are more interested in information breadth than depth.

However, anyone who has seen a teenager research strategies for a World of Warcraft video game or watched a child develop a digital story on a meaningful topic knows that today's students are attentive if — and this is the big "if" in education today — the tasks they're pursuing are interesting, intellectually engaging and allow them to see the relevance and meaning of the activity at hand.

Key insights about today's students come courtesy of Project Tomorrow's *Speak Up 2009* report of students' thoughts and ideas about 21st century learning. The report, which surveyed nearly 300,000 K–12 students in fall 2009, found that students "are increasingly taking responsibility for their own learning, defining their own education path through alternative sources and feeling not just a right, but a responsibility for creating personalized learning experiences."

Increasing the relevance of the learning process, they say, begins with these essential elements:

- **Social-based learning:** Students want to leverage emerging communication and collaboration tools to create and personalize networks of experts to inform their education process.
- **Untethered learning:** Students envision technology-enabled learning experiences that transcend classroom walls and aren't limited by resource constraints, traditional funding streams, geography, community assets or even teacher knowledge and skills.
- **Digitally rich learning:** Students see the use of relevancy-based digital tools, content and resources as a key to driving learning productivity.

"At the heart of each element is the innovative use of a wide range of emerging technologies, including online learning, mobile devices, Web 2.0 tools and digital content," the report explains. "While these three essential elements represent some dramatically new approaches to teaching and learning in a classroom setting, for the students, the incorporation of the tools and applications is merely a natural extension of the way they are currently living and learning outside of that classroom.

"Thus, there exists a very special opportunity today to both increase the relevancy of a student's education experience and to start to close the persistent digital disconnect between students and educators on learning with technology."

The Teaching and Learning Benefits of Technology

Truly effective learning environments encompass both the physical and the digital. Within them, students interact with teachers, each other and the world around them using a variety of technological tools, including interactive whiteboards, cameras and camcorders, student response systems, digital content, and social media.

These environments transform the entire teaching and learning experience — from the structure and location of the classroom to instructional practice, the sequencing of instruction and the interconnectedness of disciplines.

Among other benefits, technology-rich classrooms facilitate more visual and interactive presentations of content. They also make possible collaborative discussions of ideas, problem solving, research and even networking. And they allow teachers to incorporate the very latest thinking on all kinds of subjects into their lessons.

Studies show that classrooms that leverage technology can engage and empower both students and teachers. As noted in the *CDW·G 2010 21st Century Classroom Report* — a survey of approximately 1,000 high school students, teachers and district IT professionals about how technology is used in their schools — today's students feel that technology is vital not only to their personal lives, but also to their education and to their future.

In fact, 84 percent of them said technology is important or very important to their ability to study and work on class assignments. Ninety-four percent said they anticipate using technology to complete their assignments in college. As one student noted, technology-rich instruction not only better prepares students for college, it also makes their classes "more productive" and "enables them to learn more."

It's therefore critical for all school stakeholders — superintendents and principals, IT directors and network administrators, teachers and staff, and even parents — to understand how the appropriate use of technology impacts student learning and to make every effort to leverage its power.

Conversations must go beyond a focus on the technology itself, however, and explore what technology enables students and teachers to do, as well as the personnel and technical structures that are required to support technology-rich learning environments.

What Is a 21st Century Education?

An educated workforce is one of the keys to regional and national economic success. But how do we define "educated" in an increasingly connected, increasingly mobile world?

The Federal Communications Commission (FCC) argues in its National Broadband Plan (broadband.gov/plan) that affordable, high-speed broadband access can help "stimulate economic growth, spur job creation and boost our capabilities" in education and other key areas.

The plan, which the FCC calls a "roadmap to America's future," acknowledges that the "public education system has effectively developed a workforce for the industrial age" and that "its graduates have helped the United States become the most prosperous nation in the world." But it also warns, "The demands of the new information-based economy require substantial changes to the existing system."

Central to these changes is an increased focus on the study of science, technology, engineering and math (commonly known as STEM). The FCC says STEM is "critical to maintaining the United States' competitive edge in the 21st century" and proposes that "providing access to more online learning systems, coursework and materials in STEM can improve opportunities for students who are interested in working in these areas but lack local, high-quality learning opportunities."

The Obama Administration agrees, judging from the White House's fall 2010 launch of the "Educate to Innovate" campaign, which aims to improve the participation and performance of America's students in STEM subjects.

Change the Equation, a White House–backed, CEO-led nonprofit, also is working to better prepare students to lead in the 21st century economy. The initiative's aims include improving STEM teaching at all grade levels; inspiring student appreciation and excitement for STEM (especially among women and underrepresented minorities); and achieving a sustained commitment to improving STEM education.

The Partnership for 21st Century Skills, meanwhile, advocates for the integration of the "three Rs and four Cs" in education.

Besides the traditional subjects of reading, writing and arithmetic, which have long been considered the foundation of a basic education, the organization believes that "what separates students who are prepared for increasingly complex life and work environments in today's world" are creativity and innovation; critical thinking and problem solving; communication; and collaboration. These skills, it says, "promote an understanding of academic content at much higher levels."

Technology facilitates students' development of these and other core skills, including self-sufficiency and media literacy, while also extending the walls of the classroom to include both local and global communities.

Students quoted in the *CDW·G 2010 21st Century Classroom Report* said a technology-rich classroom teaches them how to search for information more effectively and delivers better visuals to enhance their understanding of the material. They also cited technology's ability to "open opportunities for outside input and research, while speeding and improving the quality of work."

Surveyed teachers, meanwhile, said technology broadens the types of lessons they can present in class and gives students access to a wider array of supporting materials and learning aids. One respondent observed that having better access to video and audio recording capabilities, for example, "enhances and brings depth to lessons for students with different learning styles."

A Closer Look at the Value Proposition

Business leaders understand that technology investments must meet specific organizational needs. For schools, those organizational needs can be divided into three key areas: supporting teaching and learning, protecting student data and creating efficiencies in administrative practices. Although the protection of student data and administrative support are important, the focus here is technology's impact on the classroom itself.

Ninety-six percent of the *CDW·G 2010 21st Century Classroom Report's* student respondents said that they're using technology at home as an educational tool to complete class assignments — most notably MP3 players (78 percent); social media, including Facebook, Twitter, blogs and wikis (76 percent); and smartphones (38 percent).

And yet, just 57 percent of students said that their high school is preparing them to successfully use technology in college and in the workforce. The remaining 43 percent said their school

isn't properly preparing them to use technology in the future (17 percent) or weren't sure (26 percent). As one district IT professional noted, "The use of technology in schools is behind current technology use in everyday life."

Other findings from the report bear this out. Although six in 10 students said their teachers regularly use technology to teach, only a quarter of them (26 percent) said they're encouraged to use technology throughout the day for their own learning.

Even more disconcerting, just 36 percent of high school teachers said they regularly discuss 21st century skills and incorporate student feedback into their lesson plans. In addition, 53 percent of teacher respondents said they either don't hold any of their classes in a 21st century classroom or didn't know if they do.

The ultimate lesson to take from these findings and other research is that schools must begin teaching to the future. This means investing in the technologies that empower students to take control of their individual learning and that provide the intellectually challenging and engaging learning environments they want and need.

NEW LEARNING OPPORTUNITIES

Opportunities to upgrade classroom technology can present themselves in the most dire of circumstances.

Visit **edtechmag.com/k12** to view a video highlighting Charlotte County Public Schools' experience with revamping its classrooms for the 21st century following a hurricane.

Once that infrastructure is in place, educators and other stakeholders must work to create collaborative, dynamic learning communities where students and teachers from all over the world can share their knowledge and learn from one another. From these communities, teachers can develop performance-based learning objectives, locate student-centered content and craft authentic learning activities and assessments using problem- and project-based approaches.

Students, in turn, can use the technologies that their schools make available to them to connect with their teachers, classmates and other students and experts from around the world; to access digital content; to develop a deeper understanding of the subjects they're studying; to develop proficiency in the practical skills that will drive their future success in college and the workforce; and to demonstrate their knowledge in ways that were unimaginable only a few years ago.

Technical Support

Today's technology-savvy students want and expect to have access in the classroom to the same tools they're using at home and on the go to communicate, collaborate and connect. Technology is as integral to their lives as sleeping, eating and breathing.

Teachers and IT professionals, on the other hand, are either playing catch-up or providing an infrastructure that doesn't live up to students' expectations.

The high school teachers and IT professionals surveyed for the *CDW·G 2010 21st Century Classroom Report* believe, for the most part, that technology is available and supported in their schools. When asked which technologies they consider essential to a 21st century classroom, teachers most often cited wireless Internet access (70 percent); student computing devices — specifically notebooks, netbooks and smartphones (66 percent); and interactive whiteboards (59 percent).

It seems district IT departments are meeting and exceeding that vision in most cases, with 65 percent of IT professionals reporting that their districts offer Wi-Fi; 90 percent reporting the presence of computer labs; 12 percent reporting the presence of one-to-one computing programs; and 69 percent confirming the availability of interactive whiteboards.

The disconnect between students, teachers and IT staff concerning the level of technology integration that currently exists is telling, however. Two statistics in particular illustrate this difference in opinion:

- More than half (58 percent) of teacher respondents said technology is either fully integrated (18 percent) or nearly fully integrated (40 percent) in their classrooms. By comparison, only 9 percent of student respondents called their classrooms fully integrated and 25 percent said they're nearly fully integrated.

- More than two thirds (67 percent) of IT professionals say their districts understand how students want to use technology as a learning tool, but only 47 percent of students agree.

Information technology has long been the backbone of technology support for many districts, requiring knowledge of administrative, data and networking systems. But the slow and steady integration of technology into the curriculum has presented the traditional IT director with new challenges.

It therefore falls to school administrators and teachers to work with both information technology and instructional technology staff members to develop an infrastructure that can support the robust learning environment that will drive student success.

The Big Picture

The Obama Administration has made education an urgent priority, challenging all educators to raise the proportion of college graduates from 41 to 60 percent by 2020 and to close the achievement gap so that all high school graduates are properly equipped to succeed in college and the workforce. But where do we start?

The National Education Technology Plan 2010 (ed.gov/technology) produced by the U.S. Department of Education (DOE) acknowledges that technology "is at the core of virtually every aspect of our daily lives and work."

The plan, *Transforming American Education: Learning Powered by Technology*, challenges our education system at all levels "to provide engaging and powerful learning experiences and content, as well as resources and assessments that measure student achievement in more complete, authentic and meaningful ways."

It also proposes a new model of learning powered by technology, with goals and recommendations for states, districts, the federal government and other education system stakeholders that address learning, assessment, teaching, infrastructure and productivity.

Preparing students to enter today's workforce or pursue a college or university degree requires a different set of skills than those required for previous generations. Equipping our classrooms with proven 21st century tools is a great place to start.

Never before have teachers and students had access to so many digital devices that can facilitate learning when leveraged properly. Notebooks, netbooks, tablet PCs, e-readers and smartphones offer a starting point for schools and should be factored into any technology investment.

But there are a host of other tools that can open a vast realm of educational opportunities both within the classroom and in the global community.

For example, digital light processing (DLP) and LCD projectors – coupled with interactive whiteboards; digital, document and web cameras; and student response systems – can transform what were previously individualized learning activities into collaborative group work. The seemingly endless repository of content to be found online also can enhance learning if teachers provide the appropriate context.

The FCC's National Broadband Plan asserts that broadband "can be an important tool to help educators, parents and students meet major challenges in education." With it, the FCC says, "students and teachers can expand instruction beyond the confines of the physical classroom and traditional school day."

Broadband also can "provide more customized learning opportunities for students to access high-quality, low-cost and personally relevant educational material" and can even "improve the flow of educational information, [in turn] allowing teachers, parents and organizations to make better decisions tied to each student's needs and abilities."

The plan specifically calls for investments in technology, software and infrastructure that will bring potential cost savings to some schools and open new avenues of learning for others.

By investing in a robust network infrastructure, for example, urban districts can more fully take advantage of the growing number of open-source learning materials that are there for the taking. Stretching this infrastructure beyond urban areas, to rural districts that previously lacked access, brings learning opportunities to even more communities.

Finding specific examples of the long-term savings that schools can expect to achieve by investing in today's technology is tricky. This is not only because every school is different, but also because many of these tools haven't been around or in place within schools long enough for concrete savings

to be fully evident. But a 2010 report from Project RED (Revolutionizing Education), *The Technology Factor: Nine Keys to Student Achievement and Cost Effectiveness*, offers hope.

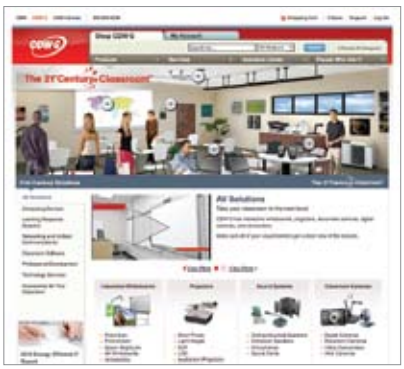
Project RED's survey of 997 schools during the 2009–2010 school year reveals that nine key implementation factors — including a strong student/computer ratio, the integration of technology into core subjects at least once a week and skillful change management leadership by the school principal — are linked to improved test scores and graduation rates, as well as reductions in disciplinary actions and dropout rates (projectred.org).

NETWORKING 101

Access to information is key to quality education.

A robust, resilient and responsive network infrastructure can connect staff, teachers and students to the educational resources they need — and to each other — at home, in the classroom and on the move. Integrated conferencing and collaboration tools deliver seamless, instant access, while network security products protect the valuable assets schools need to fulfill their missions.

Visit **the21stcenturyclassroom.com** to view a helpful video on networking solutions.



The report further shows "how reducing the number of dropouts through the use of technology provides a huge area of savings — [more than] $56,000 per student in tax revenue alone," according to Project RED co-author Michael Gielniak, Ph.D., director of programs and development at the One-to-One Institute, a national nonprofit that assists schools with their technology implementations.

Rather than making dollar-for-dollar comparisons, school boards, superintendents and principals, IT directors, and other stakeholders (including the community at large) should consider instead what the Consortium for School Networking (CoSN) refers to as VOI: the value of investment that comes from the deployment of a robust technology infrastructure.

Cost is a valid consideration for any school considering technology investments — especially when budgets are tight. But three other VOI indicators are more important over the long term: impact on learning, increased capacity and impact on the community.

When investing in any technology, a school's first question should be: How will this technology impact student learning? This pertains to any piece of instructional software or classroom hardware, as well as to investments in servers, routers and other network equipment.

Increasing the capacity of a school or district has to do with how a given technology would impact teachers and students. Interactive whiteboards, classroom audio systems, learning management systems and student response systems offer teachers new ways to deliver content to and interact with students.

And network enhancements give teachers better access to materials that allow them to differentiate instruction for students with different learning styles. Fully equipped learning environments increase not only students' ability to learn, but also their ability to express and share their knowledge with others.

The final indicator of VOI is the impact technology has on the wider community. By delivering engaging, interactive learning opportunities using the technologies students are begging to use, schools enable students to connect beyond school walls and teach them the skills and tools they need to become successful, productive citizens. As already noted, students who are engaged in the learning process are more likely to stay in school, in turn increasing schools' retention and graduation rates. ■

21st CENTURY TECHNOLOGY IN THE CLASSROOM

Tools for advancing learning

The National Educational Technology Plan (NETP) presents a technology-powered model of learning, offering goals and recommendations that address the essential areas of learning, assessment, teaching, infrastructure and productivity. Within each area exists powerful tools that expand the potential for learning.

These tools make it possible for students, teachers and parents to create learning communities and personal learning networks; to access and use creativity, collaboration, communication and other knowledge-building resources; and to exchange information with peers and subject matter experts around the world.

Learning

The model of learning described in the NETP "calls for engaging and empowering learning experiences for all learners." It challenges educators to "focus what and how we teach to match what people need to know, how they learn, where and when they will learn, and who needs to learn."

Computing Devices in the Classroom

Just as a pencil and paper were basic student supplies 100 years ago, a computing device has become the essential learning tool for 21st century students. There are several computing device options to choose from.

Desktop computers: For years, the desktop was the most common computing device in schools and other organizations. Desktops come in many sizes and configurations but usually consist of a base unit or CPU, monitor, keyboard and mouse.

Although most desktop systems are used to develop or access class materials, they can be equipped with high-end graphics cards and additional monitors to create a powerful platform that allows students and teachers to complete graphic visualizations, video editing and game development. Whether they're configured for teachers' desks, library workstations or computer labs, desktop computers continue to serve as the computing backbone in most schools.

Thin clients: Unlike desktops, a thin client relies on a server for data processing; a display terminal provides the user interface. The terminal sends user input (via keyboard or mouse) to a server, which then provides the processing power.

For schools with a robust network, dedicated thin client terminals and PCs running thin client software can be particularly cost-effective replacements for more expensive desktop systems. Thin clients also are easier to maintain and secure, as updates and virus protection can be handled on a single server.

Notebook computers: Notebooks are lightweight personal computers that typically weigh 5 to 7 pounds. Their small size and rechargeable batteries make them incredibly portable, giving students and teachers around-the-clock access to learning tools. Features include a flip-up display, keyboard, built-in pointing device (such as a track pad) and hard drive. An internal read/write DVD drive also is common.

Netbooks: Netbooks are lighter (typically weighing 2 to 3 pounds) and less expensive than their notebook cousins, making them a popular choice for school one-to-one computing initiatives.

However, with their smaller form factor come somewhat limited features. They lack optical drives, have smaller screens and keyboards, and are unable to handle compute-intensive applications involving graphics, audio and video editing.

Tablet PCs: This variation of the standard notebook features a touch- or stylus-enabled screen that swivels to change from notebook (screen and keyboard) to tablet (touch screen) mode. Tablets incorporate digital ink technology through which a digitizer translates handwriting into digital form. The memory, hard drive and other hardware are housed in the base, with the display doubling as an input device when in tablet position.

Some newer models combine computing power and the interactive display in a single lightweight device.

E-readers: E-readers (also known as e-book readers) are handheld devices that are used to read electronic books and periodicals. Many models allow users to highlight or bookmark passages, and some include built-in dictionaries, language translators and assistive technologies that read text aloud.

E-readers use e-ink technology to display content. Their main benefits are portability, easy readability and long battery life. Screens are typically small and monochromatic, but some devices in development offer larger, full-color displays.

The Value Question

Desktop systems offer all the functionality teachers need to showcase complex applications and subject matter. Thin clients deliver much of the same functionality at a fraction of the cost and with fewer administrative issues. And the wide array of lightweight, low-cost mobile computing devices available today make anytime, anywhere learning possible.

Portable notebooks, netbooks and tablet PCs allow teachers and students to work in the classroom, at home or on the go; and e-readers have the potential to revolutionize how students read and interact with classroom textbooks.

The *CDW·G 2010 21st Century Classroom Report* confirms the value of these technologies. Two-thirds of teachers surveyed said they consider student computing devices an essential component of the 21st century classroom experience. Students agree, identifying computing devices and e-readers as the technology tools they believe to be most useful to their education.

Collaboration Technologies in the Classroom

The use of collaborative software and hardware in modern classrooms is skyrocketing as teachers and IT professionals come to understand what these solutions can do to help users achieve shared goals.

The majority of collaborative software packages (sometimes referred to as "groupware") fall into four major classes.

Two-way and small-group collaboration software: These tools enable text, audio and video chatting. Such packages often allow users to share files or screens, and some even allow conferencing. These technologies make it possible for teachers and students to communicate and collaborate with one another more effectively.

They also extend the school day, making it possible for teachers to provide online office hours at their convenience and for students to collaborate online during class, in the evenings and on weekends.

Online meeting software: These solutions make it possible for large groups to meet for a presentation or to discuss important issues. Such software can be used for direct instruction or for professional development activities.

Often, in addition to real-time chat, audio and video, online meeting software provides a whiteboard for presentations or interactive activities, screen and application sharing, polling tools, web tours, and document and media file sharing. Some packages feature breakout rooms for small-group work, and most allow meetings to be recorded.

Productivity software: These packages can encompass word processing, spreadsheet and presentation applications. Collaborative packages differ from traditional productivity suites in that documents can be shared among a group of students or teachers. Members of the group can work on shared documents on their own time or collectively and simultaneously.

Social networking tools: These applications are all the rage in education today. Some apps are designed for simple texting, while others allow teachers and students to form knowledge communities. All require a robust Internet connection and a computing device for every participant. If video conferencing is required, participants also need a web camera. If a district decides to provide its own online meeting tools, server space must be dedicated to host the meeting software.

Collaboration hardware facilitates group learning. Such systems offer varying degrees of visual and audio quality and typically require dedicated equipment and communication lines. They can be used for everything from weekly staff meetings to direct instruction both inside and outside the classroom.

Audio conferencing systems: These solutions provide a bridge for calls between three or more parties. They utilize either traditional private branch exchange (PBX) phones, which operate on a private branch exchange serving a particular school, or Voice over Internet Protocol (VoIP), which provides telephony services over a school's network, reducing costs. VoIP implementations can result in more effective communication by integrating with existing systems such as e-mail or instant messaging.

Video conferencing systems: These tools allow participants at different locations to connect using a computer network, video cameras, microphones and speakers. They cover everything from individual desktop stations to large video displays and cameras. High-end systems offer real-time, multipoint, full-screen and high-resolution video.

Web conferencing systems: These packages allow users to share desktops, presentations and other content with invited participants. This form of collaboration is made possible via a web application or one that's been downloaded to client machines.

The Value Question

Collaboration technologies are especially useful in schools. Absent, sick or traveling students can keep up with classroom activities. Teachers can arrange for guest speakers, and students can then engage with them via follow-up interviews or collaborative activities. With these tools, homework becomes group work, as students learn both the subject being studied and how to participate in a collaborative working group — a key skill in today's workforce.

Behind the scenes, collaboration technologies help busy principals attend district meetings without losing time to travel. Teachers participate in professional development and work collaboratively on everything from assignments to curriculum revisions.

Audiovisual Solutions in the Classroom

The marketplace is teeming with sophisticated audiovisual solutions that can engage and empower students to take control of their learning.

Projectors: This equipment has long been considered a basic piece of classroom equipment. Early models used LCD technology to display video, images and computer data on a screen or other flat surface. The market has expanded in recent years to include digital light processing (DLP) projectors, which create images using mirrors, and palm-size "pico" projectors.

Before the introduction of digital projectors into the classroom environment, computing was an individual or small-group activity. Now, teachers can use these devices to project their computer screens and, with the appropriate software, the work of individual students, creating an environment where learning is both shared and interactive.

Interactive whiteboards (IWBs): These devices have made the presentation of content an immersive activity. Most IWBs are mounted to a wall or floor stand and work in conjunction with a computer and projector. Teachers project content onto the board's surface, which they or their students then control using a pen, finger or some other device.

Many teachers are using IWBs to free themselves from their desktop and dynamically lead students through the day's lessons. A more powerful use emerges, however, when students are the users. IWBs facilitate, among other things, interactive navigating through information, brainstorming sessions and the active creation of knowledge (such as concept maps).

Digital cameras: These classroom tools record still images in digital form, making it possible to capture images both inside and outside the classroom and digitally repurpose them for use in coursework and other projects.

Document cameras: This equipment offers real-time image capture capabilities that let teachers display learning materials — books, photos and magazines — and other lesson content to the entire classroom. In many schools, document cameras are replacing traditional overhead projectors.

Video camcorders: These devices capture live video images and record audio for playback on computers, TVs and VCRs. Early camcorders were bulky and hard to use, but recent innovations have made the devices easier to use and transport and cheaper to acquire. Some are even marketed as plug-and-play.

Web cameras: These video cameras transmit images in real time via an Ethernet or Wi-Fi network. Webcams, as they are more commonly known, typically attach to a computing device via its USB port or are built into a desktop or notebook computer's screen. Schools most often use them for web conferencing and distance learning applications.

Classroom audio enhancement systems: Many teachers find that students sometimes have trouble hearing them. These systems can help. They typically include a wireless, wearable microphone that transmits the teacher's voice to speakers, which are mounted on ceilings or walls to transmit sound evenly throughout the classroom.

The Value Question

When configuring a classroom, it's easy to forget to include the peripheral devices that enhance the learning environment for students with varying learning styles. Projectors, interactive whiteboards, classroom cameras and audio enhancement systems help teachers create engaging lessons, which empower students to learn the necessary content and express their understanding in new and innovative ways.

A CLOSER LOOK AT AV SOLUTIONS

Teachers have a world of media and learning resources at their fingertips.

Audiovisual solutions such as projectors, interactive whiteboards and integrated sound systems make it possible for educators to personalize learning and instantly reframe concepts with which students are struggling. Web cameras help students connect with each other and with experts from around the world. Document cameras make active reading possible with any text. And video camcorders allow students to create and share their own multimedia projects.

To learn more, visit **the21stcenturyclassroom.com** to view an informative video on AV solutions.

Assessment

The National Education Technology Plan's proposed model of learning "requires new and better ways to measure what matters; diagnose strengths and weaknesses in the course of learning when there is still time to improve student performance; and involve multiple stakeholders in the process of designing, conducting and using assessment.

"In all these activities," the plan continues, "technology-based assessments can provide data to drive decisions on the basis of what is best for each and every student and that, in aggregate, will lead to continuous improvement across our entire education system."

Two technologies in particular play an important role in creating formative and summative assessments. A formative assessment provides information that allows educators to adjust teaching and learning as they're happening. A summative assessment captures what students do and don't know at a particular point in time.

Student response systems: These handheld devices, commonly known as "clickers," are gaining traction in 21st century classrooms because of their ability to make students active learners. They draw students more directly into lessons by soliciting immediate feedback on the concepts presented. That keeps them engaged in learning, while at the same time allowing teachers to gauge the effectiveness of their instruction and make refinements where needed.

Student response systems typically include three components: the devices themselves, a receiver and the controlling software (which allows teachers to embed multiple-choice or numeric questions into their lessons). Students respond to questions using the keypad on their assigned device. The signals from each device are collected through the receiver, and the software collates the answers.

The real power of student response systems lies in their ability to display immediately in a chart or graph format students' responses to a particular question (although teachers can opt to save and analyze the data at a later time). The teacher can then decide whether to proceed or to revisit the material just covered. In this way, teachers can embed formative assessment into their instruction.

E-portfolios: Electronic portfolios offer a digital record of learning that has superseded the traditional paper-based repositories of work that students and teachers used to maintain. Thanks to growing storage and networking capacities, schools can rely on e-portfolios to record, store and track a student's work throughout the academic year and over longer periods of time.

Electronic evidence of a student's achievement might include word processing and spreadsheet documents, artwork and other images, multimedia presentations, blog and social media entries, video and audio recordings, and even original wikis and web pages. E-portfolios not only document learner outcomes, they also offer an opportunity for students to reflect on what they've learned and, when appropriate, pursue additional schooling.

STUDENT RESPONSE SYSTEMS MAKE LEARNING IMMEDIATE AND FUN

The best learning happens when students are engaged and interacting.

Student response systems make it possible for every student to participate actively in classroom activities. Simple clicks of these handheld devices let young learners answer questions or contribute to discussions. Teachers can track student responses to assess their understanding of the material and adjust lesson plans as needed.

To view a video on optical digital pens and the remote devices that facilitate active learning, visit **the21stcenturyclassroom.com**

The Value Question

Teachers have been collecting data on student performance for years and making decisions based on this information as to how best to instruct students. Parents, administrators and the general public, meanwhile, use this data to measure school and teacher performance.

Teachers can now use modern assessment tools to track an individual student's daily progress in meeting specific learning objectives and, where needed, modify their instruction methods to achieve those desired outcomes. What's more, by aggregating that information across a school, superintendents and principals can monitor the intellectual health of the district or schools they oversee.

Teaching

The model of learning outlined in the National Education Technology Plan "calls for using technology to help build the capacity of educators by enabling a shift to a model of connected teaching. In such a teaching model," the plan explains, "teams of connected educators replace solo practitioners, classrooms are fully connected to provide educators with 24x7 access to data and analytic tools, and educators have access to resources that help them act on the insights the data provide."

Teachers perform at the highest level when their needs are fulfilled. As noted in the *CDW·G 2010 21st Century Classroom Report*, teachers have a clear vision of what 21st century classrooms require.

Access to computing devices: To prepare instruction and stay connected with other educators, teachers need, at a minimum, a desktop or notebook computer and a high-speed network connection. Although many schools are providing these services within individual classrooms, administrators and IT professionals must expand this access beyond school walls.

It's no longer sufficient to simply place a computer on a teacher's desk. Rather, teachers should be equipped with devices that allow them to work in the classroom, at home and everywhere in between.

Classroom management systems: These solutions are an especially valuable tool for teachers, allowing them to organize group work, monitor discussions, schedule collaborative activities and manage and track student interaction with online lessons and resources. Other collaborative systems allow teachers to aggregate data and analyze students' progress in all curricular areas across their learning career.

Access to digital content and content creation tools: A major part of being prepared to teach is having access to quality digital content, including texts, journals, photos, video and audio. Administrators and IT professionals must strategize how to provide teachers and students with access to the educationally relevant digital content they need without jeopardizing the security of the network or exposing users to inappropriate material.

Students in particular appreciate this access. In fact, high school students surveyed for the *CDW·G 2010 21st Century Classroom Report* ranked digital content among the top three technology tools they believe to be most useful in their education.

For teachers to properly engage today's students in the learning process, they also must have the ability to create their own content. Interactive whiteboards; color printers and scanners; digital, document, video and web cameras; a quality microphone; headphones; and flash memory or portable storage devices are particularly helpful.

Although it's not fiscally feasible to install such tools in every classroom, IT professionals should strive to make available desktop and web publishing software, PDF file creation software, graphics manipulation software, image libraries, and audio and video editing software. If possible, they also should set up a few workstations with visualization and 3D modeling software.

Access to other teachers: Project- and problem-based instruction is playing a greater role in 21st century classrooms, but so is cross-curricular instruction, which teaches students concepts from a variety of disciplines.

Teachers need access to other teachers with expertise in unfamiliar content areas so they can collaborate to make such instructional opportunities possible for their students. Communication and collaboration technologies enable teachers to connect with fellow teachers in their community, across the country and around the world.

Infrastructure

According to the National Education Technology Plan, a comprehensive infrastructure for learning provides every student and educator with the resources they need when and where they are needed. This is an essential component of a technology-powered learning model.

That infrastructure "includes people, processes, learning resources, policies and sustainable models for continuous improvement, in addition to broadband connectivity, servers, software, management systems and administration tools."

Networking and Unified Communications

For many years, most school and district network connections were wired. Not anymore. As the State Educational Technology Directors Association (SETDA) argues in its 2008 white paper, *High-Speed Broadband Access for All Kids: Breaking Through the Barriers*, technology-rich learning environments need external Internet connections of at least 100 megabits per second per 1,000 students or staff members.

SETDA also recommends internal wide area network connections from the district office to each school and between schools of at least 1 gigabit per second per 1,000 students or staff members.

The National Broadband Plan, released by the FCC in 2010, is similarly aggressive. Calling broadband "the great infrastructure challenge of the early 21st century," the plan aims to bring 100Mbps broadband service to 100 million U.S. homes by 2020 and to identify 500 megahertz of wireless spectrum that can be freed up for wireless broadband service.

As work is being done at the national level to make this connectivity a reality, schools must ensure they're equipped to take advantage of this new capacity.

Wireless access points (WAPs): These devices function as "base stations" for a wireless local area network. They allow wireless communication devices to connect to the wireless LAN (WLAN) using Wi-Fi, Bluetooth or related standards and relay data between wireless and wired devices on the network.

WAPs usually connect to a router, which intercepts signals on a computer network and forwards the data packets to their appropriate destinations. Routers reside at gateways, the nodes on a network that serve as an entrance to another network. Switches filter and forward data packets between LAN segments.

Load-balancing devices: Such optimizing solutions can maximize performance by distributing processing and communications activity evenly across network resources so no single device is overwhelmed.

The technique is especially important for networks that must handle an unpredictable number of requests to the servers, which manage network resources. If one server is overloaded, load balancing forwards requests to the next server with available capacity. WAN optimization also helps to manage and accelerate the flow of data across a wide area network.

Network Security Strategies

Security is especially important in an age where networks must be protected, yet agile enough to permit access to the open-source and cloud-based resources teachers and students need to maximize the learning experience. Here are some valuable security solutions to consider deploying:

- **Antimalware** protects against malicious software that secretly accesses systems without users' consent.
- **Antivirus software** protects against and removes known viruses, worms and other forms of malware.
- **Antispyware** protects computers from performance and security threats caused by spyware (including pop-ups).
- **Firewalls** should be established to allow or block traffic into and out of the network.
- **Intrusion detection systems** evaluate all network activity to identify suspicious patterns or threats.
- **Unified threat management appliances** combine a number of security capabilities into a single platform.

IT professionals must strive to deliver reliable services not only at the network level, but also at the individual device and server levels. Resources must be backed up regularly, must be redundant and must have high availability.

Productivity

The National Education Technology Plan's stated goal is to transform American education. To achieve it, the plan argues, "we must apply technology to implement personalized learning and ensure that students are making appropriate progress ... so they graduate. These and other initiatives require investment, but tight economic times and basic fiscal responsibility demand that we get more out of each dollar we spend."

Improving productivity is a central goal of all organizations, but it's especially important in education, where students' long-term success or failure hinges on what they've learned and whether they're prepared for college and the workforce. Hardware and software work together to help students and teachers perform specific tasks. If these tools aren't available or aren't functioning as needed, learning is disrupted.

In these economic times — and in the face of pressure to focus on standardized testing outcomes and to meet state standards of learning — it's easy to view the resources outlined in this chapter as nice, but not necessary.

We must stretch our thinking, however, and remember the important role that technology plays in preparing students to be successful in today's economy. It's not just about investing in boxes and wires. It's about helping students learn the necessary content and develop the necessary 21st century skills that will keep them competitive and help the country thrive. ■

FINANCING A HIGH-TECH CLASSROOM

Finding the money to upgrade your technology

With financing opportunities available through federal, state and local government agencies, as well as nonprofit foundations and corporations, schools have more funding options then they may realize.

This chapter summarizes several key sources of funding for educational technology investments. It also shares grant-writing strategies that can help school stakeholders improve their chances of securing funding.

Government Initiatives

The National Education Technology Plan notes that the federal government "has an important role to play in funding and coordinating some of the [research and development] challenges associated with leveraging technology in education to ensure the maximum opportunity to learn." Several efforts are furthering that goal.

Enhancing Education Through Technology (Ed-Tech) State Program (EETT): The American Recovery and Reinvestment Act (ARRA) dedicated $650 million to educational technology via EETT, which originated with the No Child Left Behind Act of 2001.

Administered by the Office of School Support and Technology Programs at the U.S. Department of Education (DOE), EETT aims "to improve student achievement through the use of technology in elementary and secondary schools." Formula grants are available to fund local activities that "include the support of continuing, sustained professional development programs and public–private partnerships."

EETT also funds technology-driven curricula that meet state academic standards, as well as technology use that improves academic achievement, increases parent involvement in schools, and enhances teaching and school improvement through data collection, management and analysis. For more information, visit www2.ed.gov/programs/edtech.

Investing in Innovation Fund (i3): i3 provides competitive grants to local educational agencies (LEAs) and nonprofits working with LEAs or a consortium of schools.

The purpose of this program, overseen by the DOE's Office of Innovation and Improvement, is to fund "the development of path-breaking new ideas, the validation of approaches that have demonstrated promise, and the scale-up of the nation's most successful and proven education innovations."

Successful proposals support effective teachers and principals; improve the use of data to accelerate student achievement; complement the implementation of standards and assessments that prepare students for success in college and careers; and turn around persistently low-performing schools.

Three types of grants are available through the i3 program, based on the level of evidence supplied:

- **Development grants** (up to $5 million each) support "new concepts that are deemed worthy of further study."
- **Validation grants** (up to $30 million each) aid "programs that have already

shown promise but need additional evidence of effectiveness."

- **Scale-up grants** (up to $50 million each) award programs "that have already proved effective and have had large effect sizes, with adequate evidence to support any claims of effectiveness."

For more information, visit www2.ed.gov/programs/innovation.

Race to the Top: This competitive program administered by the DOE's Office of Elementary and Secondary Education (OESE) "rewards states for past accomplishments, creates incentives for future improvements and challenges states to create comprehensive strategies for addressing reforms that will drive school improvement."

Grants are rewarded in two phases to applicants whose reforms center on the following: the adoption of standards and assessments; the development of data systems that measure student growth and success; the recruitment, development and retention of effective teachers and principals; and turning around the nation's lowest-achieving schools. For more information, visit www2.ed.gov/programs/racetothetop.

Race to the Top Assessment Program: This related program, also overseen by OESE, provides funding "to consortia of states to develop assessments that are valid, support and inform instruction, provide accurate information about what students know and can do, and measure student achievement against standards." Available grants include:

- **Comprehensive Assessment Systems Grants**, which support the development of standards-based assessment systems "that prepare students for college and the workplace, that more validly measure student knowledge and skills, that better reflect good instructional practices, and that support a culture of continuous improvement in education."
- **High School Course Assessment Grants**, which support the development of high school course assessment programs that "promote consistently high levels of rigor in high school courses across a well-rounded curriculum."

Although this program doesn't directly address technology, there are opportunities to include it in the development of assessment instruments for core academic subjects and in career and technical education. For more information, visit www2.ed.gov/programs/racetothetop-assessment.

INSIDE THE 21st CENTURY CLASSROOM

CDW·G's 21st Century Classroom microsite showcases the technology products and services K–12 schools can leverage to enhance the learning experience for today's students.

The interactive site is organized into eight resource categories: AV solutions; computing devices; student response systems; networking and unified communications; classroom software; professional development; technology services; and classroom accessories.

Other features include lesson plans to help teachers integrate technology into their instruction; an online tool to help schools assess their readiness for a one-to-one computing program; relevant reference and how-to guides; and links to videos and other resources of interest.

Visit **the21stcenturyclassroom.com** for a closer look at the full capabilities of a 21st century classroom.

E-Rate: This program is administered by the Universal Service Administrative Company under the direction of the Federal Communications Commission. The program offers schools discounts of 20 to 90 percent on telecommunications services, Internet access, internal connections and basic maintenance of internal connections.

The level of poverty and urban/rural status of the population a school serves determine the discount it receives. The percentage of students who are eligible for free and reduced lunches under the National School Lunch Program is the primary measure by which a discount is determined. For more information, visit universalservice.org/sl.

Additional government resources: Other helpful resources for researching grant opportunities include the DOE (www2.ed.gov/fund/grants-apply.html) and its Office of School Support and Technology Programs (www2.ed.gov/programs/innovative); Grants.gov (grants.gov); and Technology Grant News, which tracks both educational technology and K–12 grants (technologygrantnews.com/grant-money-index-type.html).

The Editorial Projects in Education Research Center: This organization's 2010 *State Policies That Pay* report provides a helpful overview of opportunities available at the state level (edweek.org/media/eperc_finance_0410.pdf).

Other Funding Sources (Nonprofit & Corporate)

Numerous foundations promote the use of technology. Three in particular are known for supporting technology in education.

The Bill & Melinda Gates Foundation: This nonprofit's education efforts "work to make sure high school students graduate ready for success and prepared to earn postsecondary degrees."

Investments focus on developing new technology and tools to effectively engage and support students, including next-generation classroom technology and STEM education. For more information, visit gatesfoundation.org/Pages/home.aspx.

The John D. & Catherine T. MacArthur Foundation: This foundation's Digital Media and Learning Initiative "aims to determine how digital media are changing the way young people learn, play, socialize and participate in civic life."

The initiative funds educators' research about students and digital media; efforts "to develop new learning environments and to understand how schools [must] adapt and change as a result of" young people's digital media usage; and efforts to build the emerging field of digital media and learning. For more information, visit macfound.org/learning.

The National Science Foundation's Directorate for Computer & Information Science & Engineering (CISE): This organization works to help the United States "uphold a position of world leadership in computing, communications, and information science and engineering."

CISE operates the Division of Computing & Communication Foundations, Division of Computer and Network Systems, and Division of Information and Intelligent Systems, which manage grant competitions related to computing and information infrastructure research and education. CISE also contributes to the education and training of the next generation of computer scientists and engineers. For more information, visit nsf.gov/cise/about.jsp.

Corporations: A number of corporations offer grant assistance to schools, including Intel (intel.com/about/corporateresponsibility/community/giving/usgrants.htm), Sony (sony.com/SCA/philanthropy/education.shtml) and Sprint (sprint.com/responsibility/education/character). A search engine and your state's Department of Education can be your best friends in finding these and other leads.

Grant-writing Strategies

Asking for funding isn't easy. It's time-consuming and requires a lot of legwork. The school's job is to convince the proposal evaluator that it has a specific problem it needs to solve and a strategy for solving it, and that it knows how to assess if the project is successful.

Each grantor will have different requirements, but there are a few best practices that can boost the chances of securing the funding being sought.

Know the requirements. Most grants outline their requirements in a request for proposal. Read the RFP carefully and make sure you qualify.

Make it a group effort. Identify which personnel need to be on the grant-writing team. Along with teachers, be sure to include IT leadership.

Develop a timeline. A grant written at the last minute looks and reads like it was written at the last minute. Read the directions fully and then create a realistic timeline that details each step of the process. Estimate how long it will take to write each section, and then add a few days to account for inevitable delays.

Be thorough — and inspiring. As you begin writing, organize each section of the proposal using the requirements as a guide. If the RFP includes a rubric, copy the criteria for "exceeds" into the appropriate sections and aim for those targets.

Give proposal evaluators what they want. Every reviewer reads dozens (if not hundreds) of proposals, so be mindful of basic mechanics when writing to make that person's job easier. Follow the RFP's requirements to the letter. If the RFP calls for 10 pages, don't submit 11.

Be sure your budget and goals are realistic. Do your homework on costs and explain each one thoroughly. Don't forget in-kind contributions. Remember, your work on the project has a dollar equivalent.

Also, establish realistic goals and explain how you will evaluate them. If your project is replicable elsewhere in your school or in other districts, make sure to highlight this as well.

Have an outside party read and comment on the proposal. Ask someone who isn't familiar with the project to read the proposal before you submit it. If that person can't tell you what you're trying to do after reading it, develop a version that addresses problem areas.

If at first you don't succeed — try again. Grant competitions often receive hundreds (if not thousands) of proposals. If your project wasn't funded, ask for the reviewer's comments. Some organizations can't reveal them, but there's usually a program officer who will be willing to discuss your proposal and make suggestions. Listen to and incorporate that person's suggestions — and then submit again. ■

LAUNCHING A 21st CENTURY CLASSROOM

Planning and rolling out new learning technology

Developing a successful 21st century classroom requires two basic, but detailed steps.

The first step is to draft a technology plan that addresses the current reality of your school or district, as well as the needs of students, teachers, administrators and support staff. It must also incorporate best practices for teaching and technology support, a realistic plan for securing funding, and an achievable vision of what the new classrooms will include and how they will affect learning.

The second step is to identify and establish specific goals and tasks, a step-by-step action plan, a budget, and a set of measurements for success.

Once this roadmap is defined, you can begin the ongoing process of implementation, assessment and revision. Every roadmap will differ in the details, but at its core each should follow the sequence of steps outlined in this chapter. If you're writing a district-level technology plan, be sure to check with your state's Department of Education to see if it requires (as many states do) a particular format for district plans.

Creating the Vision: Planning a 21st Century Classroom

Innovative classroom development begins with a common vision and a common language. Make planning a collaborative process among all stakeholders. Here are the key steps to take in order to comprehensively plan out a 21st century classroom.

Recruit and organize a planning team. An effective planning team comprises not only teachers, administrators and IT staff, but also students, parents, community leaders and even facilities staff. Including all stakeholders at the beginning of the process allows you to cultivate stakeholder buy-in and ensures that everyone supports the project. It also can help ease the process of seeking funding from community leaders and other sources.

Conduct a needs assessment. Before developing a vision for your 21st century classroom or putting steps to paper, spend some time researching your school or district's existing situation to determine what will be needed to implement and sustain a conversion of this magnitude. Begin by examining the current capacity — knowledge, skills and competencies — of students, teachers and IT staff, as well as the current IT infrastructure.

Students: As noted in Chapter 1, today's students are immersed in a digital culture. This doesn't mean that all students have the same level of use or skill, however. Begin your planning process by surveying students to gauge the breadth and depth of their access to technology outside of school and their knowledge of how to use it to advance learning.

Teachers: A widespread misconception is that teachers are hesitant to use technology. And yet the *CDW·G 2010 21st Century Classroom Report* indicates that teachers consider wireless Internet access, student computing devices and interactive whiteboards to be

essential to a 21st century classroom. It's not that teachers aren't interested in 21st century technologies. Rather, they often don't know how best to use these tools for instruction and lack the time or support to learn how to do so.

In addition to asking teachers about their comfort level with technology, assess their knowledge of 21st century teaching and learning concepts. The planning team must evaluate the professional development capacity of the school or district and take action to close any gaps that are identified.

IT staff: While most IT plans assess the capacity of the IT infrastructure, few actually assess the capacity of the IT staff. During the needs assessment phase, the planning team should examine the current knowledge level of the entire IT team. Which tools are they currently able to support? Do they have access to the resources they'll need to support new technologies? These are necessary questions that must be asked and answered.

IT infrastructure: The planning team also must assess the capacity of the infrastructure by taking a hard look at existing hardware, software, networking and telecommunication services. Be sure to evaluate impacts beyond the classroom, such as increased network load, support of individual devices, and device and network security concerns.

The "Checklist for Efficient IT Operations" (cosn.org/tabid/5126/Default.aspx) developed by the Consortium for School Networking provides a good resource for identifying possible issues of concern.

Research and explore options. When creating a 21st century classroom, there's no need to reinvent the wheel. A number of schools and districts have done wonderful, truly innovative things with technology. Don't hesitate to visit them online or in person for ideas. State Department of Education websites often highlight local success stories and can point out innovative schools in the area.

Industry organizations also offer a treasure-trove of resources on the latest technologies and how to deploy them. ISTE Learning (istelearning.org), the learning community established by the International Society for Technology in Education, is a good place to start.

Another great resource is the New Media Consortium's *Horizon Report: K–12 Edition.* Produced annually in conjunction with CoSN, the *Horizon Report* identifies technologies that will be in schools within a five-year period. CoSN offers the guide and a corresponding toolkit for implementation planning on its website (cosn.org/horizon).

Implementing new technologies and the teaching practices they support can be expensive, especially when they're done on a large scale. It's often a good idea to begin with smaller pilot programs, which can help your planning team determine exact costs and identify professional development and support needs, as well as potential pitfalls. A pilot program can be carried out within a single classroom or school or conducted at multiple sites across a district.

This is also the time to explore the anticipated costs for the specific equipment, additional resources and any intangibles that will be necessary to implement and support a 21st century classroom. The results of your research and pilot program can help the planning team develop a list of all necessary hardware and software. Determining the costs for these should be fairly easy.

Identifying the intangible costs will be more difficult. Costs such as increased professional development for teachers, administrators and IT staff should be considered, as well as costs for any additional infrastructure that might be necessary.

Estimate the value of investment. As discussed in Chapter 1, the final step before writing your technology plan is to determine the anticipated value of investment (VOI). If the planning team has done its research, it should be easy to state the anticipated value in terms of student outcomes. Knowing the VOI will not only help guide the implementation and provide tangible measures for success, it also will help when reaching out to potential funding sources.

Create the vision. A good technology plan begins with a vision of what the classroom, school or district will be able to achieve in terms of student outcomes once the technology deployment is completed.

For example, a vision statement might include: "We will provide students with 24x7 access to the technology and learning resources they need to learn how to communicate, collaborate and

BEYOND THE DESKTOP

The availability of affordable, portable and secure computer technologies in school classrooms enables teachers to adapt to individual learning styles and better serve the needs of all students.

Netbooks offer young learners a less expensive, lightweight, mobile computing alternative, while notebook computers deliver a more robust learning experience. Schools looking to securely connect multiple users to server-based applications can turn to thin client solutions. Tablet PCs allow users to draw on and display content in landscape or portrait mode. Even e-readers are finding a place in the classroom as the availability of e-books continues to grow.

CDW•G's online assessment tool can help schools gauge their readiness for a one-to-one computing environment. To view a video on portable computer technologies and how to protect them, visit **the21stcenturyclassroom.com**

be creative in today's society." It should not include: "We will provide all students with netbook computers." That's a goal, which is discussed in the next section.

Your planning team should take into account the school or district's mission and vision statements, as well as its curriculum plan, when developing a vision for its 21st century classroom. The team also should be mindful of administrators' and teachers' goals and values, in addition to best current instructional practices, activities and assessment tools. All stakeholders should be consulted during this process to ensure buy-in on the deployment's overall vision.

Develop goals, tasks and an action plan. Once the planning team has developed the vision, it's time to detail specific goals and tasks and to develop an action plan.

When developing these components of the roadmap, your planning team should revisit the information gathered in the needs assessment phase and identify the gaps between the school or district's current capacity and what will be needed to support the new learning environment. This exercise, commonly called a "gap analysis," is used to identify needed resources.

To determine the width of the gap between your school or district's current reality and your technology plan's intended outcomes, your planning team must consider a number of issues. In developing its second-edition National Educational Technology Standards for Students (widely known as NETS·S) in 2007, the International Society for Technology in Education established a set of "Essential Conditions" to help a school or district build its roadmap to a 21st century learning environment (iste.org/standards/nets-for-students/nets-for-students-essential-conditions.aspx).

The following is a list of what ISTE defines as the "essential conditions necessary to effectively leverage technology for learning."

Shared vision: Proactive leadership is needed to develop a shared vision for educational technology among all education stakeholders, including teachers and support staff, school and district administrators, teachers, students, parents and the community.

Empowered leaders: Stakeholders at every level are empowered to be leaders in effecting change.

Implementation planning: A systematic plan aligns with a shared vision for school effectiveness and student learning through the infusion of information and communication technologies (ICT) and digital learning resources.

Consistent and adequate funding: Ongoing funding is available to support technology infrastructure, personnel, digital resources and staff development.

Equitable access: Robust and reliable access is offered to current and emerging technologies and digital resources, with connectivity for all students, teachers, staff and school leaders.

Skilled personnel: Educators, support staff and other leaders are skilled in the selection and effective use of appropriate ICT resources.

Ongoing professional learning: Technology-related professional learning plans and opportunities are available with dedicated time to practice and share ideas.

Technical support: Consistent and reliable assistance is offered for maintaining, renewing and using ICT and digital learning resources.

Curriculum framework: Content standards and related digital curriculum resources align with and support digital-age learning and work.

Student-centered learning: Planning, teaching and assessment are centered on the needs and abilities of students.

Assessment and evaluation: Continuous assessment of teaching, learning and leadership is provided, and evaluation of the use of ICT and digital resources.

Engaged communities: Partnerships and collaboration are pursued within communities to support and fund the use of ICT and digital resources.

Support policies: Policies, financial plans, accountability measures and incentive structures are in place to support the use of ICT and digital resources for learning and in district school operations.

Supportive external context: Policies and initiatives at the national, regional and local levels are leveraged to support schools and teacher preparation programs in effective implementation of technology for achieving curriculum and learning technology standards.

With these conditions in mind, your team can begin to outline its goals,

tasks and action plan. Goals are simple statements about a specific target to be reached and how that target will be measured. For example:

- "We will provide all students with netbooks."
- "We will provide all students with 24x7 access to school resources."
- "We will provide all teachers with notebook computers capable of producing rich media content."

Tasks are the specific steps to be taken to meet those goals. Task statement examples include "Purchase [X number of] netbooks and install basic productivity software." Or "Install [X] routers, [Y] switches and [Z] wireless hubs."

The action plan should map out tasks in a sequential manner. Identify the specific actions, tools and additional resources that will be needed to complete the tasks, along with the personnel who will be responsible for carrying them out and a timeline to completion. Continuing the example above, your action plan might include statements such as:

- "The implementation team and IT staff will create requirements for the netbooks by [insert date]."
- "Based on the requirements, the IT staff and purchasing department will write an RFP by [insert date]."
- "Upon receipt of the RFP, the implementation team, IT staff and a purchasing agent will review the proposals received and select a manufacturer by [insert date]."

The action plan also should discuss any obstacles to completing specific actions and offer suggestions for corrective action, where possible.

Organize your action plan in whatever format your planning team determines is easiest to manage. You might choose to organize the document as a series of statements (as seen in the examples above), or you might wish to present the information in a tabular format.

Remember the intangibles. Developing goals, tasks and an action plan for installing new hardware and software is a relatively easy task. Acknowledging and addressing the intangibles of the project is a bit trickier. Two intangibles that your project team can't ignore are adequate professional development and the policies and procedures that will govern your school or district's use of technology.

Professional development: Sustained professional development is perhaps the most critical component of creating and building capacity in a 21st century classroom. A district can install the most advanced hardware and software on the market, but it will sit idle if teachers aren't taught how to use it.

Research shows that a shotgun approach to professional development — one- to two-hour workshops offered sporadically throughout the year — cannot effectively change instructional practice. Instead, teachers must be provided

TEACHING THE TEACHERS

A 21st century classroom is only as good as the ways in which a teacher makes use of it.

To maximize their technology investments, schools also must invest in their teachers. CDW·G's professional development partners are knowledgeable in national and state technology standards and can help educators learn to use 21st century classroom technologies efficiently and effectively.

In-person professional development, video on demand and software-based learning products ease teachers' transition from providers of knowledge through static, text-based materials to facilitators of interactive learning.

To view an informative video on CDW·G's professional development offerings, visit **the21stcenturyclassroom.com**

with the opportunity to experiment, fail, discuss, reflect on and rework lessons as they learn the skills necessary to develop a 21st century curriculum.

An excellent guide for developing a professional development plan can be found in ISTE's National Educational Technology Standards for Teachers (iste.org/standards/nets-for-teachers/nets-for-teachers-2008.aspx).

Unfortunately, administrators and IT staff often are overlooked when professional development opportunities are offered. These forgotten groups must be included.

Administrators must be given the opportunity to learn about new instructional practices and how to lead teachers in implementing and assessing them. That way, they can build the assessment of new instructional practices into teacher evaluations and monitor, track and analyze progress on reaching institutional goals.

IT professionals must be given regular opportunities to learn and refine their skills and to acquire new knowledge that will help them support their school or district's constantly changing technology environment.

Policies and procedures: What's the point of implementing new teaching practices if your school or district's firewall or filtering software immediately blocks them? To prevent this from happening, review all policies and procedures to determine how they promote or hinder 21st century learning.

If needed, establish new policies and procedures that facilitate new instructional practices without compromising the safety and security of your computing environment.

Assess the implementation. The final step before launching a 21st century classroom is to develop measures by which the success of the implementation will be determined — both in the short term and the long term.

Initial implementation: First, determine how the success of the initial implementation should be judged. Questions to consider include:

- "What milestones and key performance indicators will be measured?"
- "How will they be measured?"
- "What should be done if milestones or indicators aren't met?"

Overall implementation: Next, determine how the success of the deployment will be measured once it's completed, using student outcomes as your guide. Establishing milestones to strive for will be important, but remember that some goals belong in the initial implementation phase instead.

For example, a statement such as "All netbooks will be set up and distributed to students by [insert date]." is an appropriate target for the initial implementation, but it doesn't address the student outcomes your 21st century classroom deployment aims to achieve.

To measure your deployment's success over time, consider this type of statement instead: "Scores on the eighth-grade assessment of technology skills will improve by 25 percent each year, with 95 percent of students demonstrating proficiency by 2014."

Establish a budget. As noted in Chapter 3, your technology plan isn't realistic if you don't have sufficient funding to make it happen. Be sure to establish a budget that will cover the acquisition and support of all components in your plan, including the hardware, software, infrastructure, professional development and other services.

From Vision to Reality: Implementing a 21st Century Classroom

The first step toward implementing your 21st century classroom technology is to assemble an implementation team. The composition of your implementation team will be determined in large part by the size of your school or district and the scope of the project.

At a minimum, include one or two members of the planning team on the implementation team to ensure continuity of vision. Including initial planning team members in the final implementation also provides a safeguard against "scope creep" — a project management phenomenon in which features that weren't included in the original plan are added at a later stage without corresponding increases in resources needed to support those changes.

Obtain funding. The implementation team's first task is to obtain the necessary funding detailed in the budget. Chapter 3 suggests a number of potential sources for funding, but the implementation team also should cultivate relationships with local business partners, participate in purchasing consortia and discuss funding opportunities with state and local leaders.

Implement, adjust and repeat. Developing a technology plan can be a lengthy task. If done correctly, however, its actual implementation becomes a recursive process rather than one that must be reinvented each time a new tool is added to the learning environment.

The implementation team should monitor milestones and key performance indicators as your 21st century classroom deployment progresses, and make adjustments where and when they're needed. While monitoring the physical implementation, the implementation team also should continuously monitor stakeholder buy-in to make sure everyone remains committed to the project's success.

The important thing to remember is that the anticipated student outcomes developed in the plan are the guideposts for the project. Any potential change to the plan should be measured against its impact on facilitating these outcomes. ■

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

GLOSSARY

21st century (classrooms/ learning/technology)

In the context of technology and education, the phrase *21st century* refers to the tools, teaching and learning techniques, and physical characteristics of an environment that facilitates the development of the knowledge and skills students need to achieve success in the modern world — both in college and the workforce.

The concept goes beyond traditional rote learning, which focuses on memorization and learning by repetition, to include technology integration in lesson plans, personalized learning experiences and 24x7 access to educational resources both inside and outside the classroom. Specific 21st century technologies that foster collaboration, critical thinking, creativity, media literacy and other 21st century skills include interactive whiteboards, cameras and camcorders, and student response systems.

Assessments

Assessments are used in education to measure and document a student's knowledge and skills. A formative assessment is an ongoing process throughout an assessment period (a unit or lesson, for example) that gives teachers information they can use to adjust instruction during that period (as needed) and that gives students feedback on their progress. A summative assessment is a method for evaluating what a student has learned after an assessment period (a class, for example) is over.

Broadband

This term refers to network connectivity: the broader the bandwidth, the greater the network's capacity to deliver information. Broadband speeds vary by location. The United States' National Broadband Plan aims to provide all of the nation's households with access to 100-megabits-per-second connections.

Desktop publishing software

Desktop publishing software allows administrators, teachers and students to design brochures, posters and other materials using text, graphics, visuals, banners and other design elements. Traditionally used for printed materials, desktop publishing software now is used to create and format online materials as well.

Digital content

This is the umbrella term for information that's stored in a digital format (for example, word processing or spreadsheet documents, PDF files, audio or video files, and photos or illustrations). Digital content can be stored locally on portable media or on networked servers, or it can be accessed via the Internet.

Editing software

Many software packages allow students and teachers to manipulate images and to record and edit audio and video. Graphics software (also known as image editing or image manipulation software) allows teachers and students to enhance or transform digital images.

Audio editing and video editing software allow them to manipulate audio and video files, respectively. Most of these tools are workstation-based, but web-based applications are becoming more common. A variety of file formats

(JPEG, GIF, Windows Media Video and so on) typically are supported.

Emerging technologies

This term refers to technologies that are in the early stages of adoption within the K–12 sector. The New Media Consortium's annual *Horizon Report: K–12 Edition* identifies as "emerging" the technologies that it expects will be used widely within the next one to five years. Examples include mobile devices, augmented reality and e-books.

Generation Y/Millennials/ Digital Natives

Generation Y and Millennials are terms used to describe the demographic of students born between the mid-1970s and early 2000s. Marc Prensky coined the term *digital native* in 2001 to describe the generation born after the current age of technology began.

Because this generation was exposed to or grew up with technology in their everyday lives, it's presumed that they have a technological proficiency that earlier age groups lack. Caution should be taken in making these assumptions, however, due to differences in students' socioeconomic backgrounds and the types of technologies they use at home and at school.

Infrastructure

When discussing technology, infrastructure is typically assumed to encompass the physical environment needed to support networking, hardware and software applications, as well as such intangibles as support services, professional development, and technology policies and procedures.

Key performance indicators (KPIs)

KPIs are the factors that indicate whether a project or activity is on track or performing within expectations. In an education setting, examples of KPIs include graduation and retention rates, the number of students who have access to technology, and the technology literacy of users.

Mobile device

A mobile device can be held in one or two hands and manipulated using a touch screen, stylus or small keyboard. Common features include audio and video streaming, text messaging, e-mail, web access, applications, a calendar and an address book. Examples include smartphones, personal digital assistants (PDA) and some tablets.

One-to-one computing

This term describes an initiative through which every student in a class, school or district is provided with a personal computing device. Most one-to-one programs issue notebook computers, netbooks or tablet PCs.

Personal learning network

A community of users who come together to share and learn about issues of common interest. Also known as learning communities, online learning communities or knowledge communities, these groups can include teachers, students, administrators and parents.

Problem- and project-based learning (PBL and PjBL)

In PBL, students are presented with a problem, usually defined by the teacher, and work either individually or in groups for a period of time to develop solutions. The exercise is meant to teach them how to solve real-world problems using their knowledge, experiences and creativity.

In PjBL, students work on a project that usually results in a product, such as a presentation or report. Such projects generally follow a timeline, with a set of milestones used as formative assessments.

Science, technology, engineering and mathematics (STEM)

The acronym STEM refers to the teaching of science, technology, engineering and mathematics. Collectively, these fields are widely regarded as the cornerstones of a 21st century education.

Smartphone

A smartphone differs from a basic cellular telephone by offering computing functionality and Internet access. Most include digital voice services, text messaging, e-mail, web browsing, audio and video streaming and other applications.

Social media

Social media are web-based technologies that facilitate interactive communication and the sharing of resources among users, creating a social network of connections. Social media types include collaborative projects, content communities and social networking sites. Examples include Facebook, Twitter, blogs and wikis.

Student-centered learning

This is an approach to education that focuses on a student's needs, abilities, interests and learning styles, with the teacher serving as a learning facilitator. Student-centered learning requires students to be active, responsible participants in their own learning.

Value of investment (VOI)

VOI is a measure by which schools and districts can examine the costs and benefits of technology-related projects. As defined by the Consortium for School Networking, VOI evaluates a technology project's anticipated costs weighted against its potential benefits, whereas total cost of ownership (TCO) examines the costs associated with already-completed projects.

Web 2.0

This is an umbrella term for the second wave of the web. It is commonly associated with web-based tools that allow users to generate their own content and interact dynamically with content created by others.

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LOOK INSIDE FOR MORE INFORMATION ON:

- How 21st century classroom technology improves learning
- The tech tools that facilitate 21st century learning
- Tracking down tech funding
- Launching a 21st century classroom