

IMPROVING ENGAGEMENT THROUGH CLASSROOM TECHNOLOGY

21st century tools enhance students' learning and collaboration skills, readying them for the digital future.

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Executive Summary

As technology has redefined people's everyday lives, so, too, has it redefined education.

Instead of passively listening to teacher presentations and reading textbooks about other communities and cultures, K–12 students are doing research online, taking virtual field trips, and communicating with their peers around the world over blogs, social networks and video conferences.

College and university students, meanwhile, are using online video chats, instant messaging and social media tools to consult with their professors. They're deploying wikis and other web tools to collaborate with classmates. And they're prepping for exams by watching video or listening to audio of past lectures on computers and MP3 players.

Equipping learning institutions with 21st century technologies empowers educators and students by giving them access to dynamic new teaching and learning tools and by making lessons more visual, interactive, collaborative and hands-on.

When properly deployed and fully leveraged, these tools – interactive whiteboards, student response systems, online communication tools and other technologies – help students develop the necessary 21st century tech skills they need to succeed in college, graduate school and the global workforce.

This white paper explains how 21st century technologies increase collaboration and enhance learning, identify the most popular tools used in today's classrooms, and provide examples of how schools and postsecondary institutions are taking advantage of them.

Increased Classroom Collaboration

School districts, colleges and universities are investing in the latest educational technologies for three key reasons:

- Today's generation of students expects technology in their classes;
- It helps develop critical technological and 21st century skills, such as the ability to communicate and collaborate with others;
- Research shows that it produces positive results.

Teaching Generation Y and Millennials

Today's youth have grown up in a digital society, and many are surrounded by technology in their personal lives – from cell phones and computers to video games and high-definition (HD) television. As a result, they've come to expect the same at school and on campus.

However, providing these tools isn't about entertainment. It's about engaging young people in learning through technology-

driven interactive lessons and activities. In a country where high school dropout rates continue to hover around 25 percent (according to the latest U.S. Department of Education data), the goal should be to use technology to capture students' attention, motivate them to learn and teach them the skills they need to thrive in college and their careers.

Educators and researchers agree: The old model of education that worked for two centuries, in which the teacher stands in front of a chalkboard and lectures day after day, is no longer enough.

"Kids are growing up in an era where they are immersed in technology. You have to instruct them in the way with which they are most comfortable," explains Alan Knapp, national policy director for the Partnership for 21st Century Skills (P21), an educational advocacy group. "If you have a traditional classroom and you power down equipment and teach them in a 20th century way, you will lose them."

According to the *2010 CDW-G 21st Century Classroom Report* (cdwg.com/21stCenturyClassroomReport) – a survey of roughly 1,000 high school students, faculty and district IT professionals about how technology is used in their schools – today's students believe technology is vital not only to their personal lives, but also to their education and their future.

Indeed, 84 percent said technology is important or very important to their ability to study and work on class assignments, and 94 percent said they anticipate using technology to complete their assignments in college. As one student noted, a technology-rich classroom "would teach me the technological skills necessary for college. It would also make [classes] more productive and enable me to learn more."

Developing 21st Century Skills

The Partnership for 21st Century Skills argues that today's students must not only master core academic content (reading, writing and arithmetic, among other subjects), but also develop the 21st century skills that will enable them to compete effectively in today's rapidly changing, technology- and knowledge-based society.

A 2010 survey by the American Management Association confirms that employers need a workforce that possesses these skills. Nearly 76 percent of the 2,115 managers and executives who participated in the *AMA 2010 Critical Skills Survey* said the "four Cs" – critical thinking and problem solving, communication, collaboration, and creativity and innovation – will become more important in their organizations in the next three to four years.

They cited four reasons why such skills are important: the pace of change in business today, global competitiveness, the nature of how work is accomplished today and the way their organizations are structured.

What Are 21st Century Skills?

Critical thinking and problem solving involve analyzing evidence, arguments and beliefs and effectively drawing conclusions. This skill set requires solving problems in both conventional and innovative ways.

Communication involves articulating thoughts and ideas in written, oral and nonverbal ways. Other components include listening effectively and using different media, technologies and languages.

Collaboration involves working effectively and respectfully with diverse teams, having the flexibility to compromise, assuming shared responsibility for collaborative work and valuing the contributions of each individual.

Creativity and innovation involve using techniques such as brainstorming to develop innovative ideas. This skill set also requires working creatively with others, being open to new and diverse opinions, incorporating feedback into the work and viewing failure as an opportunity to learn.

Today's students also must develop global awareness; environmental, civic and financial literacy; and health and wellness awareness skills.

SOURCE: Partnership for 21st Century Skills

"Today's youth will take jobs that don't exist yet and will use technology that hasn't been invented yet. But by having these 21st century skills, they can apply what they know and figure it out," says Tim Magner, P21's executive director. "We are in an environment with big challenges ahead and no clear answers. Climate change, medicine and energy are huge issues, and we don't have solutions. Kids today will have to solve those problems."

Although today's students have grown up with technology, they don't always know how to use it correctly in an educational or work environment. Thus, it's equally important that they learn how to properly use technology to conduct research and access information (also known as digital literacy).

They also must learn how to critically and competently evaluate and organize online information and to distinguish credible sources of information from noncredible ones (also known as digital citizenship).

"Kids have access to technology in their personal lives, but no one is necessarily teaching them how to use these tools effectively and how to process and judge information they receive online," explains Leslie S. Conery, deputy CEO of the International Society for Technology in Education.

"If students don't have access to technology in school and aren't taught media awareness, then we aren't preparing them

for when they leave school and need to use these tools in their careers."

P21's Magner says this shift in educational direction can be traced to a change in the economy that occurred over the past 20 years, when the industrial economy based on manufacturing evolved into a service economy driven by knowledge, innovation and creativity.

Before, a traditional lecture by a teacher in front of a chalkboard was the most efficient and effective way to disseminate information to students. By knowing the core subjects, a high school graduate could make a good living and support a family with a manufacturing job that he or she might hold for life.

But today, according to the U.S. Department of Labor, 90 percent of high-growth, high-paying jobs require postsecondary education or training. Because students now can turn to a search engine to access seemingly limitless information on any subject, the lecture format is no longer the most efficient (nor the most effective) way to facilitate genuine learning.

Experts believe education institutions at all levels must adapt and reshape what happens in the classroom to meet today's needs. That means pairing lectures with hands-on tools that engage students in problem-solving and project-based tasks and helping them develop those critical 21st century skills.

As more students gain access to computers and the Internet at home and on the go, P21 advocates a new approach to learning. One innovation it suggests is flipping the homework/schoolwork paradigm, with students accessing information at home and using class time to build 21st century skills.

In this alternate learning environment, teachers could assign online reading materials as homework or record video lectures for students to view on their own time, Magner says. At school the next day, students could discuss what they learned and work on problems as a group.

As P21's Knapp points out, such an approach "personalizes instruction, engages students and provides the infrastructure for them to communicate and collaborate."

Improved Student Achievement

Studies and anecdotal evidence show that technology inspires students to not only stay in school, but also to excel.

According to a recent two-year study by Marzano Research Laboratory, students who were taught with interactive instructional tools such as interactive whiteboards and student response systems saw, on average, an academic achievement gain of 15.9 percentile points. The study, completed in 2010, involved more than 4,900 students and 120 teachers.

Elsewhere, a survey of 997 schools during the 2009–2010 school year by Project RED (Revolutionizing Education), a

national research and advocacy plan to facilitate technology in education, found that nine key technology implementation factors – including a strong student/computer ratio and the integration of technology into core subjects at least once a week – are linked to improved test scores and graduation rates and a reduction in disciplinary actions.

Students surveyed for the *2010 CDW·G 21st Century Classroom Report* agreed that technology improves learning and facilitates the development of technological and 21st century skills.

One respondent said having technology-rich schools teaches students to search for information more effectively and that having better visuals improves their understanding of material. Another student said technology “opens opportunities for outside input and research, while speeding and improving the quality of work.”

Surveyed teachers, meanwhile, said that technology personalizes lessons and facilitates anytime, anywhere learning. Technology “enhances and brings depth to lessons for students with differing learning styles,” said one. Another instructor observed that online courses, wikis and blogs help “extend the classroom beyond the eight-hour school day.”

College and university faculty and students also see benefits, according to the *2010 CDW·G 21st Century Campus Report: Campus 2.0*, a survey of more than 1,000 postsecondary students, faculty and IT staff (cdwg.com/21stCenturyCampus). “The greater the interactive technology available to students, and the richer the media, the more effective the learning,” said one faculty member respondent.

A student respondent praised the communication benefits, saying technology “enables students to reach new levels of connectedness to their professors, bosses, peers and families.”

What Is a 21st Century Classroom?

A typical 21st century K–12 classroom features high-speed Internet access; software for a range of learning activities; computing devices for students (such as desktop or notebook computers or netbooks); a desktop or notebook computer for teachers; and audiovisual equipment.

To make the learning process more dynamic, schools in recent years have adopted interactive whiteboards and student response systems, which can liven the pace of lessons. Interactive whiteboards let teachers present lessons with animation and graphics, and they allow students to interact with the material and even solve problems by highlighting and moving objects around with their fingers or pens.

With student response systems, teachers can poll students (who answer via wireless remote controls) and review the tabulated results on their classroom computers. The

Head of the Class

Beauvoir, the National Cathedral Elementary School, is successfully putting technology into the hands of its students.

This pre-K–3 school located in Washington, D.C., has launched a one-to-one computing program for its 80 third-graders, providing each student with an Intel-powered classmate PC, says Matthew Castanera-Bartoszek, director of technology. Every first- and second-grade classroom, meanwhile, is equipped with six tablets.

Some students use computers just once a week, while others use the devices daily if they're working on a research project. Such access helps them tap online resources; learn through videos, interactive lessons and virtual labs; and hone their research skills on search engines.

“The technology engages students,” Castanera-Bartoszek says. “It makes school fun and gives them a reason to be excited about a topic being discussed. It also helps make difficult, abstract concepts simpler to understand.”

technology not only allows teachers to gauge student comprehension, it also promotes class participation and discussions.

Some students may think they're the only ones with a specific opinion. But if they see that some of their classmates believe the same thing, it may embolden them to discuss their views.

In addition to technology, a 21st century classroom features flexible learning spaces for small-group collaborative learning activities or whole-class instruction. Furniture is light and mobile, allowing the room to be quickly and easily reconfigured to support a variety of learning activities.

A 21st century technology-equipped higher education classroom typically features a computer for the professor or instructor, a projector, a student response system, a DVD player and a high-tech podium with touchpads or switching devices that allow faculty to toggle between devices.

Some classrooms have video conferencing equipment for guest speakers and lecture capture systems to record audio and video of lectures. Larger classrooms and lecture halls typically have audio systems as well.

Colleges and universities increasingly are adopting emerging technologies, including digital content such as e-books and web-based office productivity applications that promote student collaboration and enable the retrieval of lecture notes, recorded videos of lectures and other course materials over a web-based learning or course management system.

The *2010 CDW-G 21st Century Campus Report: Campus 2.0* confirms that campus IT departments have increased support for collaboration tools (such as web and video conferencing tools and online chat applications), giving students more opportunities to connect online. Students have embraced blogs, wikis, Facebook and Twitter, for example, because the tools allow them to communicate, collaborate and share content with their classmates and professors in real time.

In fact, 64 percent of student respondents said they use social media to connect with their classmates to study or work on class assignments together, and 27 percent use it to connect with their professors.

What's more, faculty members increasingly are using Web 2.0 tools in their courses: 23 percent of respondents said they're using wikis and blogs, 19 percent are using online texting or video chatting, and 12 percent are deploying podcasts and vodcasts.

Some surveyed professors also reported that they're recording their lectures in an MP3 format; offering interactive, online practice quizzes; and holding live online pre-exam review sessions that are recorded so students who can't attend can view the recordings at their leisure.

"We are used to an on-demand lifestyle, and undergraduates are no exception. They have come of age in an era where you can do nearly anything 24x7, and they are coming to school expecting to access coursework and to communicate and collaborate with their classmates and professors with the same ease and convenience," says Shannon D. Smith, associate director of teaching, learning and professional development for Educause.

"Technology is enabling teaching and learning to take place well beyond the campus classroom."

Adoption Trends

Many school districts are adopting these new technologies, but there's room for improvement. According to the *2010 CDW-G 21st Century Classroom Report*, just 57 percent of student respondents said their school is preparing them to use technology in college or the workplace. The remaining 43 percent said their school isn't properly preparing them – or they weren't sure if it was.

The report also found that while many educators use technology to teach, most of them aren't allowing students to use the technology as a hands-on learning tool. Fifty-three percent of teacher respondents said they don't hold any of their classes in a 21st century classroom (or don't know if they do), and 64 percent said they aren't regularly discussing 21st century skills in their lesson plans.

"The use of technology in schools is behind current technology use in everyday life," said one teacher respondent.

That's not to say students want to be bombarded by a nonstop influx of technology. In a recent survey of 36,950 college freshmen and seniors, the Educause Center for Applied Research found that most students want a moderate amount of technology in their classes.

Results of the *2010 CDW-G 21st Century Campus Report: Campus 2.0* show that higher education faculty and IT staff do prioritize technology, and that many institutions are successfully integrating new tools that empower faculty and students to personalize and enhance the learning experience.

In fact, 70 percent of institutions offer digital content and 58 percent offer online collaboration software. Three out of four students said their institution understands how they use or want to use technology as a learning tool, and 76 percent said their college or university is adequately preparing students to use technology in their careers.

Increasing Collaboration and Enhancing Learning

Students don't want to passively watch a teacher give a lecture in front of a chalkboard. They want to be actively engaged.

To make 21st century classrooms a reality in our schools and institutions of higher learning, all stakeholders – district and institution leaders, principals and deans, educators, and information and instructional technology staff – must work together to infuse technology throughout the curriculum.

There must also be ongoing professional development that gives all educators the skills they need to effectively incorporate the technology into their classes.

Using 21st century technologies, students can brainstorm ideas or potential solutions individually and collaboratively. They can do online research. They can use web-based office productivity tools to write or edit the same document. They can share their work online so it becomes a resource for others. All of these exercises facilitate the development of essential 21st century skills.

In this type of environment, students "share their ideas for potential solutions and critique each other's ideas and work," says Dr. Paul Resta, director of the Learning Technology Center at the University of Texas at Austin. "They have the benefit of the perspectives and helpful feedback of other learners."

Such access "not only deepens their own understanding," Resta continues, it also helps "develop shared understanding with other team members as they build knowledge together."

Beauvoir, the National Cathedral Elementary School in Washington, D.C., is giving its young students access to the latest communication tools to teach them 21st century skills. When students researched different countries as part of a schoolwide project, for example, second graders connected with students in India over a social network.

In so doing, they discovered that technology tools allow them to communicate and collaborate globally, says Director of Technology Matthew Castanera-Bartoszek. In another instance, a second-grade class used video conferencing over a classroom projector to talk with a class in Argentina.

One hundred twenty miles away, Maryland's Salisbury University offers traditional and distance learning opportunities to its 8,450 students. As a part of a satellite degree program in various locations in Maryland, SU offers more than 50 online courses per year. Faculty and students interact live via web video conferencing, says Salisbury CIO Jerome F. Waldron.

Using classroom video conferencing, off-campus guest speakers can engage with students. Students can access a rich selection of professor-provided articles, videos and lectures via Salisbury's course management system. Faculty members can even direct students to listen to a particular recorded lecture online for homework, and then the next day, initiate a class discussion on the topic.

"Faculty still value class lectures, but use of digital content grows each semester," Waldron says. "They're saying, 'Wait a minute. This could free up my time for more interactive discussion and make better use of class time.'"

Creating videos also is gaining traction. Students in many different departments – including English, social work, biology, communications, education and history – are filming short videos to present research. "Each semester, 1,000 course sections are taught using a mix of learning technologies that fit the needs of students and the goals of the faculty," Waldron says.

21st Century Technologies in the K–12 Classroom

More and more school districts are deploying 21st century technologies to make lessons more engaging for students and teachers. Interactive whiteboards, student response systems, video camcorders and audio systems are especially popular.

Interactive Whiteboards

Interactive whiteboards are large displays that replace traditional chalkboards and whiteboards. They typically are mounted on walls or floor stands and work with computers and projectors. Some boards come with projectors attached and can wirelessly connect to classroom computers. Schools can also turn their traditional whiteboards into interactive ones through receivers that attach to computers and devices that attach to the sides of the whiteboards.

Teachers use interactive whiteboards to engage students via multimedia lessons. Vendor-supplied software lets teachers use predesigned lessons or design their own, complete with graphics and animation. Students can write on the boards with

a stylus pen or their fingers and work on problems individually or collaboratively.

Educators say the most powerful, effective way to use interactive whiteboards is to have students on the boards most of the time. Rather than presenting lessons themselves, teachers can have students manipulate the information on the board. Some whiteboards allow teachers to save what they write on the board, which they can then reuse for a later class or provide to students in a digital format.

Student Response Systems

Also called classroom or learning response systems or "clickers," student response systems allow teachers to poll or quiz students in real time. Most ship with computer software, a small wireless receiver that connects to a computer's USB port, remote controls (or clickers) for every student and a whiteboard or projector screen for viewing student responses.

Students answer teacher questions using their wireless remote controls, and the cumulative results are displayed on a whiteboard or projector screen at the front of the classroom. Some systems allow students to provide text answers, and they typically allow teachers to protect student anonymity by having responses routed directly to the teacher's computers.

Teachers use the devices primarily to engage students and stimulate classroom discussions, to take attendance and to administer tests. They can prepare multiple-choice, true/false or yes/no questions in advance or ask questions on the fly by having students press the appropriate button on their devices. Results can be tabulated and imported directly to online grade books.

A primary benefit of student response systems is that they allow teachers to get immediate feedback on student comprehension. If students score poorly on certain questions, for example, teachers can go over that material again.

Video Camcorders

Recent advances in video camcorder technology make it easy for students to shoot and edit their own videos, which can be posted online or shown on classroom computers and TVs.

Today's camcorders are small handheld devices, some no larger than a smartphone. Many record HD video and have zoom capabilities. The devices save both time and money, as schools no longer need to purchase blank videotape to record on or waste time converting analog video to a digital format.

Better still, modern camcorders are easy to use: Students simply point and click a button to start shooting video or take digital photos. Current models hold one to four hours of video and come preloaded with video editing software. Once students finish shooting, they can connect the camcorder to a computer (usually via USB port) and use the preloaded software to edit and share their work.

Iffy Infrastructures

To properly support 21st century classroom technologies, schools need a good IT infrastructure. Eight percent of district IT pros surveyed for the *2010 CDW-G 21st Century Classroom Report* said their high schools have new, innovative technology installed. Another 33 percent said their technology is current and less than three years old. But 59 percent said their technology needs to be refreshed, is aging or is “in the dark ages.”

Although 51 percent of IT respondents said they plan to upgrade or improve classroom technology in the next two years, just 10 percent of them said their IT budgets will increase in the upcoming school year.

Meanwhile, 44 percent of college and university IT staff surveyed for the *2010 CDW-G 21st Century Campus Report: Campus 2.0* said their IT infrastructure – particularly storage, security and servers – needs to be refreshed.

The preloaded software typically allows students to trim, edit and add music; advanced tools allow users to create more sophisticated effects, such as voiceovers, titles and graphics.

Audio Systems

Some teachers don't project their voices as well as others, making it difficult for some students (particularly those at the back of a classroom) to hear them. An audio system – consisting of speakers, microphones, sound cards and audiovisual cables – can help.

Many options are available. For example, schools can connect computer speakers and wireless, handheld or podium microphones to classroom desktop or notebook PCs and install PCI or USB sound cards to boost audio performance.

They can purchase higher-end systems with ceiling-mounted or in-wall speakers and amplifier/receiver units that connect via CAT 5 cabling. High-end systems include different audio/video inputs for computers, DVD players and projectors.

21st Century Technologies in the Campus Classroom

Colleges and universities have embraced two product categories that give students new ways to access information presented in class: lecture capture systems and distance learning technologies, including course management systems and video conferencing equipment.

Lecture Capture and Retrieval

Lecture capture and retrieval tools allow faculty members to record audio and video of their class lectures and post them online or in a course management system. This allows students who miss class or want to revisit a lecture to review it online.

If students don't grasp a particular portion of a lecture while in class, they can access the recording, fast-forward to the exact spot and listen to the lesson again. Such systems also augment distance learning or online courses, as professors can record video lectures from their computers and make them available to students online.

Institutions can choose from a variety of software and hardware lecture capture solutions. Software-based options are the most affordable. Faculty teaching online courses can create presentations that combine video, Microsoft PowerPoint slides and audio recorded using lecture capture software on their computers.

Professors also can attach a USB microphone and USB video camera to their computer to record lectures that will be delivered in the classroom. High-end systems include recording hardware devices installed in classrooms and server software that allows IT administrators to centrally manage, catalog and track recorded lectures.

Lecture capture systems are designed to record lectures with very little or no user intervention. Some require professors to press a button on their computers to start recording a class lecture, which can be posted to the institution's course management system after class with a few mouse clicks.

Other systems allow IT administrators to schedule lecture recordings. These systems automatically start recording at the beginning of class; once the class ends, the systems stop recording and automatically post the content online.

The technology can record everything that's said or shown during a class lecture, including audio from a microphone, video from a video camera and presentation slides on a computer screen. During playback, students see multiple windows, including video of the faculty member lecturing and the slides they're presenting.

Lecture capture systems have received high marks from students and faculty. Students believe the technology improves the learning process. Knowing they can review lectures later allows students to focus on listening and understanding lectures. There's less pressure to jot down notes verbatim. Some educators, meanwhile, believe lecture capture systems increase students' retention by giving them flexibility in learning and obtaining course information.

Distance Learning

Distance learning is available at many institutions through online courses and live video conferencing.

Course management systems allow campuses to offer online courses through which students can access course content (video lectures, podcasts and online reading materials, for example) and assignments using tools such as e-mail, online chat rooms and discussion boards.

New Learning

Sixty-one percent of the college and university IT leaders surveyed for the *2010 CDW-G 21st Century Campus Report: Campus 2.0* said their campuses offer virtual learning. And 53 percent of student respondents said they have taken an online class.

Besides enabling adults to take classes while working full time, the survey found that virtual learning increases the variety of courses students can take and gives them the opportunity to learn from a broader number of instructors.

Digital content, such as online textbooks and other class materials provided in a digital format, gives campuses the opportunity to augment or even replace traditional textbooks. Among faculty survey respondents, 62 percent reported that they use digital content in conjunction with teaching. Nearly all view digital content as a viable textbook alternative.

Video conferencing equipment allows a college or university to offer courses taught by the same instructor across multiple campuses and gives remote students access to courses they otherwise couldn't take. Guest speakers also can use video conferencing equipment to lecture remotely.

Vendors offer a full range of technologies at different price points – from low-end webcams for computers that allow professors to lecture to and collaborate with their online

students in real time to HD equipment. On the high end, telepresence equipment uses multiple large screens to make people appear life-size, as if they were in the same room.

An HD video conferencing system consists of HD cameras, speakers, microphones and a codec that codes and decodes audio and video for streaming. The codec, software or hardware that serves as the brain of the system, connects video cameras, microphones and other devices that teachers use in a lecture, such as computers, DVD players and document cameras.

The codec distributes the audio and video signals over the Internet to a remote classroom's video conferencing system. And, in turn, it receives the audio and video signals from the remote classroom's video conferencing system.

With large HD television screens or LCD projection screens, a professor can see and hear students in other locations, and vice versa. When professors use a PowerPoint presentation or other documents in their lectures, remote students also see the material. One site can connect directly to another site via video conference by inputting the other site's IP address. If one site needs to connect to multiple sites, a bridge system can be deployed.

Institutions using course management systems for online courses and video conferencing for distance learning may need to upgrade their networking equipment. Colleges and universities using video conferencing may need to upgrade bandwidth between sites to eliminate jitter and ensure high-quality video.