CENTER FOR DIGITAL EDUCATION'S

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Special Report

VOL2
ISSUE4

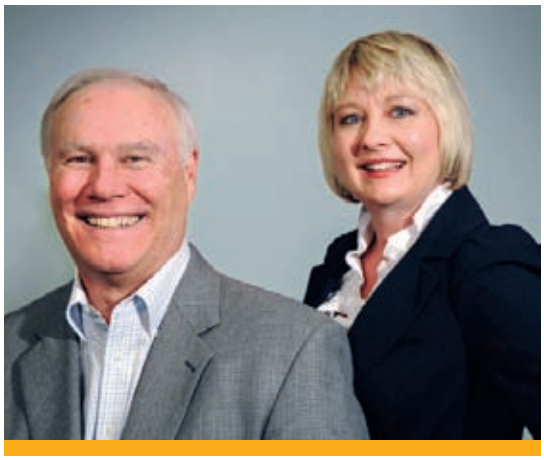
The Evolving Classroom

CENTER FOR DIGITAL EDUCATION

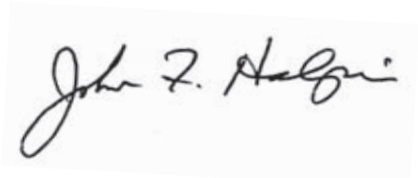
from the publisher

In this Special Report we look at the various methodologies that are evolving to provide optimized learning experiences for students. Many of these techniques are leveraging key assets offered by technology in a way that enables more engaging learning opportunities. The definition of a classroom is evolving to include many settings in which active instruction and learning can take place. Just as digital media and devices, and high-speed networks make the world virtual, they can transform 'school' into a virtual place as well.

Please read this Special Report to see how learning settings are evolving to meet today's demands and to reflect the world in which our students must become more observant, discerning and collaborative. Evolving learning environments are also allowing students to access tools and information whenever and wherever needed. Innovative educators are working to turn many of the evolving settings and technologies described in this report into the learning environments of the near future. Please enjoy this Special Report on The Evolving Classroom.



We started out with a desire to have this Special Report entitled "The Alternative Classroom," but feedback we received from individuals in education and industry, and a more in-depth look at the national education scene, caused us to move our topic to "The Evolving Classroom." We are living in an age where a major transition in education is taking place. The variety of evolving learning models, a changing economy and the number of technology innovations available can be overwhelming to education decision-makers. I was recently at a conference where I asked many of the CIOs and top curriculum managers in the room a question about how many of them knew their technology options "decently well." They just laughed, as I should have suspected. There are hundreds of companies of all shapes and sizes in the tech and tech curriculum field; there are shifting policies; and there are great advances and challenges as well. As you consider what your institution is doing to move forward, my advice is to look around. If you extend your view to the students and the world they graduate into — with a future job market that may demand something beyond what we have even thought of yet — you will be right in your choices more than wrong.



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INTRODUCTION

Before the emergence of Internet-based technologies, the classroom was still a room. It featured a teacher at the front delivering learning content to a group of students. Much of today's teaching and learning is still conducted within the four walls of the classroom. However, the ubiquity of the Internet, mobile devices, wireless networks and other technologies has torn down the walls of the classroom, enabling a variety of unconventional, location-independent learning environments.

By allowing students flexible learning options, schools can provide more individualized instruction. If implemented properly, online and hybrid learning engage students of all ages, ensure equal access to underserved areas, provide learning opportunities for students with family and job responsibilities, and give older learners a second chance at a college degree.

This Special Report will focus on the evolution of learning settings from traditional, instructor-led classrooms to completely virtual, student-centric classes and schools. We will describe and illustrate myriad K-12, college and university learning environments, give examples of how evolving classroom models impact students and teachers, and highlight the technologies that make it possible.

Today's students use technology to make decisions, manage information and engage socially. They require new ways of learning, communicating, thinking, finding information and problem-solving. To continue to keep students engaged in learning in an environment of ever-changing technology, the classroom — be it a familiar on-campus environment or a student's home or even a coffee shop — must evolve.

TRADITIONAL CLASSROOMS VS. EMERGING LEARNING MODELS

"Traditional" learning environments are characterized primarily by one-to-many learning and specific, scheduled meeting times and locations. With the exception of guest lecturers or substitute teachers, the instructor is the same throughout the school year.

Learning is delivered by the teacher, usually standing at the front of a classroom, using a combination of lectures, chalkboards, flipcharts, whiteboards, laptops connected to projectors for presentation or television sets for video instruction. The instructor presents content to the entire class based on a lesson plan; students are periodically assessed as a group, given individual grades and moved as a class to the next unit of learning.

Computers may be used by the teacher to deliver instruction, or by students for research or to complete homework. Technology is used in the classroom but may be seen as a supplement to other methods. Textbooks and other reading materials are the primary resources. Outside of the classroom, students may supplement their learning using library resources, the Internet, or if they have funds, paid online or electronic resources.

On the other hand, evolving learning environments are defined by one-on-one learning delivery, and the ability for educators to provide a customized experience and personalized content to meet the specific needs of each student. Teachers are viewed as facilitators or coaches, helping individual students master specific concepts with which they may be struggling. A class may have many instructors, depending on their expertise level and content needs.

HOW WE GOT HERE

1980s

The evolution from traditional to more technology-enhanced classroom environments began in the 1980s, with the advent of computer-based learning, or CBL. Primarily a self-directed model, CBL consists of student interaction with the computer such as study drills, simulations or tutorials.

1990s

With the rise of digital communications and enterprise networking in the 1990s, students began interacting with the Internet instead of an individual computer. This became computer-mediated communication (CMC), which requires more teacher facilitation, customization and development of lessons, and involves learning communities, student management and curriculum management.

Technology is not supplemental; it's integrated into the learning environment. Learning is delivered via a combination of traditional methods and Internet-connected devices, including desktops, laptops, tablets and smartphones. Instruction and resources are accessible to the student via the Internet in or outside of the classroom. Rich, multi-media digital textbooks and other online resources can be used from any place the student has Internet access. Homework is turned in and assessed online, often automatically. Students collaborate with each other and their peers via social networks, and they maintain electronic portfolios that represent their very best work. Students and their parents have online access to grades, attendance records and transcripts, and can track progress throughout the year.

In both K-12 and higher education, students may choose from a variety of blended or hybrid courses, which combine traditional and alternative elements. Completely virtual courses, certificate programs, and even undergraduate and graduate degrees are available at many community colleges, colleges and universities.

Both traditional and up-and-coming environments may be found in K-12 and higher education institutions; in public, private, charter or home schools; hybrid campus-home settings; or multi-campus or shared campus settings. Settings where the classroom has expanded beyond the four walls of a physical classroom — such as virtual academies, online universities and other forms of distance learning; blended online and in-class learning; remote campuses; and open course initiatives — are by their nature evolving learning environments.

THE IMPACT OF THE EVOLVING CLASSROOM

As more states, districts and campuses adopt technology and tools that enable new models of teaching and learning, we can begin to gauge the impact of the evolving classroom on students, teachers and administrators.

STUDENT-CENTRIC LEARNING

By far, the evolving classroom's biggest impact is on its students. It changes the traditional classroom dynamic by putting the student and his or her individual needs at the heart of the learning experience. In a traditional classroom, students are receivers of information provided by textbooks and teachers who lecture from the front of the classroom. The entire class proceeds through lessons and assessments at the same pace.

In the evolving classroom, whether the student is on campus or online, his or her specific learning needs are factored into an individualized learning program. Students no longer move at a single pace through the curriculum and content, which can be customized depending on how well each student has mastered the material.

Technology broadens the reach of the school or district, enabling students that are unable to attend class in person to participate and engage in social learning experiences. Studies show that students learn basic reading, writing and math better and faster if they use technology to practice those skills. They are more willing to spend time learning and show higher levels of comprehension. In addition, because students who use technology are able to communicate and learn in multiple ways, they can choose the methods with which they are most comfortable. This builds self-confidence, self-esteem and pride.[1]

LATE 1990s

Towards the end of the 1990s, these same technologies expanded beyond the classroom, playing a major role in online and distance learning — especially in higher education — through the use of software- and Web-enabled forums, e-mail, instant messaging, videoconferencing and other technologies.

2000-PRESENT

The emergence of broadband Internet, wireless networking and mobile Internet devices has led to the integration of learning and technology resulting in blended models that combine online, mobile and classroom-based learning.

UNITED STATES OF EVOLVING LEARNING MODELS

IDAHO

The Idaho Digital Learning Academy is a state-sponsored, accredited online school that was created by the Idaho Legislature in 2002. The Academy's online infrastructure connects students across the state, even in rural areas, and has served over 40,000 student enrollments since its inception.

IOWA

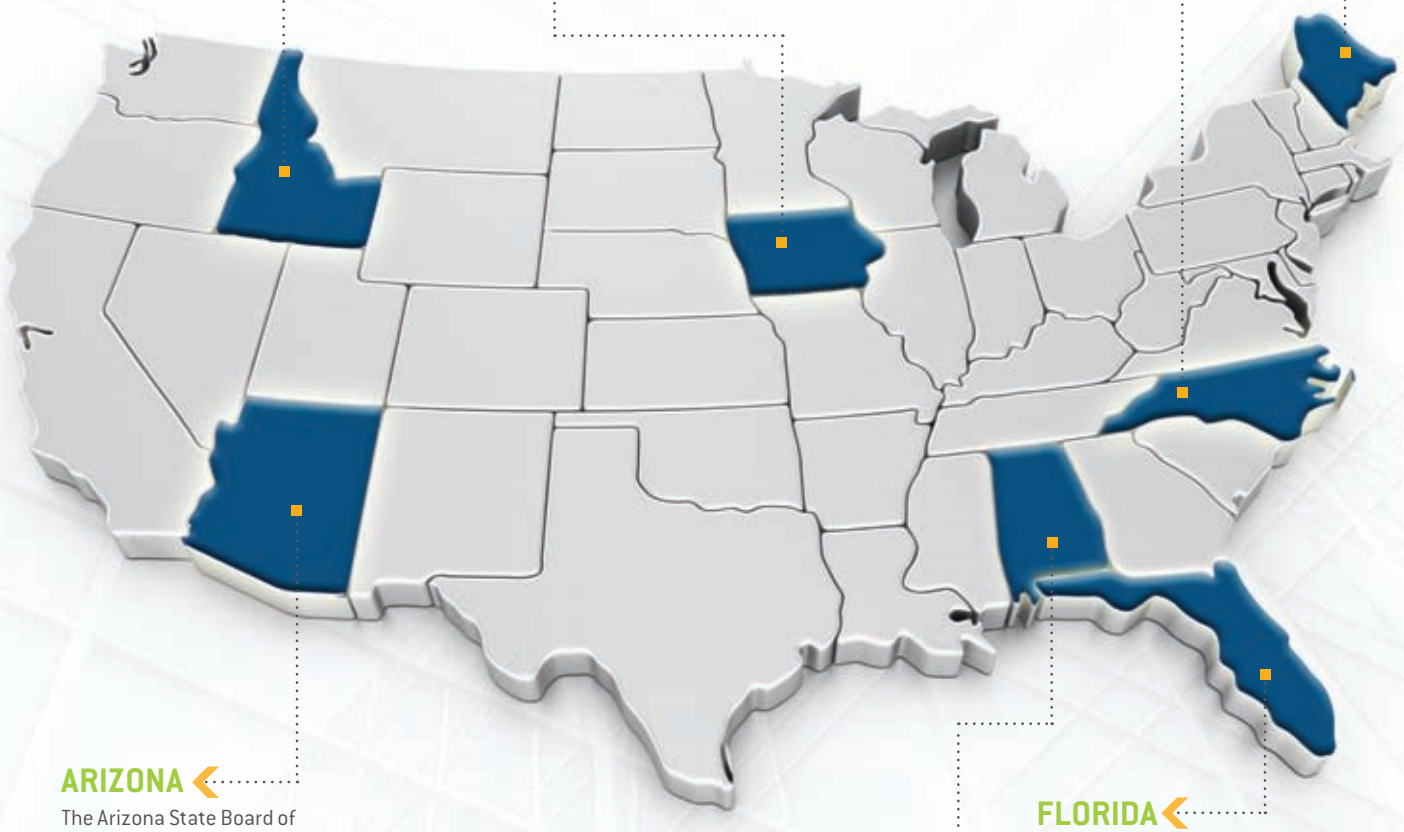
To help school districts expand learning opportunities for high school students, the state created Iowa Learning Online (ILO).

NORTH CAROLINA

The state department of education collaborated with a foundation and a private company on a program that provides a wireless computing device for every student and teacher.

MAINE

In 2002, Maine began one of the first initiatives in the country to equip students and teachers with computers.



ARIZONA

The Arizona State Board of Education approved research-based educational technology standards, which incorporate the Framework for 21st Century Learning.

ALABAMA

The Alabama Department of Education created the Alabama Learning Exchange (ALEX), a statewide online platform that allows educators to share lessons, find digital resources and participate in a professional learning community called ALEXville.

FLORIDA

The Florida Virtual Curriculum Marketplace is an open, searchable repository of free and fee-based digital content that is designed to make it easier to find relevant curricula.

Anecdotal evidence suggests that students are more enthusiastic about learning using technology. Most educators notice a discernable difference in student interest and enthusiasm for learning in technology-based environments.

"You can see students in the [computer] lab soaking up learning like sponges," said Mary George, district engineering program coordinator of Minnesota's Mahtomedi Public School District. "We can't get them to leave when class is over — they'd rather take a tardy. How many classes can say their kids won't leave?"[2]

In spite of encouraging anecdotes, however, K-12 students are ultimately measured on standardized test performance. Is there evidence that technology actually helps improve performance on standardized tests? Project RED, a national research and advocacy project found that schools with properly implemented technology have improved test scores and higher graduation rates. For example, their findings indicate that the proper implementation of 1:1 computing initiatives reduced disciplinary action by 92 percent and dropout rates by 89 percent, while graduation rates and test scores increased by 63 and 90 percent, respectively.[3]

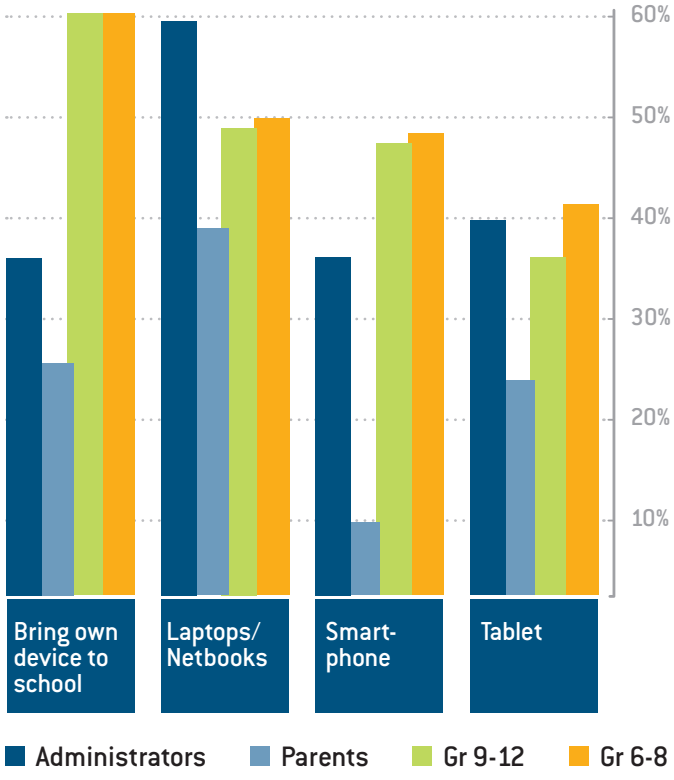
Other research is not so conclusive. The U.S. Department of Education found that there is a lack of scientific proof of the effectiveness of online studies.[4] A study by McREL concurred, noting that a 1:1 laptop program is only as effective as the school's teachers: "Rather than being a cure-all or silver bullet, one-to-one laptop programs may simply amplify what's already occurring — for better or worse."[5] What is clear is that for evolving classroom environments to be truly effective, they must be implemented thoughtfully and appropriately.

"YOU CAN SEE STUDENTS IN THE [COMPUTER] LAB SOAKING UP LEARNING LIKE SPONGES. WE CAN'T GET THEM TO LEAVE WHEN CLASS IS OVER — THEY'D RATHER TAKE A TARDY. HOW MANY CLASSES CAN SAY THEIR KIDS WON'T LEAVE?"

MARY GEORGE
DISTRICT ENGINEERING PROGRAM COORDINATOR
MAHTOMEDI PUBLIC SCHOOL DISTRICT, MINN.

THE IDEAL SCHOOL

The figure below, from the 2010 Speak Up Survey, shares respondents' views of the components their ideal school would include.



Source: 2010 Speak Up Survey

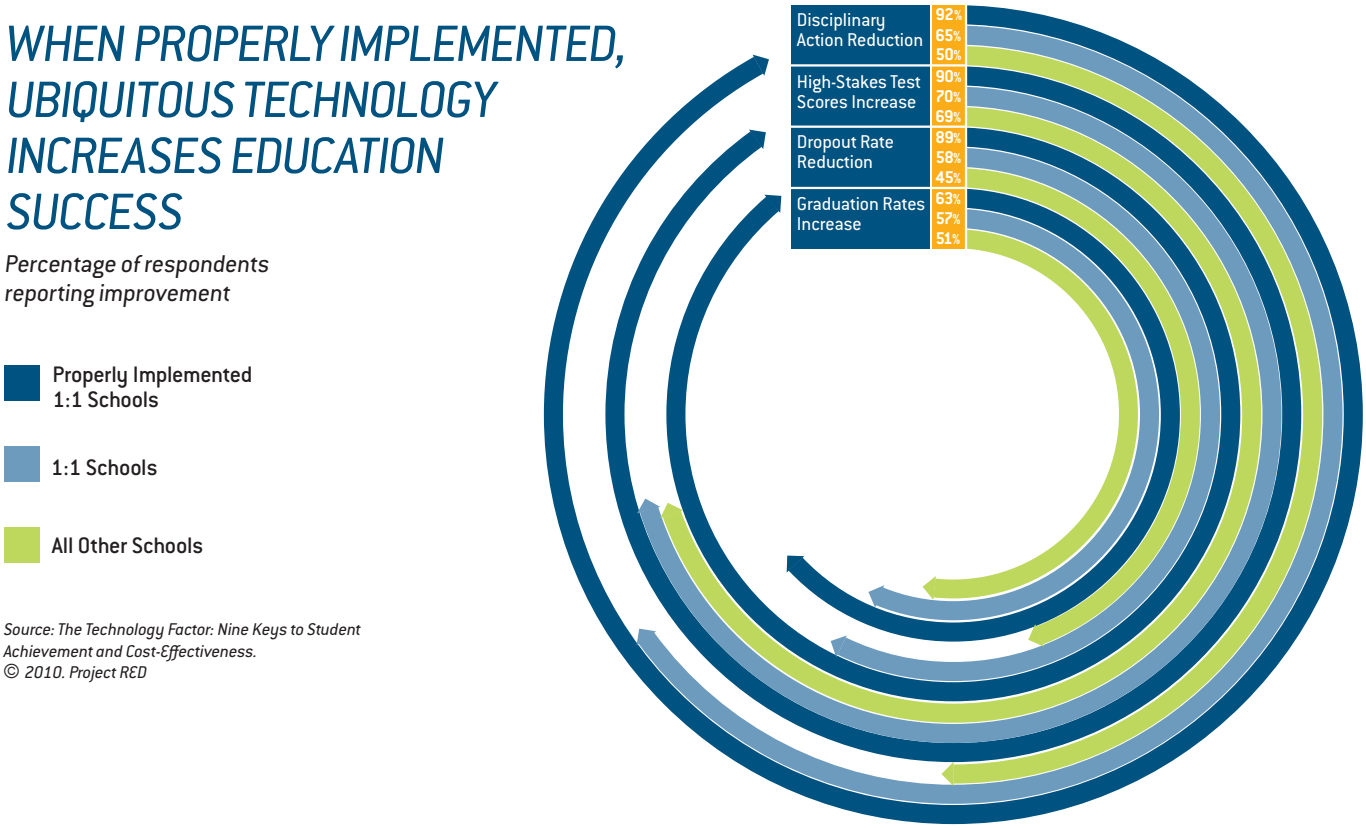
THE MENTORING TEACHER

Teaching in the K-12 evolving classroom is more student-centric in part because of technology's ability to automate many teaching tasks, allowing the teacher to focus on the student. The automation of curriculum development, standards compliance, lesson planning and assessments gives the teacher more time to spend with students.

Critics say new models de-emphasize the teacher. But this is only the case in a poorly planned and executed implementation. If a classroom technology plan is strategized and implemented appropriately, the teacher is more valuable than ever before. Traditionally, teachers deliver information one-to-many. In the evolving classroom, educators are able to focus on individual learning needs by working one-on-one with students and in small groups.

WHEN PROPERLY IMPLEMENTED, UBIQUITOUS TECHNOLOGY INCREASES EDUCATION SUCCESS

Percentage of respondents reporting improvement



Source: The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness.
© 2010. Project RED

In colleges and universities, classroom technologies are hastening the change in the role of the college professor. The professor still presents course material to students, but in a way that allows students to interact with it and relate to it.[6] Educators in blended in-class and online environments (whether higher education or K-12) epitomize the concept of the "guide on the side" that is responsible for facilitating student interaction with instructional material and class peers.

ADMINISTRATORS LEAD THE TECHNOLOGY REVOLUTION

The evolving classroom requires education leaders to be creative and capable of re-imagining learning delivery. They must also be flexible and willing to plan and work collaboratively to accomplish goals. Unless they are prepared to face the significant changes required by new classroom technology, they may end up with a poorly executed deployment that does not meet learning needs and is criticized by parents, students, teachers, and school or governing board members.

Consider the behind-the-scenes administrative decision-making and planning that occurs in the development of a charter school with a blended learning program. A good example of this is Albuquerque, N.M.-based Southwest Secondary Learning Center's blended learning program, in which three 3 ½ hour teaching blocks are held Monday through Thursday between 8 a.m. and 7:30 p.m. (see "K-12 Profile: Southwest Learning Centers" on page 29). Students are required to attend three teaching blocks each week plus a separate 3 ½ hour SmartLab, or technology lab, session; all of the school's teachers must each work two teaching blocks a day.

This requires teachers to break out of their typical 8 a.m. to 3 p.m. workday. School leaders must work to bring teachers and teacher unions on board with this plan. Also, the school must meet certain state and federal mandates for seat time, compulsory attendance and special education teacher caseload.

"As a charter school, we have some flexibility with state requirements but you can never be exempt from

federal requirements," notes Scott Glasrud, the school's head administrator. "You have to craft a creative program that meets necessary mandates without affecting teaching quality and learning outcomes."[7]

College and university administrators must be similarly persistent and determined to manage speed bumps that can occur if everyone is not on board. Indiana University's administration was able to overcome bureaucratic obstacles to establish a digital textbook pilot program that has the potential to save students $600 per year in textbook costs.

Through the program, students are charged an additional required fee of $35 per each participating course for digital textbooks that the university purchases in bulk through its technology vendor. Since any fee increase requires legislative approval, the university and its vendor developed a proposal and made a presentation to the state legislature, which was at first opposed to new fees but ultimately approved the increase. The administration also approached student government officials for feedback to ensure student buy-in.[8]

THE EVOLVING LEARNING ENVIRONMENTS

Predictably, the first widespread use of evolving classroom environments was in higher education. But as technology matured and became more affordable, the technology-based learning experience trickled down to K-12. According to the Innosight Institute, 45,000 K-12 students took online learning classes in 2000, a number that increased to more than four million by 2010.[9]

Emerging classroom models are more prevalent in high schools, where students are more mature and better able to manage their time, than in elementary and middle schools, which have been slower to adopt because of the high need for face-to-face instruction and interaction, directed activities and learning based on previous knowledge.

At lower grade levels, most teachers provide computer-assisted instruction, also known as online learning or e-learning, by integrating basic technology such as the Internet, e-mail, software programs and learning games into the traditional in-class experience. Many homeschooled students, even in K-6, make extensive use of the evolving classroom experience, with the parent serving as the teacher or coach.

Institutions of higher education were the pioneers of the evolving classroom because of a pre-existing comfort with the concept of long-distance learning. Prior to the emergence of online courses and universities in the mid-1990s, many colleges and universities already used distance learning methods such as correspondence and self-paced courses commitment.

When technology evolved to the point that universities could deliver an effective online learning experience, higher education institutions quickly saw that the technology could be used to increase enrollment while lowering cost of. At the same time, student demand for online classes, degrees and programs has continued to increase.

The 2010 Sloan Survey of Education Online Learning in the U.S. reported that during the fall 2009 term, more than 5.6 million students — almost 30 percent of all higher education students — were taking at least one online course, an increase of almost one million students from the previous year. The growth rate for online enrollments was 21 percent over the previous year, compared to less than 2 percent growth among the overall higher education student population. The Sloan Survey also reported that 63 percent of the 2,500 participating colleges and universities said that online learning was critical to their institution's long-term strategy.[10]

In both K-12 and higher education, technology has altered the learning experience to include:

- blended or hybrid learning; and
- distance learning or online-only schools.

K-12 EDUCATION PROFILE:

EPGY Online High School

Stanford University's Education Program for Gifted Youth (EPGY) is home to the Online High School (OHS), an independent, tuition-based school for grades 7-12. When it was established in 2006, the fully accredited, diploma-granting institution was the first online-only school for gifted students. OHS enrolls approximately 300 students from across the U.S., Asia and Europe.

The class schedule, modeled after college courses, emphasizes independent study and is intended to foster discipline and time management skills. Students can choose among self-directed courses that use recorded material and have little peer interaction, and seminar courses that employ Internet-based videoconferencing, pre-recorded lectures, and discussion seminars with their peers and instructor.

The class Web page provides downloadable course materials such as a syllabus, reading and assignment schedule, and lecture outlines, and is also used to submit homework and tests and receive assessments. An interactive Web conferencing and online learning solution enables real-time videoconferencing, allowing students to participate in synchronous and asynchronous discussion with their classmates and instructors.

OHS students score much higher than the national mean for the SAT, SAT subject tests and ACT. For example, the national mean total SAT score is 1509; the mean total score for an EPGY OHS student is 2199. Graduates are accepted to top tier universities, including Yale, CalTech, Johns Hopkins, Cornell, MIT, Oxford and Stanford.[11]

BLENDED OR HYBRID LEARNING

Most of the growth in K-12 online classrooms in the last decade has been in the blended learning category.[12] Also called hybrid learning, blended programs combine both in-class and online components, incorporating the best of traditional and alternative models to deliver an interactive, technology-based learning experience.

Innosight Institute, an education and healthcare think tank, provides a definition that has been widely used, including by the U.S. Department of Education: blended learning "is any time a student learns at least in part at a supervised brick-and-mortar location away from home and at least in part through online delivery with some element of student control over time, place, path and/or pace."[13,14]

Blended learning environments are by their nature flexible and there are no hard and fast rules about how a program should be structured. Consequently, there is much debate about what constitutes blended learning in K-12. (There is more clarity in higher education, as you'll read later in this next section.)

Some argue that the "blended learning" label is too haphazardly applied to any learning environment that simply supplements in-class learning with computer-aided or online instruction. Using this definition, nearly all K-12 programs could be considered blended learning.[15] For this Special Report, we have identified two primary types of blended learning, each with multiple sub-models:

Online Component Primarily Offsite

These classes or schools have an online component that must be completed outside of class. Because of this requirement, all students must have access to high-speed Internet at home, a library or some other offsite location.

- *School with online component primarily offsite:* The school's entire instruction is delivered via the blended learning experience. Lessons typically come from online curricula, which provide multiple learning options (text, videos, labs, etc.) and integrate formative and summative assessment for the student and instructor. Students work through the lessons that can be accessed from any location with a broadband Internet connection at their own pace. They must pass online quizzes, which are automatically graded before moving on to the next section. Students meet in class, under the direction of a teacher and usually on an abbreviated, but fixed schedule. In the classroom, a teacher may deliver instructional material to the entire class, as in a traditional classroom, or he or

she may conduct small group tutoring sessions, answer individual questions, coach students, or work with them one on one on special projects or material they're having trouble mastering. This model is used for many dropout- and credit-recovery programs.

- *Class with online component primarily offsite:* For a specific class or classes within a school, coursework is delivered via the blended learning experience. Students meet in class on an abbreviated, fixed schedule. Outside of class, they proceed through online lessons at their own pace. Their online work is supervised by the course instructor, who may conduct in-class time in many formats, such as delivering the same material to the entire class, conducting small group or individual tutoring or coaching sessions, or answering individual questions.
- *Student-driven hybrid*: Students make the decision to take online, offsite courses in combination with traditional face-to-face classes at their local brick-and-mortar school. Depending on district, state and school requirements and the accreditation of the online school, their diploma may be granted by either school.

Online Component Primarily Onsite

Time is divided between traditional face-to-face learning and an online component, which is delivered completely in class.

- *Face to face with supplemental online components:* Most learning is delivered face to face by a teacher in a traditional classroom setting. Online components are used as needed to supplement or remediate. The online learning can occur in a computer learning area of the same classroom or at an onsite computer lab.
- *Class with lab-based online component*: To supplement traditional classes, some schools or districts provide lab-based online classes with no face-to-face teacher interaction, although para-professionals may supervise the lab. At a fixed time, students attend the class, which may be on the school campus or another location such as a local community college.

A higher education blended learning environment refers to a class that is taught using a variety of traditional and alternative methods and media. This can include in- class lectures, seminars, labs or recitations; real-time interactive videoconferencing, recorded lectures that can be streamed or downloaded to students' portable devices, or satellite broadcasts; interactive multi-media presentations; synchronous and asynchronous online discussions; and computer exercises and tutorials.

Technology in the physical classroom — designed to create an interactive, collaborative experience on campus and online — includes laptops, video and document cameras, projectors, interactive whiteboards, DVD players and interactive pen displays. To supplement traditional library resources, colleges and universities provide students with a range of online materials such as instructional videos, digital textbooks and databases.

As in K-12 blended learning, technology can be used at varying levels. At the most basic level, a primarily face-to-face course provides some content through an LMS, which is also used to manage assignments. One level up is the class that adds online discussion groups, all-digital course materials and less in-class time, which is dedicated to discussion of the material and student-teacher interaction. Finally, at the highest level of a blended class experience, students are required to occasionally "check in" onsite — perhaps at the beginning and end of the semester, for testing or project presentation days, or weekend seminars.

BEST PRACTICES FOR IMPLEMENTING EVOLVING CLASSROOM TECHNOLOGIES IN K-12

Because K-12 schools aren't as far along as higher education institutions in their use of emerging classroom technologies, a few best practices may help them develop technology-based distance and blended models.

PLAN THOROUGHLY

Allot plenty of time for planning — six months to a year is not unreasonable. The planning phase includes an infrastructure evaluation. Internet access must be fast, reliable and available throughout campus. Wireless coverage should be as ubiquitous as possible. At minimum, the wireless network should cover all classrooms and common areas such as the library and cafeteria. Determine technology staffing needs (for example, lab facilitators and technical support) and hire them before ordering equipment.

ENSURE STAKEHOLDER SUPPORT

A successful program depends on key staff, including the school's technology facilitator, media coordinator and especially the principal. They must be comfortable with technology and unafraid of change. Support for the project must occur at all levels — technology strategy and objectives must be presented to teachers, staff, administration, parents, students and taxpayers. Set realistic expectations of timelines for deployment and measuring results.

CULTIVATE TEACHER COMMITMENT

Help teachers and faculty members understand the differences of the evolving classroom and how it improves teaching and learning. Realize that not every teacher will have the same level of commitment immediately. Don't scrimp with student or teacher technology — make sure that everyone has what they need to do their job easily and well, or teachers may see the effort as a failure and withdraw support for future projects.

PRIORITIZE PROFESSIONAL DEVELOPMENT

Don't forget about professional development. To be successful in the evolving classroom, educators must feel confident about how to use technology, and most important, how to integrate it into their teaching and assessments. Enlist vendors' help to provide pre-deployment training and technical support on the go-live date. Provide ongoing training throughout the school year and summer if needed.

UNDERSTAND STUDENT MATURITY

Online education should be dependent on student maturity level, time management and planning skills, and the ability to work and study independently. Depending on your students' age and maturity level, consider implementing transitional or training options for those that aren't mature enough to jump into fully online models right away.

USE DIVERSE IN-CLASS TECHNOLOGY AND TOOLS

There's more to the evolving classroom than Internet access and student laptops. In-class technology can help both on-campus and online students. Make sure classes have core technology such as interactive whiteboards, projectors, digital/video cameras, and don't forget subject-specific equipment such as laboratory microscopes and math software.

ENLIST STUDENT HELP

A student advisory panel can help review and recommend proposed technologies and initiatives. In exchange for learning credits, a student technical assistance team can provide support such as network maintenance, repair or re-imaging laptops.

DEVELOP AN ACCEPTABLE USE POLICY

To ensure students' Internet safety, develop an acceptable use policy (AUP) that defines responsible and educationally appropriate use of computer resources. An AUP requires parents, students, teachers and administrators to agree to a code of conduct for using school technology and personal technology on school property. This can include regulations on respecting others' privacy, plagiarizing digital content, and the use of inappropriate or illegal material or behavior on the Internet. It may also include a provision reserving the right to discipline the student for on- and/or off-campus cyber-bullying, cyber-stalking, and cyber-harassment of other students.

MEET FEDERAL SAFETY REQUIREMENTS

Federal laws and funding programs require publicly funded schools to protect students from inappropriate Internet content. Proper filters, firewalls and other security measures can safeguard your networks, data, students and staff from viruses and hackers.

INCLUDE SPECIAL EDUCATION

Technology can help students with special needs access and participate in the general curriculum. By personalizing instruction, schools can provide an inclusive environment for English language learners; students with learning or behavioral disabilities; and those with visual, hearing and speech impairments, and other disabilities.

BE FLEXIBLE

For students to achieve technology's full benefits, teachers and administrators may need to reconsider and change — or at least be willing to bend — conventional rules and wisdom. For example, a no-cell-phones-in-class policy may inhibit the use of smartphones for in-class research. And blocking access to social networking websites will prevent their use as legitimate learning delivery tools. Work with parents, teachers and technology staff to determine the safest ways to use technology tools to achieve student outcomes.

BRIDGE THE DIGITAL DIVIDE

Plan carefully to ensure that lack of technology access does not exclude some learners from participation. For example, when planning a bring-your-own-device initiative, estimate how many students lack a device and create a pool of them for checkout. If out-of-school Internet access is required, make sure there's a solution for students that don't have broadband at home.

HAVE A MAINTENANCE PLAN

The costs of the evolving classroom extend far beyond implementation. Be sure to develop a plan for maintaining, upgrading, repairing and replacing hardware and software as needed.

DISTANCE LEARNING/ONLINE-ONLY SCHOOLS

Distance learning historically referred to college or university correspondence courses. The U.S. Department of Education currently defines distance education as "the transmission of educational or instructional programming to geographically dispersed individuals and groups via telecommunications."[16] Telecommunications is understood primarily to be the Internet. Other names for distance learning are online school, virtual school or academy, e-school and cyberschool.

Most often, virtual schools have no physical location and there are no face-to-face meetings — instruction takes place solely online. In some cases, virtual schools, particularly those associated with brick-and-mortar institutions, may offer optional or required face-to-face check-ins or introductions.

Class sessions, presented via online video, may be synchronous (real-time or live lectures that require students and teacher to log in at an appointed time and provide instant feedback and collaboration) or asynchronous (recorded learning sessions or self-paced lessons that can be downloaded or streamed at the student's convenience).

Supporting content combines interactive text, digital textbooks and slide presentations. Online quizzes and tests are used for assessment, and homework and other written assignments are turned in online. Instant messaging boards, chat rooms or discussion groups may be employed to foster peer interactions. Students (and their parents) keep in contact with teachers via videoconference, phone or e-mail.

Nearly every U.S. state offers fully accredited public schools for an all-online class experience. They were initially used to help meet federal requirements to provide equal access to students in high-need areas. Now, as a way to cut costs during a time of increasing budgetary constraints, virtual schools offer core curriculum in addition to supplemental courses.

Some virtual academies have the option to earn a high school diploma, completely online. There are also many virtual academies and non-accredited online schools that don't provide a diploma. For the purposes of this Special Report, we use the term distance learning, and all of its synonyms, to refer to accredited institutions, whether public or private, that provide credited coursework.

The models for participation in online schools are fairly flexible to meet multiple student needs:

- Full-time study for a high school diploma
- Temporary full-time study with future credit transfer to another school
- Part-time study for access to courses not available locally or advanced placement courses
- Supplemental courses or full-time study for homeschool students
- Credit recovery classes to obtain additional credits

Hundreds of colleges and universities dot the online-only landscape. Unlike traditional nonprofit universities, these for-profit institutions are managed as businesses by investors for the purpose of earning revenue.

Endowments at private schools have been impacted by the poor economy, and public universities are dealing with massive budget cuts. But online universities are weathering the storm thanks in part to their for-profit business status. They usually charge similar tuition rates as public schools for online courses, and keep costs down with low overhead and innovative technology.

Degree programs often follow an open admissions policy; they are open to anyone with a high school

degree. Schools can enroll seemingly unlimited numbers of students. Many online learning programs have multiple satellite campuses located around the world. Students can earn degrees entirely online or take courses onsite if they live near a campus.

However, there is much criticism of online schools, especially within the traditional academic community. Graduates have found that employers can sometimes place less value on a degree from a fully online school than on a degree from a traditional institution. Many disparage what they perceive as a lack of academic rigor in fully online for-profit institutions. Often, online schools do not provide tenure and rely on part-time lecturers and adjunct professors.

Some of the criticism is earned. Many online schools are merely diploma mills, and it can be difficult to determine the difference between a legitimate school and a diploma mill because online-only institutions are not included in college ranking systems such as Princeton Review or U.S. News and World Report. However, many for-profit online colleges and universities are accredited by regional and national agencies.

For-profit institutions received a lot of unwanted press in 2010, when the Government Accountability Office (GAO) conducted an undercover investigation into 15 for-profit colleges that revealed a wealth of fraudulent, deceptive or questionable marketing and recruiting practices at the schools.[17]

As a result of the investigation, the Department of Education released new aid rules for federal student aid programs. The rules pertain to all higher education institutions, although the Obama administration clearly singled out for-profit schools, whose students represent 11 percent of all higher education students, receive 26 percent of federal education loans and account for 43 percent of all loan defaulters. More than a quarter of for-profit institutions receive 80 percent of their revenues from taxpayer financed federal student aid.[18]

MANY ONLINE LEARNING PROGRAMS HAVE MULTIPLE SATELLITE CAMPUSES LOCATED AROUND THE WORLD. STUDENTS CAN EARN DEGREES ENTIRELY ONLINE OR TAKE COURSES ONSITE IF THEY LIVE NEAR A CAMPUS.

The new rules are meant to ensure program integrity and accountability, protect consumers and provide federal aid only to eligible students and for eligible programs and courses. It is not yet known how these rules will impact fully online institutions.

ADVANTAGES AND DISADVANTAGES

Both online schools and blended learning models have many advantages for students, schools and educators. The most salient is their ability to increase student access to learning and provide otherwise unavailable learning opportunities. In addition, today's digital natives find it more engaging than traditional teaching methods, and teachers can deliver customized instructional experiences that individually address each student's learning style.

Online schools provide the following:

- **More class choices.** Students can take classes that may otherwise not be offered such as accelerated or advanced placement courses.
- **Teacher shortage relief.** This is especially beneficial for students in rural or underserved areas and helps states adhere to federal requirements for improving student achievement in high-need areas.
- **Less crowded classrooms.** Virtual schools help alleviate overcrowded classrooms and schools, improving the quality of education for students who are on campus and online.

- **Better resource use.** Allowing students to learn without coming to campus relieves the strain of student body growth on building and technology infrastructure. Using broadband and wireless technologies to enable full wireless access frees up real estate space and funds previously used for computer labs.
- **Expansion of institution reach.** Because it allows more flexible schedules and learning locations, online learning expands an institution's reach to include students who might otherwise be unable to attend classes because of time or location limitations. This opens previously unavailable learning opportunities to groups such as high school and college dropouts, late bloomers, senior citizens and long-distance learners. Injured or sick students may use virtual academies on a temporary basis to keep up with studies. Those with long-term medical or behavioral issues that limit their ability to achieve may also benefit from virtual arrangements.
- **More flexible schedules.** Students with a number of extracurricular activities or part-time jobs can benefit from the ability to take a class at their convenience.
- **More choices for homeschooled students.** Online schools help parents create a more structured learning environment for homeschooled students. Curriculum at state-based schools meets state and national standards, and because students are considered part of the district, they're eligible for grades, diplomas, and other documentation for graduation and college applications.

BECAUSE IT ALLOWS MORE FLEXIBLE SCHEDULES AND LEARNING LOCATIONS, ONLINE LEARNING EXPANDS AN INSTITUTION'S REACH TO INCLUDE STUDENTS WHO MIGHT OTHERWISE BE UNABLE TO ATTEND CLASSES BECAUSE OF TIME OR LOCATION LIMITATIONS.

- **Individualized learning.** Online education offers opportunities for customized instruction that aren't available in traditional one-to-many settings. Students proceed at their own pace using the methods they're most comfortable with. In the virtual classroom, students have less embarrassment about not understanding a topic. If they have trouble comprehending a lesson, they can stop and focus on the material without drawing attention to themselves.
- **Additional revenue streams.** Online learning extends the age range of learners well beyond the traditional schooling range, allowing colleges to tap new markets for revenue streams from tuition and alumni donations.[19]

Blended learning provides many of the same benefits, with additional advantages because it gives students the best of both online and in-class learning experiences.

- **Improved social opportunities.** Unlike purely online learning, hybrid programs enable in-person socialization, allowing students to foster face-to-face friendships with peers and develop student/mentor relationships with instructors.
- **Face-to-face teacher interaction.** Teachers and students spend more time interacting face to face, which can provide structure and discipline for students that haven't developed the skills to work in true distance learning environments.
- **Personalized, student-centric instruction.** In blended learning, the focus shifts from the instructor-led lecture or discussion to the students' needs. Students benefit from the personalized learning experience and the ability to learn at their own pace.
- **Better teacher experience.** Online curricula frees up teachers from time spent grading assignments and planning lessons. They instead spend that time doing what most of them enjoy the most — working with students.

- **Smaller class size.** In hybrid programs, students typically attend school two or three days a week. Administrators can have students attend on a staggered schedule so that only certain grades are on campus on specific days.

There are of course critics of increased use of technology in education and evolving environments. They worry about the indiscriminate digitizing and delivering of course content, the demotion of human educators and the impact upon learning quality. The use of evolving models is in its infancy and has seen rapid growth in the last decade. Some of the disadvantages of online and blended learning will disappear as these learning environments and their enabling technology mature. It's likely that objections to "replacing teachers with technology" will remain for years to come, as some simply prefer the face-to-face model. In the short term, judicious application of online and evolving classroom technologies by campuses can alleviate many of the challenges faced when moving to these environments.

HIGHER EDUCATION-SPECIFIC ENVIRONMENTS

There are some evolving learning environments specific to higher education. These include:

- open course and open courseware initiatives; and
- online programs from traditional institutions.

Open Course and Open Courseware Initiatives

MIT initiated the open course movement in 2001 when it launched MIT OpenCourseWare (MIT OCW), beginning the process of making all of its undergraduate and graduate course materials available on the Web, free of charge, to any user. MIT OCW spurred hundreds of other universities to offer free, open, online content. Depending on the class, materials include streaming lecture video, lecture notes, interactive Web demonstrations and entire textbooks authored by MIT professors.

In 2005, MIT and other open course initiatives collaborated to create the OpenCourseWare Consortium, a global community of hundreds of public and private institutions and other educational organizations committed to promoting open course initiatives. The OCW Consortium serves as a resource and forum for colleges and universities and coordinates the global OCS movement. U.S. members include Arizona State, UC Berkeley, Notre Dame, Tufts, Michigan State, UMass Boston and University of Wisconsin-Eau Claire.[24]

Outside of the auspices of the OCW Consortium, many universities publish free digital learning materials online. Carnegie Mellon, Harvard, University of Michigan, Boston College, University of Washington, UC Irvine, Stanford and UC Davis are just a few. Open courseware from these universities is a boon to educators of all levels who can use the content to supplement their own courses. This includes high school teachers, as well as college and university professors that don't have the resources to put their own course materials online.

HIGHER EDUCATION PROFILE:

MIT OpenCourseWare

MIT OpenCourseWare (MIT OCW) was a radical, early online model designed to move beyond providing educational materials for enrolled students, as most institutions did at the time. MIT OCW provides free access to educational materials, including video lectures, for all of its classes online. It grants no degrees or certificates. The school is quick to note that MIT OCW content is not a substitute for MIT education, and that participants have no interaction with MIT faculty or students.[20]

The initiative boasts impressive statistics. In the 10 years since the program's introduction, all MIT undergraduate and graduate classes from all 33 MIT academic departments — more than 2,000 classes — have been made available online. More than 93 percent of MIT undergraduates and 82 percent of graduate students use the OpenCourseWare to supplement formal coursework.[21] More than 87 million visitors have made 122 million visits since 2001. The site averages 1.5 million visits each month.[22]

Every course made available to MIT OCW costs the school $10,000-$15,000. The funds are needed to compile course materials, manage licensing for open sharing and format materials for global distribution.[23]

HIGHER EDUCATION PROFILE:

Montgomery County Community College

The blended or hybrid model is very practical for community college students who often juggle full- or part-time jobs and family responsibilities. A 2010 Center for Digital Education survey revealed that between 35 and 65 percent of community college students were registered for online or blended courses.[25] For example, all of the classrooms at Montgomery County Community College (MCCC) are equipped with digital technology for better in-class and online learning.

MCCC serves 30,000 students at its main campus in Blue Bell, Pa., and a satellite campus in neighboring Pottstown. The college offers a variety of online-only, hybrid and videoconference-based classes. Hybrid classes usually consist of 60 percent online instruction and 40 percent traditional face-to-face meetings. Videoconference classes are conducted at two or more locations through two-way audio and video transmissions, with an instructor present at one location and able to interact with students at all remote locations simultaneously.

Students have access to professor-directed podcasts that can be downloaded to their smartphones. Students in online-only classes can opt for a face-to-face meeting with their professor, conducted via videoconferencing tools over the Internet. Professors videoconference between both campuses, and can use interactive whiteboards to allow students from either location to participate in real time.

MCCC received an A+, the highest rating possible, in the Center for Digital Education's 2010 Digital Community Colleges Survey.[26]

The Community College Consortium for Open Education Resources is a corresponding organization for community colleges. Its primary purpose is to drive the development and use of open educational resources, especially community college course textbooks. It currently has nearly 200 members. And the Khan Academy is a nonprofit organization whose library of more than 2,400 videos and corresponding instructional exercises is available for free to students and teachers to supplement learning.

Sustainability is a major challenge to the open course model. Open online courses are expensive to produce, and there is no income since the content is free. The open course model was born in a time when foundations and universities had more generous budgets. As foundation and private donor funding decreases, proponents of open course initiatives consider increasing advertising on courseware sites and offering "freemium" content, modeled after mobile application store content. In this model, some content and functionality are free while more advanced features have a cost attached.

Online Programs from Traditional Institutions

The early years of online education were dominated by for-profit institutions that were often fully online. However, traditional public and private colleges and universities responded to increased student demand for online options. Potential students may include alumni, part-time learners with jobs and family responsibilities, casual learners or fully matriculated students.

Now, under pressure to increase revenue, public and private schools continue to increase the quantity and quality of fully online classes and degree and certificate programs. When compared to for-profit institutions, nonprofits have the edge of name recognition and geographic dominance. Even for fully online programs, students may be more comfortable taking a class or course of study from an established, accredited institution with a physical campus (versus a fully online, for-profit school).

Most online degrees and certificate programs are as selective as their on-campus counterparts. In many cases, the online degree is no different from the on-campus degree. The coursework is the same and the student's degree and transcript are not specially designated.

Classes — As in K-12, classes are presented using a mix of online lecture and digital reference tools including textbooks, interactive materials and presentations. Online classes may be presented in several

ADVANCED TECHNOLOGY ALLOWS INSTRUCTORS TO DEVELOP ENGAGING MULTI-MODAL COURSES AND CREATE LIVELY ONLINE SOCIAL EXPERIENCES.

ways. A class may be offered on campus with an option to attend online. In these cases, the student may be invited to log on and view the lecture in real time — sometimes with the ability to interact with the professor and in-class students — or access a recorded session at his or her convenience. Recorded classes can be viewed online via streaming or downloaded video.

A second option is for a live class to be recorded during a previous term; there is no real-time attendance option. Lectures may be available on the Internet for streaming or downloading or on CD-ROM. Another option is to skip the lecture completely — a professor may provide a presentation with lecture notes and/or audio.

Course lessons may be supplemented with weekly live interactive sessions. Regardless of the delivery method, the student will have access to the instructor (via phone, videoconference or e-mail) for the duration of the class.

Assignments, including homework, quizzes, and essays or papers are handed in and returned to the student via a learning management system. The social aspect of learning is highly stressed in higher education online learning. Communication with instructors and fellow students may occur using synchronous or asynchronous online message boards, two-way Voice over Internet Protocol (VoIP), live chat rooms, virtual whiteboards or e-mail.

Degrees — An entire online bachelor's or master's degree from a traditional educational institution would have been unimaginable just 10 years ago. College faculty and administration did not think a rich learning experience could be delivered online, and employers did not consider an online degree to be as valuable as one achieved traditionally.

Attitudes have shifted considerably. Advanced technology allows instructors to develop engaging multi-modal courses and create lively online social experiences. Online degrees and on-campus degrees from traditional, accredited public and private nonprofit institutions are now considered to be as academically challenging as their on-campus counterparts. On the student transcript, the degrees are usually identical.

Online undergraduate degrees are often bachelor's completion degrees; students sign up for a specific online program after completing lower division and general education requirements on-campus or at another institution. Master's and doctoral degrees can sometimes be completed entirely online. Some require one or two visits to campus during the course of the degree for networking or research purposes.

Certificates — Online certificate programs are popular for post-baccalaureate or associate degree holders and working professionals who want to enhance their knowledge and skills and improve their career prospects.

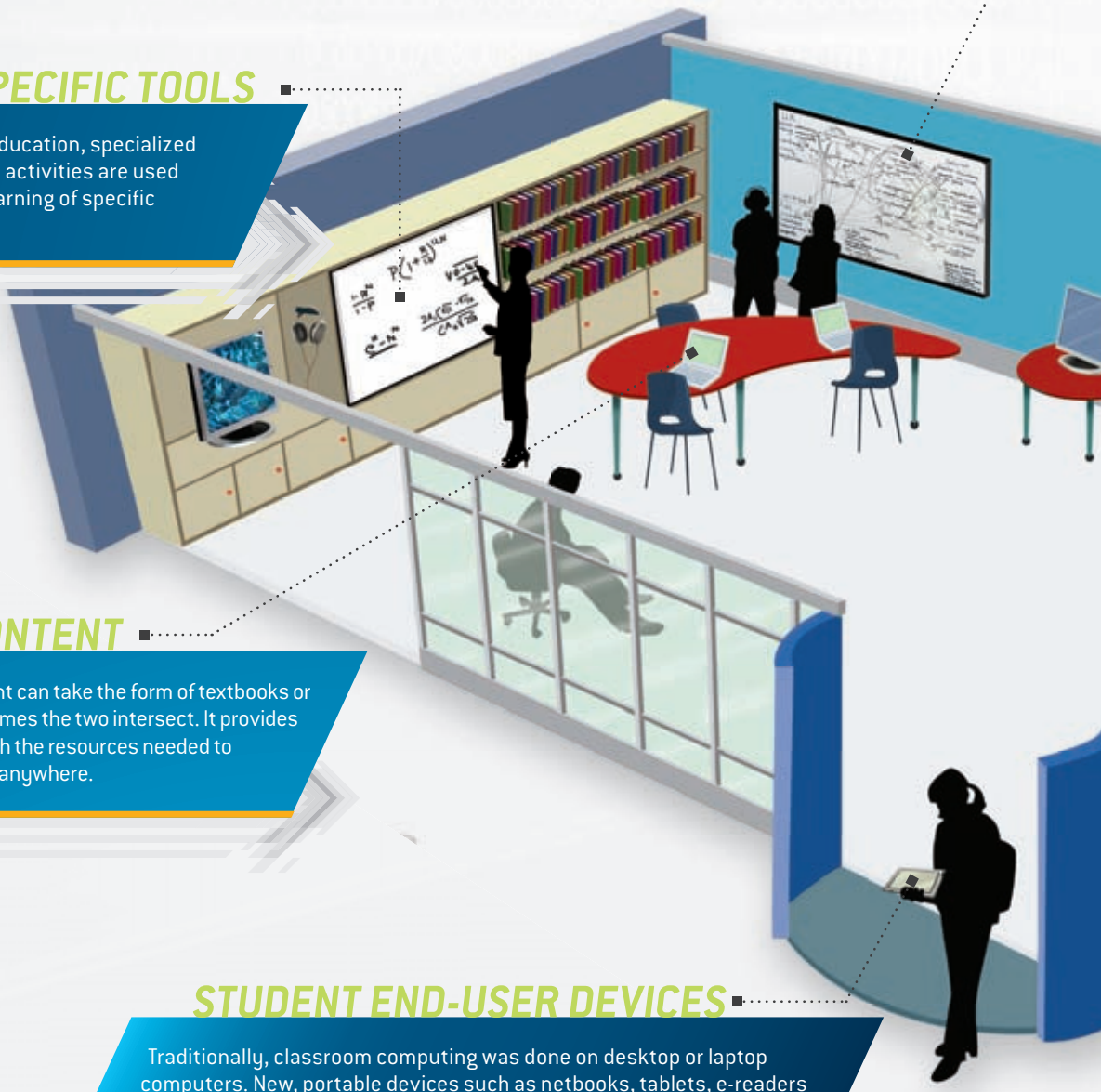
Participants typically continue to work full time while taking one class per semester at their convenience. Depending on the institution and type of certificate, completion of 5-12 undergraduate or graduate level courses is required.

THE TECHNOLOGY BEHIND THE EVOLVING CLASSROOM

Evolving classrooms differ from traditional classrooms largely because of the use of technology that creates radically different models of teaching and learning. Emerging educational environments require a variety of technology products, services and systems, including a versatile network infrastructure, collaboration and communication tools, digital content, audiovisual aids, student end-user devices, teacher tools and subject-specific tools.

SUBJECT-SPECIFIC TOOLS

In both K-12 and higher education, specialized tools or technology-based activities are used to enhance teaching and learning of specific subjects or vocations.



DIGITAL CONTENT

Digital educational content can take the form of textbooks or course curriculum; sometimes the two intersect. It provides students and educators with the resources needed to enable learning anytime and anywhere.

STUDENT END-USER DEVICES

Traditionally, classroom computing was done on desktop or laptop computers. New, portable devices such as netbooks, tablets, e-readers and smartphones are beginning to emerge in the classroom, bringing with them new computing trends — mobility and ubiquitous computing, and bring-your-own-device initiatives.

TEACHER TOOLS

To be a leader in the evolving classroom, teachers must go through extensive professional development to be able to be as proficient as their students with end-user and classroom management technologies.

COLLABORATION AND COMMUNICATION TOOLS

Collaboration and communication tools allow real-time communication and interaction among multiple locations and people and encourage sharing and collaboration on learning projects. They provide a social classroom experience for remote students and enable virtual study groups and tutoring sessions.

AUDIOVISUAL AIDS

Students in both physical and virtual classrooms benefit from the use of audiovisual aids such as classroom projectors, document cameras and interactive whiteboards since they add sensory components that increase student interest and collaboration.

NETWORK INFRASTRUCTURE

The technology and systems that comprise an educational institution's network infrastructure are the foundation of the evolving classroom. The network includes the school's broadband network and its wired and wireless infrastructure.

New infrastructure technologies such as desktop virtualization and cloud computing are beginning to be used in educational institutions. These technologies simplify the operating environment, improve security, increase productivity and allow students to access their personalized virtual desktop, including coursework and applications, from any location and any device.

Broadband Network

High-speed Internet access is the cornerstone of the evolving classroom. A high-speed or broadband network delivers high-speed Internet and phone services from the service provider to the school, what is known as the "last mile" of telecommunications delivery. Without the availability of affordable high-speed Internet in classrooms and students' homes, data does not flow freely and quickly enough to share and present large files, stream video or audio, load multi-media-intensive Web pages or Web-based software, or collaborate in real time.

Access to broadband Internet is an issue in rural and economically disadvantaged schools and households. According to a report released earlier this year by the U.S. Commerce Department, two-thirds of schools have broadband connections that are too slow to meet their needs.[27] Through the E-Rate federal funding program, K-12 institutions can apply for discounts on broadband infrastructure services.

Among higher education institutions, 90 percent of research universities have broadband connections, with community colleges lagging far behind at just 16 percent. A bill currently in Congress aims to extend E-Rate to include community colleges to bridge this gap.[28]

Both K-12 and higher education organizations require an Internet access solution that supports wireless networks, multi-media capabilities and high data security. K-12 schools need reliable, affordable

service that scales as the school grows. Colleges and universities need to provide dependable bandwidth for a range of applications, in spite of fluctuating traffic and network demand.

Wired Infrastructrure

Within the education enterprise, the cabling, switches and routers that transfer and manage Internet and phone traffic and support end-user network applications comprise its wired infrastructure. Depending on the size of the organization, it may use:

- Local area network (LAN), which connects network devices over short distances
- Wide area network (WAN), a collection of LANs that connect multiple buildings and locations in geographically separate areas
- Campus area network, a collection of LANs that connect multiple buildings and locations in a limited geographic area

These wired networks host onsite end-user devices that are connected to the network via physical cables. Online users access the network remotely using specialized communication software and security technology and protocols. The wired network also supports the institution's wireless infrastructure, which is vital to the success of the evolving classroom.

Wireless Networks

Wireless networks, also called wireless LANs or Wi-Fi networks, consist of wireless devices and access points that allow students, faculty and visitors to automatically connect to the Internet from any mobile or fixed computing device on campus.

By their nature, education institutions require mobility — students, teachers and their computing devices move among different classrooms, buildings and common areas several times a day. An institution's wireless network must be able to support the use of fixed computer labs, laptop carts, 1:1 computing initiatives and bring-your-own-device (BYOD) programs. It must also scale to the maximum number of users and end-user devices using any access point at any given time without slowing down or "hanging," and be able to reliably manage bandwidth-intensive multi-media, Internet-based learning materials and digital curriculum.

Managing a school's wired and wireless infrastructure includes operating, administrating and maintaining the networks and provisioning services and

AN INSTITUTION'S WIRELESS NETWORK MUST BE ABLE TO SUPPORT THE USE OF FIXED COMPUTER LABS, LAPTOP CARTS, 1:1 COMPUTING INITIATIVES AND BRING-YOUR-OWN-DEVICE (BYOD) PROGRAMS.

HIGHER EDUCATION PROFILE:

Oregon State University's eCampus

Oregon State University (OSU) has staked out a leadership position with a comprehensive distance education strategy that combines online classes with degree and certificate programs. Through its Extended Campus (eCampus), OSU offers a broad range of fully online classes, bachelor's and master's degrees, and certificates in the sciences and liberal arts.

OSU's extensive online academic offerings have garnered many awards.[29] eCampus has more than 700 classes in 70 subjects. It offers 13 online bachelor's degrees, including economics, fisheries and wildlife, and general horticulture; 10 graduate degrees, including a master's degree in radiation health physics and education and a doctoral degree in counseling; and five graduate certificates, including water conflict management, fisheries management and natural resources management. Participants in online classes and degree or certificate programs are given remote access to the OSU libraries, Extended Campus Student Services Center, OSU Computer Helpdesk and OSU Career Services.

Students who earn an online degree from OSU Online receive the same degree and transcript as on-campus OSU students. During the 2010-11 academic year, 386 students earned eCampus degrees, an increase from 210 in 2009-10.

resources. The wired network infrastructure must be monitored so problems can be identified and repaired quickly. Equipment and software must be maintained and upgraded. IT staff manage, configure and provision network resources, such as setting up e-mail, voicemail, and secure access for new employees. They deploy new equipment to create the least amount of network disturbance and collect and analyze usage statistics and other relevant data.

Wireless network management involves troubleshooting client device access and access point problems, fixing incorrect passwords, managing wireless traffic patterns and capacity to make real-time network adjustments, locating and eliminating security issues such as rogue access points, and configuring and upgrading access points.

Network Security

Network security helps protect students, their devices and their data by preventing unauthorized access, misuse, modification or denial of the computer network and its resources. Security experts rely on powerful antivirus and Internet security tools, firewalls, proxy servers and authentication to manage access and encryption to secure information.

Network security helps education institutions ensure their network infrastructure supports compliance with the Family Educational Rights and Privacy Act (FERPA), a federal law that protects a student's right to education records privacy. To comply with the Children's Internet Protection Act (CIPA), which requires schools to protect students from harmful Internet content such as pornography, K-12 schools must use Internet filtering technology. They may also choose to block the inappropriate use of gaming, social media or other sites or applications.

Desktop Virtualization

By allowing multiple systems to run virtually on a single physical system, desktop virtualization makes it easier and more cost-effective to manage computing resources for multiple sites and users.

Desktop virtualization is the process of separating software applications from hardware, replacing conventional desktops with lower-priced "thin clients" that have no software or data storage and rely on servers to deliver applications. Operating systems, software and data reside on a single server in the data center where they are centrally managed and administered.

With this virtual desktop, the end user enjoys a typical PC experience and isn't concerned with where his or her software and data reside. Virtual desktops make it easy to "clone" desktop environments and provision to hundreds or even thousands of users. They support the use of BYOD programs by making each user's customized virtual desktop available from any device in any location.

Cloud Computing

With cloud computing, applications and data reside in the Internet (the "cloud") instead of on a server in the school or district data center. Cloud computing services are subscription-based or pay-as-you-go, which is powerful because it provides on-demand rapid scalability and access to computing resources and applications.

By locating applications off premises (on the Internet), cloud computing decreases costs and scales as required to meet the needs of the maximum number of users. Students' assignments and data are always available from the Internet. With cloud-based applications, students in multiple locations can "meet in the cloud" to collaborate.

COLLABORATION AND COMMUNICATION TOOLS

Collaboration and communication tools allow real-time communication and interaction among multiple locations and people and encourage sharing and collaboration on learning projects. They provide a social classroom experience for remote students and enable virtual study groups and tutoring sessions.

Synchronous technologies such as videoconferencing and webcasting/Web conferencing provide an interactive, dynamic virtual classroom environment. Other tools, both synchronous and asynchronous, allow multiple people to manipulate text, projects, photos, graphics, spreadsheets and other items, regardless of geographic location. This includes Web-based applications for office productivity, file storage, voice and texting; and collaborative editing tools such as content management systems and wikis; and many others.

Videoconferencing

Videoconferencing refers to Internet-based technology that provides for two-way video and audio communication between two or more locations. In education, it improves the quality of distance education by creating a sense of social connection between remote parties and enhancing lectures. Several models are used:

- *Student/teacher communication*. Students consult with their teachers face to face in real time during office hours or a scheduled weekly appointment.
- *Virtual field trips*. Educators can arrange virtual visits to museums, observatories, laboratories, historic sites or educational facilities, which enrich the learning experience at a lower cost. Videoconferencing also allows students from different economic, social and cultural backgrounds and communities to meet to collaborate and learn from each other. Especially in rural or economically disadvantaged communities, this can open doors to previously unimagined opportunities.
- *Guest lecturers and tele-seminars*. Researchers, remote subject experts or well-known lecturers can be brought in via videoconference for a fraction of the cost of arranging an in-person lecture or seminar and without the hassles of organizing travel schedules and arrangements. A faculty member attending a conference can also continue to meet with his or her class at the appointed time.
- *Institutional collaboration*. Higher education faculty may participate in thesis defenses or collaborate with colleagues at other institutions without the expense and disruption of traveling. Researchers may videoconference with proposal review committees or grant agencies.

COLLABORATION AND COMMUNICATION TOOLS PROVIDE A SOCIAL CLASSROOM EXPERIENCE FOR REMOTE STUDENTS AND ENABLE VIRTUAL STUDY GROUPS AND TUTORING SESSIONS.

- *Multi- or intra-campus collaboration*. Faculty and administrators at large campuses or multi-campus institutions will find it easier to collaborate with a videoconferencing solution. Professors can easily teach classes on more than one campus. A popular professor can set up a separate class section in an overflow room. Videoconferencing also enables inter- and intra-school district collaboration among teachers and administrators at the K-12 level.
- *Interviews*. Videoconferencing can be used to facilitate interviews with candidates for faculty or staff positions, student scholarships and program admissions. Graduating students could schedule long-distance job interviews.

Each location participating in the videoconference needs a video camera or webcam for video input; microphones for audio input; monitor, TV or projector for video output; speakers for audio output; an Internet connection; and hardware and software that manages the network link and the compression and decompression of the video. Most systems can provide a recording of the event.

Webcasting/Web Conferencing

These tools evolved from enterprise collaboration and meeting software. They increase ad hoc student discussion and participation by providing an integrated online classroom experience.

Capabilities include live two-way interactive audio and video, VoIP, instant messaging and chat between multiple locations; the ability to share applications, websites and other content on the desktop; integration of multi-media and applications such as word processing, spreadsheet and presentation software; and virtual whiteboarding, note-taking, hand-raising and Web polling.

With webcasting/Web conferencing tools:

- Students can interact within classes and multiple classes can interact with each other.
- Teachers can create and explain homework assignments; students can discuss and complete them.
- Teachers can provide documents, course and reference materials.
- Instructors can send out notifications about events to participants or their parents.
- Teachers can restrict webcasting/Web conferencing applications to legitimate participants and take attendance.
- Participants have the ability to know who the other participants are and acknowledge each other.

A host of other synchronous and asynchronous communication and collaborative tools allow students in disparate locations to work together:

- Web-based office productivity software allows users to collaboratively create and edit documents online and work in real time with other users.
- Web-based file storage enables users to store and share files and folders with others across the Internet using file synchronization.
- VoIP solutions turn computers into phones, allowing users to make free Web-based phone calls.
- Instant messaging is real-time, text-based chatting between two or more people using a computer or mobile device.
- Online content management systems let groups of

VIDEOCONFERENCING ALLOWS STUDENTS FROM DIFFERENT ECONOMIC, SOCIAL AND CULTURAL BACKGROUNDS AND COMMUNITIES TO MEET TO COLLABORATE AND LEARN FROM EACH OTHER.

students work together to create blogs, Web pages and other Web-based content.

- Wikis are shared workspaces for collaborative editing. They allow multiple users to create and edit web pages.

Social Media and Social Environments

These can include social networks, blogging sites and discussion boards that:

- provide an interactive platform for students to share experiences, photos, video, audio and text;
- create common interest groups that can collaboratively solve problems or virtually study together; and
- enable asynchronous online discussions where text-based conversations are archived for future reference.

Educators have historically been wary of the negative possibilities of social media such as cyber-bullying, sexual predators and inappropriate material. However, a University of Minnesota study showed that students were using social tools in positive ways, such as editing and customizing content, developing online design skills, sharing creative original work and learning about safe technology use.[30]

The study's authors encouraged teachers to leverage these positive behaviors to create relevant, social learning experiences. In other words, instead of fighting social media, educators should harness its power to engage students and improve their learning experience.

If a school or district blocks popular social media sites to comply with CIPA, educators can take advantage of safe social media platforms, which are often free. Also, learning tools such as webcasting/Web conferencing and digital curriculum often integrate social media tools such as blogs and discussion boards so that students can have a class-specific social experience.

For those worried that students will waste time socializing instead of learning, consider the example of a pilot social media program developed by a Portland, Ore., seventh-grade teacher. Using social media, 20 percent of students school-wide completed no-credit assignments such as commenting on presidential speeches and making and sharing videos. Grades went up more than 50 percent that year and the school met its AYP goal for absenteeism for the first time in its history.[31]

K-12 PROFILE:

Mahtomedi Public School District

Based in Mahtomedi, Minn., the Mahtomedi Public School District serves approximately 3,000 students at four schools. The district has been committed to engineering education since 2007, when it launched its well-known engineering program to meet newly developed science standards that required engineering to be embedded in science learning.

The program first introduces students to engineering in its early childhood program. By the time they reach high school, engineering and technology skills are fully integrated into everyday learning activities. "We first introduced engineering into the high school curriculum, but we realized that was too late. So then we introduced it into the middle school curriculum — even that was too late," said Patrick Crothers, district technology coordinator. "We realized that to be effective, we had to integrate engineering into curriculum from the very beginning."

Students thrived in the new program and constantly asked for more technology-based programming. "Our students are the driver. They don't want to be empty buckets that we fill with information that they regurgitate on tests," said Crothers. "They want to learn things that are relevant to them."

So it made sense last year when the district successfully applied to be the first public school district to develop an onsite FabLab, or fabrication laboratory. The FabLab is a workshop where students can design and make anything using the latest computer-operated manufacturing fabrication equipment, such as laser cutters, CAD programs, silhouette fabricators, 3-D scanners and printers, and milling machines.

The FabLab is part of MIT's FabLab program, a global network of more than 40 fabrication laboratories using an MIT-developed curriculum and connected via videoconferencing technology for global sharing, collaborating and problem-solving. The district built the FabLabs by leveraging grants from local corporations and funding from a school bond issue that had recently been approved by local voters.[32]

DIGITAL CONTENT

Digital educational content can take the form of textbooks or course curriculum; sometimes the two intersect. K-12 schools may use both digital textbooks and curriculum, which is required because of standards compliance. Colleges and universities are looking to digital textbooks as student demand for a more economical (and less weighty) solution for educational materials increases.

Digital Textbooks

The paper textbook market has been criticized for decades. They're heavy, they're expensive and many are out-of-date by the time they arrive at the bookstores. Higher education publishers churn out updated editions every year, saddling students with outdated texts they're unable to resell. K-12 schools are stuck with 10-year old science textbooks that are badly outdated.

Current trends that bear monitoring include:

- *E-reader textbooks*. E-reader producers are developing digital textbook programs to make inroads with educators and students. Students can rent digital textbooks that "expire" after a certain time period at a fraction of the cost. Instructors can integrate e-reader applications with many learning management systems.
- *Open textbooks* are free, openly licensed textbooks offered online with the author's permission. Like open courseware and other open education content initiatives, the open textbook movement is rapidly gaining steam, particularly in higher education, although its long-term financial sustainability is in question.
- *College-driven textbook purchases*. A new model takes advantage of the bulk buying power of colleges and universities, which work in concert with content developers and brokers to charge a course materials fee for each course. The course materials are aggregated and delivered to students via an application and a common set of digital reading and note-taking tools across all content. This could dramatically reduce textbook costs. At Indiana University, the course materials fee is $35 per course, saving students an estimated $600 per year.
- *Interactivity*. To take full advantage of the features of tablets, new developers are re-inventing the textbook, adding more interactivity to textbooks, including clickable video and 3-D models. Social features are built in; the student can see what others have highlighted and noted, and discuss the reading with other students and their professor. Students may purchase only the chapters as required by the professor and when needed, instead of buying the entire book at one time.

Digital Curriculum and Courseware

Digital curriculum and courseware is used primarily in K-12 institutions, which must comply with state and national standards. It supports online and blended

learning; credit recovery; and state, end-of-year and standardized exams.

Virtual courseware includes standards-based instructional multi-media content and integrated assessment, developed for online delivery and customizable to meet individual district or school needs. By engaging students in self-directed learning, digital curriculum allows teachers to work one on one with students to address individual needs.

Many digital curriculum programs can be customized by the teacher who can craft lesson plans; develop content; create assignments and projects; and prepare and deliver online homework, quizzes and tests for in-class or online work. Many include searchable libraries of multi-media content such as full-length video and video clips, speeches, images, songs, articles and activities; teachers can search by subject, grade, type of media and state standards.

Instructors can create course Web pages for completing assignments, watching video clips, archiving research materials, taking tests and communicating with teachers and classmates. They can integrate social media such as blogs and discussion groups to create a more social experience.

Educational Video Games

These games help students learn by blending learning with one of the most popular student leisure activities. Their purpose is to encourage students to practice learning skills by making classwork and homework "fun." Educational video games have the characteristics of an entertaining video game, but grade-appropriate educational outcomes are expected.

Video games can be used to help students recall factual content and practice problem-solving. Simulation games help students learn more advanced principles such as strategic planning and decision-making. Remote students can interact with their fellow learners by participating in online educational gaming.

BY ENGAGING STUDENTS IN SELF-DIRECTED LEARNING, DIGITAL CURRICULUM ALLOWS TEACHERS TO WORK ONE ON ONE WITH STUDENTS TO ADDRESS INDIVIDUAL NEEDS.

K-12 PROFILE:

Southwest Learning Centers

Based in Albuquerque, N.M., Southwest Learning Centers (SLC) is a consortium of three charter schools that cover students in grades 4-12. The students' exposure to technology increases as they mature and graduate to the next level of schooling. Students at Southwest Primary (grades 4-6) learn reading, writing and math skills in a traditional classroom setting, with separate classes for fourth, fifth and sixth graders. They have access to state-of-the-art technology to supplement face-to-face teaching. At Southwest Intermediate (grades 7-8) and Southwest Secondary (grades 7-12), students are exposed to extensive computer-based and online instruction that expands the classroom beyond the walls of the school.

At Southwest Secondary, onsite classes are held in a main learning lab and a technology lab known as SmartLab. Students are required to attend three 3½ hour in-class teaching sessions each week and one 3 ½ hour SmartLab session. SmartLab is a technology electives lab, staffed by technology specialists that help students learn technology skills for career-readiness, such as digital publishing; engineering; video, audio and music production; laser technology, software design; and computer-aided design (CAD).

During onsite teaching sessions, all teaching occurs one on one. Students work through the online curriculum watching lectures, taking notes, quizzes and tests. If they don't master the material, the teacher provides in-person remediation. "Our teachers are all willing to try something different, because one-on-one teaching is unusual," said Robert Pasztor, director of academic support and one of the school's first teachers.

Since students are able to master content at their own pace, many students are able to begin college level work while still in high school. More than 35 percent of Southwest Secondary's 276 students in grades 9-12 are dual-enrolled in post-secondary classes, and the school boasts the largest number of successfully completed dual-enrollment courses of all Albuquerque high schools.

The students at SLC have achieved the highest test scores on the New Mexico Standards Based Assessment and higher scores on the ACT than the national average.[33]

AUDIOVISUAL AIDS

Students in both physical and virtual classrooms benefit from the use of audiovisual aids such as classroom projectors and document cameras; interactive whiteboards; DVD, DVR and CD technologies; cameras, including both digital still and digital video cameras; digital voice/audio recorders; lecture capture technology; copiers, printers, scanners and multi-function devices; and interactive tables.

Classroom Projectors and Document Cameras

These tools help instructors improve the lecture component of their courses by adding visual components that increase student interest. They enlarge visual learning components, so that students in and out of the physical classroom can clearly visualize the content.

A classroom projector is connected to a teacher's computer screen or mobile device to display presentations with embedded sound and video, relevant Web content or other multi-media content. Instructors can show students how to use specific technology applications such as spreadsheets, math software or computer programming.

Document cameras are essentially high-resolution webcams that can be used to display two- and three-dimensional objects to the class. Document cameras can zoom in on their subject so students can see the smallest details.

Students can easily share their own work with the class using the classroom projector. Via data ports, projectors and document cameras connect to multiple devices, including PCs, Macs, laptops, mobile devices, DVD players, digital video recorders (DVR) and even VCRs. When combined with videoconferencing software, they can be used to broadcast video and images and display content to online or remote students.

Interactive Whiteboard

Combine a projector with an interactive touchscreen that can be connected to a computing device, and the result is an interactive whiteboard. The interactive whiteboard allows the instructor (and students) to interact with multi-media content.

Using built-in keyboard and mouse emulation, the instructor can conduct a presentation entirely from the whiteboard. Interactive whiteboards can support pen and finger touch, and include software tools that optimize student interaction such as highlighters,

pens, rulers and other classroom instruments. Teachers can save their notes and distribute them to the class for review.

Like the classroom projector, the interactive whiteboard can be combined with videoconferencing tools to display content to online students or those in a remote classroom. Remote students in a satellite classroom with compatible interactive whiteboard technology can participate in the interaction.

3-D Technology

3-D technology adds a visual element to online content that was previously unimaginable. Interactive 3-D modules in science lab experiments, for example, provide students a safe and life-like experience. Content comes to life when presented in a 3-D format and suddenly learning about things like the solar system becomes a lot more interesting for students. More vendors are starting to offer 3-D content in the form of videos, 3-D projectors and virtual labs, and you can be sure that a lot more is to come in the future.

DVD, DVR and CD Technologies

These are important tools for presenting and sharing pre-recorded video and audio. DVD and DVR technologies make it easy for instructors to integrate educational video programming into coursework to develop engaging learning experiences. DVR technology allows the instructor to record educational TV programs and use them in class, while access to a DVD player opens the door to volumes and volumes of educational programming. CD players allow use of audiobooks and other audio materials.

In addition, DVD, DVR and CD technology is used to record, preserve and share the classroom experience. Students can use them for recording and sharing video-based homework assignments.

Cameras

Cameras, including digital still cameras and portable video cameras, are used to illustrate concepts with photos and movies. Cameras bring visual creation skills into the classroom, allowing students to create, share and collaborate using images and movies.

CAMERAS BRING VISUAL CREATION SKILLS INTO THE CLASSROOM, ALLOWING STUDENTS TO CREATE, SHARE AND COLLABORATE USING IMAGES AND MOVIES.

For example, students can use cameras to create images for newsletters, book reports and other assignments, or create slideshows or poster presentations. Using portable digital video cameras, students might create a movie as part of a literature project, or develop multi-media presentations and reports. Students can be asked to make videos that represent science and math concepts, record scientific phenomena or experimental observations, or create a digital story.

When online students submit photos and video as part of a class assignment, it can create a sense of connection with their instructor and onsite classmates.

Digital Voice/Audio Recorders

Recorders provide similar functionality for audio files. Teachers create lecture podcasts that online and in-class students can download or stream for later use. Student groups create podcasts, audio histories or narratives. Digital audio is a useful learning aid for foreign language students, or for journalism students and researchers that need to conduct interviews with students, family and community members; subject matter experts; and research participants.

K-12 PROFILE:

Florida Virtual School

Florida is an online learning pioneer. It requires all school districts to offer virtual instruction for K-12 students,[34] and accordingly, is home to the Florida Virtual School (FLVS), a fully accredited, online public high school that was the first of its kind in the country when founded in 1997. FLVS offers free online courses to Florida middle and high school students and allows non-residents to take classes on a tuition basis. More than 220,000 K-12 students (including 97,000 Floridians) took at least one virtual class through the school.[35] In 2009-2010, 66 percent of its enrolled students were from public and charter schools, 27 percent from home schools and 7 percent from private schools.[36]

A Florida watchdog organization found that FLVS was the only public school in the state that tied funding to student performance, because to generate state funds, a student must enroll, receive instruction and successfully complete a course.[37] A 2009-2010 survey of FLVS stakeholders showed that 53 percent of parents thought their student learned more in a FLVS class than in a traditional classroom format while 31 percent indicate that the level of learning is the same in both environments. Of students surveyed, 58 percent indicated that FLVS was better than the traditional classroom experiences.[38]

Lecture Capture Software

This software digitally records the classroom environment and makes it available online, where it can be used for content review; by students who miss class; or for online course development. The software program captures on-screen activity and voice.

Copiers, Printers, Scanners and Multi-Function Devices

These devices are in plentiful supply at academic institutions of all sizes. Both teachers and students — whether on campus or online — need access to printers, scanners and copiers from their own computers and mobile devices in order to share content across classrooms, schools and districts.

Print and copy management and accounting solutions help schools control their printing and copying environments more effectively, enabling distance education students to print remotely and on-campus students to use any copier or printer on campus.

Interactive Tables

Also known as an interactive learning center, the interactive table is a new category of classroom technology. An interactive tabletop surface makes it an ideal instructional tool for younger children in a classroom or computer lab setting. Multiple students work in a group at a single table, using integrated audio, video or text instructions to complete learning activities.

Teachers can plan integrated activities, develop and download their own content or use popular third-party applications. The interactive table can be integrated with compatible technology such as interactive whiteboards and document cameras.

BOTH TEACHERS AND STUDENTS — WHETHER ON CAMPUS OR ONLINE — NEED ACCESS TO PRINTERS, SCANNERS AND COPIERS FROM THEIR OWN COMPUTERS AND MOBILE DEVICES IN ORDER TO SHARE CONTENT ACROSS CLASSROOMS, SCHOOLS AND DISTRICTS.

STUDENT END-USER DEVICES

As desktop and laptop technology became faster, more powerful and less expensive during the last 10 years, the demand for the technology increased while the ratio of students to computers has steadily decreased. Traditionally, classroom computing was done on desktop or laptop computers. New, portable devices such as netbooks, tablets, e-readers and smartphones are beginning to emerge in education, bringing with them a new computing trend: mobility and ubiquitous computing, and bring-your-own-device initiatives.

Desktop and Laptop Computers

Computers change the traditional classroom dynamic by putting the student and his or her individual needs at the heart of the learning experience. In a traditional classroom without computers, students are receivers of information provided by textbooks and teachers who lecture from the front of the classroom. The entire class proceeds through lessons and assessments at the same pace.

In the computer-driven classroom — whether on campus or online — the student's specific learning needs are taken into account. Students no longer move at a single pace through the curriculum and content, which can be customized depending on how well each student has mastered the material.

Mobile Devices

Mobile devices, including netbooks, tablets, e-readers and smartphones, have most of the same benefits and functionality as desktop and laptop computers.

Their value to the evolving classroom is their mobility: they allow students to connect wirelessly from any location to access course files and materials hosted and contribute to classroom discussions. At the same time, mobile devices bring to the learning experience tools that are an innate part of the digital native's daily experience such as instant messaging, text messaging and social networking.

There are many ways to approach student device access; some are better than others at ensuring that every student can use a computing device.

- Dedicated computer labs are shared among different classes for studying and research. They are the least mobile option and allow the least level of student customization, because students share computers. If a student does not have access to a computer at home, he or she cannot fully experience the power of the device.
- Rolling carts of laptops or netbooks move between classrooms as needed. They provide a slightly higher level of mobility than the computer lab, but still do not accommodate students without computer access at home.
- 1:1 computing initiatives provide each student with a laptop or other computing device, ensuring that all students have access to a laptop during the school day, and at home if possible. Students do not share laptops with other students at the same point in time. 1:1 computing helps bridge the "digital divide" for students without home access to a computer.
- Bring-your-own-device (BYOD) programs take advantage of computing devices that students already own. By allowing students to use them, institutions can save money. The school should maintain a supply of laptops or netbooks so that students can rent a device for the school year if they don't have one.
- By providing accessories for students' devices — like portable keyboards, noise-cancelling head phones and speakers — school leaders can optimize the tools that students bring in and ensure a more consistent learning experience for all students. Providing a keyboard for students that only have a tablet is still a lot more affordable for a school than providing a laptop, and mobile apps are a lot of times free. Some vendors in the market offer device-agnostic accessories so no matter which devices the students and faculty choose, there will be accessories to support the device.[39]
- All-campus access to multiple student and faculty devices is necessary in higher education institutions, which must manage multiple devices from students and faculty and provide wireless access to students in classrooms, labs, dorms and all common areas.

BY PROVIDING ACCESSORIES FOR STUDENTS' DEVICES — LIKE PORTABLE KEYBOARDS, NOISE-CANCELLING HEAD PHONES AND SPEAKERS — SCHOOL LEADERS CAN OPTIMIZE THE TOOLS THAT STUDENTS BRING IN AND ENSURE A MORE CONSISTENT LEARNING EXPERIENCE FOR ALL STUDENTS.

TEACHER TOOLS

To be a leader in the evolving classroom, teachers must be able to use the same technologies as their students as well as classroom management technologies.

Learning Management Systems (LMS)

Learning management systems are powerful tools for administering and managing the classroom. These systems support instructors in classroom management tasks, including class scheduling; roster management and attendance; disciplinary actions; grading, creating and managing assignments; course creation; and reporting and tracking results.

Learning management systems can be tightly integrated with applications for collaboration and communication as well as digital curriculum, educational video games and textbook applications, so that relevant student assessment information and other student data are automatically populated into the LMS.

Professional Development

New classroom technologies are continually developed and older ones are constantly changing. Teachers, especially "digital immigrants," may not be as familiar with technology as their students, and must adapt to teaching using heavily technology-focused methods. It's important that current and future teachers know how to use modern learning technologies.

The most effective professional development initiatives are ongoing, collaborative and integrated with daily teaching. Most technology vendors offer onsite training as part of the implementation process, and include access to Web-based professional development and refresher courses. Subscription-based services provide schools and districts with thousands of online instructional videos and other professional development resources.

THE MOST EFFECTIVE PROFESSIONAL DEVELOPMENT INITIATIVES ARE ONGOING, COLLABORATIVE AND INTEGRATED WITH DAILY TEACHING.

SUBJECT-SPECIFIC TOOLS

In both K-12 and higher education, specialized tools or technology-based activities are used to enhance teaching and learning of specific subjects or vocations.

K-12

Foreign language students have access to computer-based and online learning labs and software that include real-time computer-assisted conversation. Foreign language websites, newsgroups, television programming and online videos can be used to reinforce skills. Via video- or audioconferencing, they can meet, converse and collaborate on projects with native language students.

English and language arts students can be engaged by using audio and video technologies in the classroom. Teachers use radio, TV and Internet audio and video segments as supplemental aids for teaching traditional materials, and students create high-tech assignments such as interviews, digital stories, movies and newsletters instead of book reports.

Technology that can be used to enhance physical education classes includes timers and heart monitors that monitor and record data about physical activity; exercise games such as Wii Fit; and sports simulators for practicing skills in golf, basketball, baseball, soccer, football and hockey. To encourage physical activity, geocaching games send students outdoors where they use GPS technology to locate and retrieve hidden items.

In science classes, videos, animation and 3-D models can be used to explain difficult scientific concepts, and students can research and create digital videos about scientific topics. Online tools can help students visualize real-time hurricanes, create virtual simulations or become involved in collaborative global science projects.

Digital sensors are used to collect ambient data about sound, light, temperature, mass, motion, force and other scientific concepts; students collect data and use software for data analysis and 3-D modeling, digital microscopes display output on computer monitors or projection screens, and can record still image and real-time and time-lapse movies that can be integrated into reports and presentations.

Younger math students use digital brain teasers and other online math games to practice and master basic math skills. Other tools include calculators, interactive software and Web-based tools for teaching algebra and geometry. Spreadsheet software enhances mathematical reasoning, computational and decision-making skills.

Higher Education

In colleges and universities, technology can be used for specific vocational training as well as undergraduate and graduate degrees.

For example, in the medical professions, a variety of technology can be used to prepare future doctors,

nurses, pharmacists and other allied health professionals. Medical professionals-in-training have access to technology that supports all aspects of patient care, including appraisal, intervention, monitoring and follow-up. Making patient data and care information available via smartphones and tablets provides students with mobile access to life-saving information.

Medical simulation relies on simulated human patients and animations to train medical and nursing students and other healthcare professionals to manage situations, emergency response, general practice, surgery, anesthesia delivery and patient monitoring.

Human patient simulations (HPS) are 3-D models of the human body that simulate physiological processes such as respiratory gas exchange; blood flow; pupil response to light; nerve response to stimuli; response to administered drugs and correct and incorrect drug dosages; urine output; and lung, chest and breathing conditions.

Software-based animated simulations of physiological processes are a step up from textbook graphics but are not multi-dimensional. Pharmacy students use video-based virtual patients to practice interviewing skills. Good interview skills produce positive patient responses while poor interview skills result in patient resistance.

Simulated patient electronic medical records (EMR) systems show nurses and other healthcare professionals how to use the EMR. Using software, students practice interacting with patient EMRs by "encountering" the patient during different time periods.

TECHNOLOGY IS THE LINGUA FRANCA OF THE EVOLVING CLASSROOM, AND IT'S HAVING A TREMENDOUS IMPACT ON THE WAY STUDENTS ARE EDUCATED.

CONCLUSION

Schools, colleges and universities must keep pace with the learning needs and styles of digital natives who use technology to navigate decision-making and problem-solving; gather and evaluate information; and connect and communicate with their family, peers and teachers. Integrating technology into the classroom is only the first step, because an initial trickle of 21st-century technologies has become a torrent that has expanded the conventional classroom well beyond the boundaries of location and time.

The next step requires institutions to understand the impact of technology on learning and use that knowledge to develop new ways of reaching students. It requires changing the classroom emphasis from the teacher to the learner by giving students more control over the delivery, location and schedule of their learning. Indeed it modifies the very definition of the classroom.

Technology is the lingua franca of the evolving classroom, and it's having a tremendous impact on the way students are educated. But while the evolving classroom may be based on technology, it owes its existence to the innovative schools, education leaders, educators and students that are using it to improve teaching and learning.

Properly implemented, the evolving classroom allows the educator to spend more time working with students and helping them learn. We encourage you to embrace it and the countless learning possibilities it enables.

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> “As schools move rapidly to an all wireless access layer, our easy-to-deploy architecture enables robust control and monitoring in today’s blended classroom environment enabling more intelligence at the edge of the network.”
>
> **Adam Conway,**
> **VP of Product Management,**
> **Aerohive Networks**

> “Today’s education is not located just in a building or in a traditional classroom. Rich multi-media, social interaction and evolving technology are morphing into a new age of the ‘evolving classroom.’ Creating confidence in this connected world is more important than ever.”
>
> **Ronald D. Partridge,**
> Senior Director, Public Sector,
> Symantec Corporation

> “The adoption of mobile computing technologies such as the iPad and the rapid rise of software-based video communication platforms is changing the very definition of the classroom. Logitech is focused on enabling The New Classroom, from face-to-face interactive teaching experiences to virtual education between distant students and teachers.”
>
> Eric Kintz, VP & GM,
> Logitech for Business

> “Traditional learning limited the teacher to deliver identical content to all 25-30 students. Alternative methods embrace more than differentiated learning, but personalized learning based upon every child’s ability.”
>
> Elliott Levine,
> Education Strategist, PSG-Americas,
> Hewlett-Packard

The Education Innovated Solutions Needed to Support an Evolving Classroom

Samsung knows that the traditional classroom model isn't enough to educate and prepare our students for the future. Learning needs to be transformed inside and outside the physical classroom. Today's students expect a more personalized and interactive learning experience.

Samsung's suite of Education Innovated solutions, including whiteboard displays, interactive monitors and video conference solutions, provides the necessary interactive tools to help support emerging models of learning environments.

These solutions are part of Samsung's commitment to improving education and supporting an evolving classroom.

SAMSUNG

For more information, visit **www.samsung.com/education**.

Samsung's interactive solutions bring countless benefits to educators, administrators and students.

Interactive whiteboards provide:

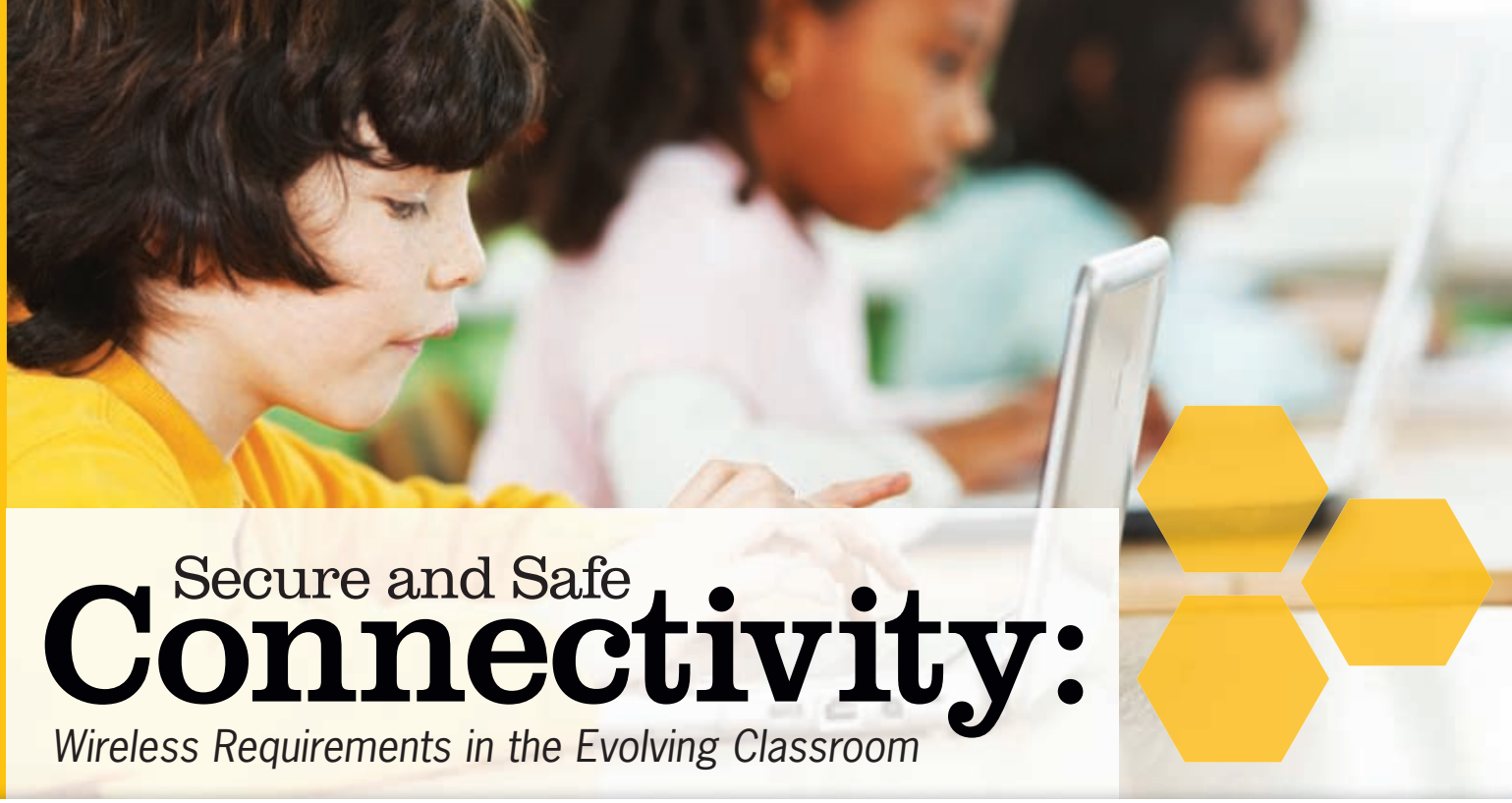
- Interaction with other digital devices
- Teacher control over access of student devices to e-board
- Ability to capture screen shots from e-board to devices
- Support for highly manipulative learning
- Support for large format video conferencing

Interactive monitors provide:

- Capability for group collaboration
- Enhanced small group instruction
- Ability for young students to manipulate shapes and letters
- Ability for students with special needs to move objects with their fingers
- Interactive kiosk monitors to direct students or to provide access to ongoing events, games, athletic records and student profiles

Video conference solutions provide:

- Support for administrative meetings in order to reduce travel
- Flexible means to deliver multi-site professional development
- Ability for virtual field trips or remote real-time instruction
- Access for small groups of students to communicate directly anywhere in the world
- An endpoint video solution to support third-party telepresence implementations



Secure and Safe Connectivity:

Wireless Requirements in the Evolving Classroom

Digital tools that improve learning — such as tablets, e-readers and netbooks — require safe, robust wireless networks. Wireless, or Wi-Fi, environments in today's technology-savvy online classroom shouldn't be restricted by space or traffic. In fact, wireless environments even provide an elegant way to get around budget-restrictive network upgrades and the wiring of older buildings. Today's sophisticated Wi-Fi networks are affordable and easy to deploy.

Aerohive Networks provides scalable wireless architecture that allows simple, centralized network management without expensive controllers, and delivers unique monitoring capabilities for classroom control. Scaling up or implementing wireless network coverage, including adding access points and network security, is more cost-effective when expensive controllers are not required. Aerohive Wi-Fi networks are also safe, secure and simple to install and maintain.

Utilize Aerohive Networks to:

Ensure student safety.
Individualized security features are important components of any wireless structure where students access content, especially on their own devices. Aerohive's networks feature standard safety features like different Service Set Identifiers (SSIDs), WPA2 encryption and restricted IP ranges. Aerohive's TeacherView monitoring application enables usage tracking and ensures student browsing control.

Connect to a resilient network.
In schools that support 1:1 device use or in entirely mobile or hybrid models, physical networks can quickly get bogged down if too many connections occur at once. Aerohive's centralized configuration and monitoring eases system-wide network policy management and allows network policies to be pushed out in an instant. Software-based management and controller-free networks reduce bottlenecks and enhance overall performance while maintaining network security requirements.

Meet budgets with less hardware.
Wireless systems mean less hardware to pay for, install and track. Aerohive employs software that allows access points to self-organize into groups, which are then centrally managed. Scalability is especially easy, so districts that want to add wireless to more schools can easily plug into existing architecture.

To read more about wireless in K-12 education, download the Center for Digital Education's "Wireless in a K-12 Environment: *Moving ahead with technology*" at **www.convergemag.com/paper/Wireless-in-a-K-12-Environment-Moving-ahead-with-technology.html.**

Track and monitor wireless use.
The TeacherView Classroom Monitoring application allows teachers to view device connectivity status and enables districts to track and monitor wireless use in schools. Teachers can disperse a Web address to all laptops in a class, or view which online resources students are accessing. These applications remove the teacher from the position of being a networking expert, and allow for more time spent on learning.

Aerohive™ NETWORKS

Aerohive Networks reduces the cost and complexity of today's networks with cloud-enabled Wi-Fi and routing solutions for medium and large enterprise headquarters, branch offices and teleworkers. Aerohive's award-winning cooperative control Wi-Fi architecture, public or private cloud-enabled network management, routing and VPN solutions eliminate costly controllers and single points of failure. This gives its customers mission critical reliability with granular security and policy enforcement and the ability to start small and expand without limitations.

Learn more at **www.aerohive.com**.

A CONSISTENT EXPERIENCE

FOR ALL STUDENTS IN THE EVOLVING CLASSROOM

Evolving learning environments require Internet-enabled devices to access digital content in and outside the classroom. Stationary desktop computers don't offer the advantages of mobile computing devices, and they're becoming obsolete. Devices like smartphones and tablets enable 1:1 programs and the necessary mobility for enhanced learning opportunities with applications (apps). However, turning these devices into robust machines requires moving beyond the limiting on-screen keyboards and touch interface. Device accessories — including portable keyboards, mice, webcams, stands and headphones — transform small screens into study workhorses. Noise-cancelling headphones and wireless tablet speakers aid study time without reducing the effectiveness of educational apps.

Logitech provides an array of accessories that allow students to transform devices into complete portable learning machines — without driving up costs. Approaching its accessories as the "last inch" between students and their devices, Logitech carries peripheral products at low price-points for major device manufacturers.

Logitech's peripheral products allow you to:

⇨ Turn tablets into perfect learning tools.
School leaders are finding it challenging to provide a consistent learning experience to all students where different devices are being used. By providing accessories for devices, school leaders can optimize the tools that students bring in and ensure a more consistent learning experience for all students. Providing a keyboard for students that only have tablets is still a lot more affordable for a school than providing a laptop.

⇨ Extend learning opportunities.
Peripheral keyboards and noise-cancelling headphones create new study spaces in any location. Because smart devices enable around-the-clock access, students use mobile devices to download and post their own material — and even start conversations through online comments.

⇨ Make it easy on users and the environment.
Students and educators are already familiar with devices like headphones, mice and keyboards — making deployment quick and simple. Low price-points mean these items have a minimal impact on student and district budgets. Tablets and accessories that are wireless or solar-powered are also energy efficient and mean no tangle of wires or cumbersome power cords. When students can access online content from their digital devices it also means less paper — translating into huge savings and no waste.

Logitech

Logitech provides tablet accessories for Android and Apple platforms. Whatever you want to do — watch, listen, surf, read, compete, tweet, shoot, navigate, connect (or even work) — we help make your world a tablet-ready place. Logitech products are distributed in more than 100 countries worldwide.

Visit http://www.logitech.com/en-us/tablet-accessories for more information.

Digital Video

Turning the lens on project-based learning

EDUCATORS HAVE LONG KNOWN that classroom projects can enrich student learning, critical thinking and collaboration skills.

To pursue project-based learning, many schools are tapping a new generation of digital video cameras and camcorders to bring history, science, language and other core topics to life — and help fully engage and excite students about those creative ventures.

For example, students at Cochrane Elementary School in Louisville, Ky., produced their own video podcasts about everything from women in the American Revolution to the development of the inline skate. The kid-friendly education videos were then posted online and available to students for free.

Likewise, for a more three-dimensional understanding of history, novice videographers at Mt. Hebron High School in Ellicott City, Md., interviewed people who lived through significant events such as the Kennedy assassinations. This novel approach engaged students in important topics and created an opportunity to give them a more well-rounded educational experience.

Video and related production add another dimension

"Instead of just writing a paper, (students) really enjoy producing a video," says Mt. Hebron Media Specialist Scott Robinson, who advocates project learning that incorporates video to his colleagues. Students also discover how to share, collaborate, budget time wisely and present core subjects in a different context, he says.

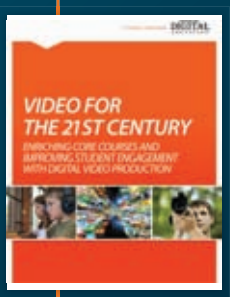
Other successful Mt. Hebron video learning projects have included:

- An English literature class production of the *Canterbury Tales*, *Pride and Prejudice* and *Hamlet*
- A student forensics class version of the *Forensic Files* show that videotaped "detectives" solving a crime
- A TV news show in Spanish created by Spanish language students

As today's classroom continues to evolve, the possibilities for tapping new and updated technologies to engage and enrich learning experiences can be endless.

Committed to enriching education

Canon is devoted to helping students inquire about the world at an ever-deepening level. Canon's easy-to-learn and use PowerShot point-and-shoot and VIXIA camcorders take stunning HD video and still photos. They're an ideal choice for schools pursuing projects that promote student thinking, learning, problem solving and collaboration — and mastering 21st-century technology skills.



To read more about how digital video can enhance instruction and teach students 21st-century skills, download the recent Center for Digital Education white paper, "Video for the 21st Century: *Enriching Core Courses and Improving Student Engagement with Digital Video Production*" at **www.convergemag.com/paper/**.

Canon

For more details about how Canon video products can enhance classroom learning, contact the Canon Education Department at **800-344-9862** or **canonsales@sedintl.com**.

Bolstering E-Learning with Unparalleled Network Security

E-learning offers amazing potential for education now — and in the future.

In the evolving classroom, K-12 and higher education students gain unprecedented access to recorded lectures, accelerated courses and individualized learning — all directly from their laptops, tablets and smartphones. A significant percentage of schools already offer online or blended courses, and nearly two-thirds see this growing trend as key to their overall education mission (Sloan/Babson College study, 2010).

E-Learning Depends on Multi-Level Security

The success of these powerful initiatives — and the ability to offer parents, school administrators and staff access to relevant online services — depends on security. That's because every open portal on an IT network can leave schools vulnerable to viruses, worms, data loss, data theft — and related privacy and compliance violations.

Unquestionably, schools will need strong network access policies. They'll also need a stalwart defense to shield their assets and help enforce those policies. Worldwide security leader Symantec is helping make e-learning innovations a reality with products that address crucial security issues:

- **Remote device management** – Updates laptops and mobile devices that access online learning by automatically pushing out security software and patches. Remotely "wipes" sensitive data on lost or stolen mobile devices.
- **Endpoint virtualization** – Gives schools complete control over related security access, and lets them monitor those operations from a single console. Students can access customized offerings and software applications via a secured Web portal.
- **Network access control** – Lets schools automatically evaluate devices attempting network access, including desktop PCs and mobile devices. Automatically blocks or quarantines suspicious devices based on pre-determined criteria.
- **Endpoint security** – Shields against viruses, malware and spam on school-owned and controlled laptops and mobile devices.
- **Data loss prevention** – Discovers and protects sensitive data from attacks and intrusions with encryption and policy enforcement. Restricts users who access sensitive data as part of school or job duties from sharing it with others.
- **User authentication** – Allows schools to control access to information. Strengthens user access security by expanding Symantec's data loss prevention solutions and data insight technology with VeriSign's identity security services to ensure that only authorized users have access to appropriate information.

E-learning is a trend that promises to provide increasing individualized instruction and added convenience, while helping schools do more with less. Symantec can provide schools with the protection they need along the way.

Symantec

Symantec is a global leader in providing security, storage and systems management solutions to help consumers and organizations secure and manage their information-driven world. Our software and services protect against more risks at more points, more completely and efficiently, enabling confidence wherever information is used or stored.

For more information, visit **http://go.symantec.com/education**.

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CENTER FOR DIGITAL EDUCATION converge

The Center for Digital Education is a national research and advisory institute specializing in K-12 and higher education technology trends, policy and funding. Along with its research services, CDE issues white papers and conducts the annual Digital School Districts and Digital Community Colleges surveys and award programs as well as hosting events across the K-12 and higher education arena. CDE also supports the Converge media platform comprised of the quarterly themed Converge Special Reports, Converge Online, and custom publishing services.

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