CENTER FOR DIGITAL EDUCATION'S

converge

Special Report

ISSUE 2

Classroom Technologies

CENTER FOR DIGITAL EDUCATION

from the publisher

As someone who enjoys playing games, watching movies, and socializing through various mediums (who doesn't, right?), I am thrilled about our latest *Converge* Special Report on Classroom Technologies.

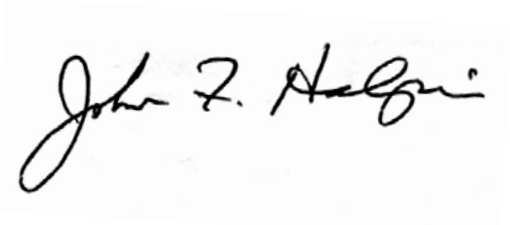
The tools available to students today that combine learning with the spirit of play are truly amazing. A classroom no longer consists of four walls with a blackboard and a lecturer in front, talking *to* students instead of interacting *with* them. Interactive whiteboards, tablet PCs, projectors and a host of other tools allow teachers to present information in ways that prompt discussion and collaboration. A classroom can now be an experience, and – through the use of virtualization, online gaming, podcasting, virtual labs and more – is not limited to a physical space.

With this Special Report, we take a peek at the constantly evolving technologies that help define the 21st-century classroom, grouping them together by function to help simplify what is out there. Through this wide array of tools, it becomes clear that the possibilities are endless to engage kids' interest – making the learning experience a whole lot more fun for everyone involved – while reaching the ultimate goal of improving student achievement and preparing them for their future lives, careers and what comes next. I can't wait to find out!

The big question in education is no longer 'What content should we teach?' It is now 'How do we teach that content most effectively?' We must arrive at that answer in an ongoing, collaborative process involving elected leaders, educational leaders and classroom instructors. Educational leaders must rally interest and support to drive the content discussion. Classroom instructors must provide the pedagogy input that brings scope, sequence and methodology to the discussion. But just as important, elected leaders must become part of the process because they need to supply the political and fiscal wherewithal to get things done. Each group has an important role to play in this process. Furthermore, these discussions must be ongoing at every level of education. As students respond to continually changing career and college requirements driven by technology, so must schools adjust to accommodate their needs.

This Special Report spotlights some of the educational technologies found in classrooms today. As schools across the country have found out, there is no silver bullet. Each institution, school and teacher must find the most appropriate technologies to meet their students' needs. At the same time they must be sure they are getting a good return on their technology spend.

Leilani Cauthen
Publisher, Converge Special Reports
Converge/Center for Digital Education



John Halpin
Vice President, Education Strategic Programs
Center for Digital Education

> INTEGRATING TECHNOLOGY INTO THE TEACHING AND LEARNING ENVIRONMENT IS POSITIVELY IMPACTING HOW STUDENTS LEARN. DELL'S CONNECTED CLASSROOM IS PROVIDING EDUCATORS WITH THE TOOLS AND SERVICES NEEDED TO PREPARE STUDENTS FOR REAL WORLD APPLICATIONS AND JOB SKILLS.

MARK HORAN,
VP AND GENERAL MANAGER, DELL

> WE'RE HEARING TEACHERS SAY THE OLD 'SAGE ON THE STAGE' MODEL OF TEACHING IS NOT WORKING FOR TODAY'S LEARNERS, AND THAT CLASSROOM TECHNOLOGIES LIKE LECTURE CAPTURE ARE GIVING TEACHERS THE ABILITY TO ACCOMMODATE THE DIGITAL NATIVES' UNIQUE LEARNING STYLE.

DAVE MCCOLLOM, EDUCATION EVANGELIST,
TECHSMITH

> BY PROVIDING STUDENTS WITH BLACKBERRY SMARTPHONES, THE LEARNING EXPERIENCE HAS BEEN TRANSFORMED INTO AN INTERACTIVE EXPERIENCE. SMARTPHONES ARE NOW LOADED WITH ROBUST LEARNING APPLICATIONS THAT PROVIDE STUDENTS WITH TOOLS THAT GIVE THE STUDENTS THE ABILITY TO STAY CONNECTED TO EACH OTHER AND TO ACCESS LEARNING MATERIAL ANYTIME, ANYWHERE.

SHELDON HEBERT,
DIRECTOR PUBLIC SECTOR,
RESEARCH IN MOTION

> AS THE DIGITAL LEARNING LANDSCAPE ADAPTS AND EVOLVES, WE ENVISION THAT THE K-12 CLASSROOM WILL BE MODELED ON COLLABORATION AMONG STUDENTS, TEACHERS AND PARENTS. WHEN WE CAN INSPIRE AND EXCITE STUDENTS THROUGH SOLUTIONS ENABLED BY TECHNOLOGY IN THE CLASSROOM, THEY WILL ULTIMATELY EXCEL AND BE PREPARED FOR THE FUTURE.

GEORGE GATSIS,
VICE PRESIDENT OF PRODUCT MANAGEMENT,
MARKETING AND DEVELOPMENT, FOLLETT

> THERE HAS TO BE A VISION FOR ADOPTION. IT CAN'T BE JUST BECAUSE THE KIDS LIKE IT; IT HAS TO GET TO THAT TRANSFORMATIVE EXPERIENCE. A LOT OF SCHOOLS ARE RIGHT NOW EVALUATING PLANS TOWARDS "SCHOOL 2.0," BUT THERE ARE A LOT MORE WHO ARE THINKING WITH A "SCHOOL 1.0" OF JUST GETTING THE EQUIPMENT AND NOT COINCIDENTALLY LEADING ACTUAL TRANSFORMATION.

NANCY KNOWLTON,
SMART TECHNOLOGIES

> USING PROBEWARE IN THE CLASSROOM CHANGES THE WAY STUDENTS LEARN SCIENCE. THEY GET TO USE TECHNOLOGY AND ANALYZE DATA THE SAME WAY REAL SCIENTISTS DO. FOR TODAY'S LEARNER, THAT IS THE MAGIC MOMENT SCIENCE BECOMES COOL.

DAYLENE LONG, CHIEF MARKETING OFFICER
VERNIER SOFTWARE & TECHNOLOGY

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John Halpin serves as the Vice President of Education Strategic Programs for the Center for Digital Education. He has worked in the public sector information technology market for over 25 years.

PREMISE

Quality learning takes place when students connect with information and can internalize it in a way that alters or enriches their thinking. In a world of rich media, instantaneous connectivity and high expectations, educators must deploy techniques that focus student attention while providing meaningful presentations that encourage and engage. This Special Report focuses on those classroom technologies that enable teachers to more effectively capture student interest, develop lifelong learning skills, deliver content relevant for each student and efficiently assess student understanding. Chalk and filmstrips don't cut it anymore.

Along those same lines, the classroom must be redefined. Today's classroom is not only that which is contained within four walls of bricks and mortar. A classroom in the 21st century is any location where a convergence of instruction and learning can take place. These new classrooms can include online sessions, collaborative sessions and other virtual sessions in addition to more traditional settings. Regardless of the setting, students and teachers expect to have access to pertinent resources that support the learning process.

In this report the term classroom refers to all of these locations. To be an effective learning locale, the site must possess appropriate technology along with other vital resources including subject content, instructional modality and assessment tools.

OVERVIEW OF THE SPECIAL REPORT

This Special Report's prime objective is to help policy decision-makers and educational leaders understand what today's classroom technologies are evolving toward, and, more importantly, why. It is hoped that examining current classroom technologies will spur conversation as to how the practice of teaching is evolving and why that evolution makes sense.

The most difficult challenge in putting this report together was to adequately address all of the key technologies deployed in classrooms today. Technologies range from tactile objects in Pre-K to hyper-dense 3D modeling programs in graduate-level science classes at research universities. They involve devices, interactive software and assessment tools. Ultimately we chose to group technologies by function as they would be used in the classroom, regardless of curriculum subject or grade level.

An important aspect of these classroom technologies is how they support 21st-century learning goals for workplace and lifestyle skills. Through the use of enhanced classroom technologies and digital content, students are working with the basic tools necessary for their future personal and professional lives. They will learn how to be discerning with the vast array of digital content and the ever-increasing modes of delivery. They will be more adept at the new literacy, a literacy that requires facility with multiple means to communicate effectively, including paper and pen.

These new classroom technologies allow for learning to be student-centered rather than instructor-centered. We have been hearing for some time that students should progress at their own rate and in the manner that best suits them. New individualized learning tools make this possible.

KEY FINDINGS

Technology is an enabler, but technology can be only as good as those using it. Expectations are high, but to achieve our goals we must be ready to meet expectations with preparation. We are poised at a new era in education. Before us lays a wide array of choices — smart devices, rich software and unique learning modalities — along with new funding structures, organizational frameworks, research and keen public interest. Never before have we had such a great opportunity to make improvements in educational outcomes than now. Federal programs are supporting change with both money and ideas. Governors and other elected leaders are offering their own reform proposals like the Common Core State Standards Initiative (CCSSI). Furthermore, public interest groups and the public in general are demanding that we improve all aspects of our education systems. This includes having more productive graduates as well as increasing transparency and becoming more efficient with financial resources.

We must remember that technologies are only tools. They should not be drivers, but enablers. Their existence in a classroom must support, not trump professional educational determinations on what should be taught, in what manner and to what outcome. To properly use classroom technologies, schools and

"OUR TECHNOLOGICAL RESOURCES PROVIDE ALL STUDENTS AND STAFF A MYRIAD OF OPPORTUNITIES TO BE REFLECTIVE, TO BE COOPERATIVE, AND TO COLLABORATIVELY EXPLORE THINKING AND RESEARCH."[1]

KURT BERNARDO, ORANGE SCHOOLS, PEPPER PIKE, OHIO

institutions must express a clear understanding of educational outcomes. They must decide upon goals, structures, assessments and processes. Once defined, they then must align professional staff and technology resources to best achieve these outcomes.

To that end, it is mandatory that educators drive improved learning by leveraging the vast capabilities of technology, not be pulled along by them. This caveat must be at the center of educational reform discussions. The K-12 education community needs to address how to provide learning opportunities that empower students to develop the cognitive skills, learn the necessary content and be prepared for the lifelong learning that the 21st century requires.

The higher education community must face similar issues. They should define the needs of their students both in the short term as well as in the long term. For instance, as K-12 schools move toward more technology-enabled student-centered learning, how will that impact the college learning environment? Will

online or blended learning models become the norm? How should instruction be adjusted to address the needs of mature learners who require ongoing education to stay current with job requirements? How do institutions control ever-escalating costs through adopting instructional technologies that are more adaptable and sustainable? These are just a few of the questions that an enriched technology environment invites institutions to consider.

1. Day in the Life of a Middle School Student

Cady is an 8th grade student in a suburban middle school. She has two female siblings, one older and one younger, and leads an active life participating in sports, music and social activities. She must compete with her sisters for time on the home computer, but she has access to computers in school in all of her classes. She has a cell phone and some of her teachers are incorporating them in their classes.

Wednesday, April 22

Dear diary,
Day started out crazy. Heather hogged the bathroom – got only 10 minutes before ride. Got to school frazzled – forgot to charge my cell – knew it was not going to be a good day. Wouldn't you know it, math class had us use our cells – used up battery – cool stuff on video about volume computations though. English paper needed work, got Bailey and Jenna to help edit it on the wireless slate thingies. Lifesavers – never understood that essay format before – got it now.

Sent B texts at lunch. I think he likes me – but had to shut down cell – battery almost gone. Science was hard – got 2 out of 4 clicker questions wrong – thought I knew this stuff, but I guess I need to study more. Cool virtual field trip to Alcatraz in Mr. Adams' class – creepy place – never knew it was used for so many things – now nothing – wonder if all special purpose buildings meet this end. I think I will write about this on my next essay. Spanish class was awesome. We talked to kids in Guadalajara – looked warm there not freezing and rainy like here, and they talked about a festival on Sunday. My Spanish is getting better.

Got to softball practice with Jennifer's mom – had to work extra hard for our game with Lincoln tomorrow. Texted mom for ride home. Texted with B all the way home, but I hate how long it takes for him to respond. Light homework tonight – once Cindy got off computer – finished science light presentation I started in class and emailed it in – worked with Bailey on math stuff. I'll get to the English paper on weekend.

Texted with Jenna and Bailey about what B said on the ride home. I can't wait for the dance this weekend.

TECHNOLOGY OVERVIEW

COMPUTER TECHNOLOGIES

It would not be appropriate to have a modern classroom technologies discussion without first addressing classroom use of computers. As we all know, the computer has taken on many shapes and functions over the past decade and all can be found in today's classrooms. Traditional desktops and laptops are used by teachers and students as an everyday tool. These computers are connected to the Internet as well as to the school's local network of resources. They are also connected to scanners and printers that enable learning objects to become digitized and shared.

Classrooms are also adopting newer computer iterations. Coming in the form of a netbook or a tablet PC, these different forms are changing how computers are used in the classroom. The tablets (sometimes called convertibles) are offering more mobility while netbooks are creating a new economic and management classroom model.

Desktops — Long a standard in classroom technology, the traditional desktop computer is still well represented in today's classrooms. They can be found in labs, on rolling carts and on teacher desks as well as in clusters in media centers. They offer a rich array of tools and access to a wide range of applications and digital content. As in business, the computer is a key tool in organizing, processing, composing and presenting educational information. As computers have become increasingly powerful — and relatively less expensive — they are deployed more widely than ever before. By the same token, computers in any of their manifestations are being taken as a given in most post-elementary educational settings.

We all know the desktop. We have come to think of it as the benchmark in computing. However, there are issues with desktops that make wide use of them in classrooms problematic. First, there is the space problem. They require a dedicated large desk surface to accommodate a keyboard, mouse and monitor along with a fixed electrical connection. The computer tower itself requires space whether it is placed under the desk or atop it. The second issue is the operating system and the applications that run on the computer. They must be kept up to date, provide a consistent experience for students who move from computer to computer, and be monitored to assure the use of licensed and approved programs. For many schools this is a daunting task because it requires IT staff to physically address each computer's needs individually.

Another issue for many schools is the cost of computers. Though schools would like to provide more 1-to-1 computer experiences for students, they don't have the money to do so. Some schools have deployed

"OUR INNOVATIVE USE OF END-TO-END VIRTUALIZATION SOLUTIONS BRINGS A KEY BENEFIT TO THE COMMUNITY COLLEGE STUDENT: AFFORDABILITY. STUDENTS NO LONGER HAVE TO CHOOSE THEIR CLASSES BASED ON THE COST OF COMPUTER OR SOFTWARE REQUIREMENTS. AND, OUR WEB-BASED ACCESS MAKES A SIGNIFICANT DIFFERENCE FOR LOW-INCOME STUDENTS WHO PREVIOUSLY HAD MANY CHALLENGES TO OVERCOME IN THEIR PURSUIT OF A COLLEGE DEGREE."[2]

DUSTIN FENNELL, SCOTTSDALE COMMUNITY COLLEGE, SCOTTSDALE, ARIZ.

multi-seat computing as an alternative. By using the multi-tasking computing power of today's computers they are simply adding additional keyboards, monitors and mice to a single desktop tower and sharing that tower's computational power. In this way, one computer equipped with approved software and access to a network can support more individual users for less money.

Thin client devices take this shared services model to new heights. Like the multi-seat model described above, each has a computer monitor, keyboard and mouse. But instead of receiving their computing power from a nearby PC, they get their computing power and applications from a centralized server. This provides a campus-wide scaled solution. Benefits of a thin client deployment include cheaper cost per station, ease of management, and the ability to reuse older equipment. Another key benefit is the ability to standardize the experience for students as they move from computer to computer.

Teachers have been helping students use desktops in classes for decades and their capabilities are well understood. However, they are a fixed resource. They provide a wealth of opportunities for learning but are limited to a fixed location and time. This limitation does not support a true 1-to-1 philosophy. In 1-to-1, students must have a consistent use of a computer whether they are in the classroom, at home or anywhere else where there is an opportunity to learn.

Virtualized desktops — When we take the concept of shared desktop computing resources to the next level, we enter into the new area of the virtualized desktop or cloud computing. Simply stated, virtualized desktops take the shared computer model a step up. Virtual desktops utilize the ability for a PC to get access to a virtualized server where it receives its operating system and campus applications. When the computing power is shared in this manner, the server is optimized for greater efficiency. Furthermore, each desktop device — regardless of age or native operating system — gives the student the same look and feel anywhere on campus. We'll include additional information about virtualized computing in the Converge Q3 Special Report on Campus Infrastructures.

Laptops — Laptops are replacing desktops in the business world. This is because business is not something that only occurs in the office between established hours. For this same reason, laptops are replacing desktops in the educational world. Learning

occurs anywhere and at any time. Today's laptops are fully featured and have become much more affordable, making them a preferred choice for many 1-to-1 initiatives. When each child has a computer, it can greatly change how learning takes place. Access to resources can be individualized. Assessments can become more instantaneous, less intrusive and more frequent. The classroom day can be more easily extended because the prime learning tool goes home with the student.

Many schools can't afford a laptop for each child. What some of them are doing is sharing laptops among several classrooms through the use of a rolling cart system. Laptops can be charged while stored in these carts in assigned slots for easy tracking. A single cart can accommodate a complete classroom with laptops and can provide connection to the Internet if necessary.

There are multiple versions of laptops. Some have been designed for student use and to provide a lower cost point. Additionally, laptop providers have greatly reduced the weight of the device, increased battery power and improved laptop ruggedness to better match student needs. As a result, when laptops are used in a 1-to-1 environment, students can carry their laptops with them anywhere. They can now work for hours without recharging while accessing the Internet wirelessly.

For most college students, a fully capable laptop is a necessity. It must be multimedia-equipped and should be wireless-enabled. These students are power users and are highly mobile. They want a laptop that can be flexible to address their various educational needs as well as provide for their personal use. Many use laptops to take notes as well as to access online resources both in and out of the classroom. They use the multimedia capabilities to collaborate with peers as well as to access a rich array of digital content and objects that enhance their learning.

The Reality of 1-to-1 — A word about 1-to-1 initiatives: Successful K-12 1-to-1 initiatives have done more than put computers in the hands of every student. Successful programs require plenty of preparation involving administration, faculty, students and parents. If all that is achieved is that students now have their own word processors and Internet access devices, then money was not well spent. Rather, all participants must comprehend that learning can now

West Des Moines Hillside Elementary, West Des Moines, Iowa
IMAGE PROVIDED BY: RDG PLANNING & DESIGN

be transformed. For this to happen, administrators must support new teaching methods and content; teachers must adapt their teaching styles; students must understand they will have more personal responsibility for their learning; and parents must acknowledge they can have an expanded role in supporting student development. Commitment to these principles will drive success.

Before implementing a 1-to-1 initiative a district should:

- set realistic goals and commit to a plan for ongoing assessment;
- create a community of support within the school environment and with the community at large;
- establish technology requirements and a support infrastructure;
- create budget and procurement cycles — include refresh for hardware and content;
- assist faculty in developing curricula that best utilizes the technology;
- develop a rollout strategy;
- roll out the program only after doing steps 1-6 above;
- provide regular assessments and ongoing faculty development support; and
- implement improvements and best practices as they develop.

Tablets — Tablet PCs are a more flexible class of laptops and have many adopters in education. Tablets are also known as convertibles because of their ability to provide both typing and stylus writing functionality on their touch-enabled screens. Tablets can be quite effective when mobility is paramount. For instance, a teacher who moves about a classroom can access all the resources of a computer and make notations through the tablet's touch screen while having that image projected onto a board for class observation. When class is over, the teacher takes this same tablet and uses its built-in keyboard to type as if it were a laptop. Tablets are most appropriate when used on the move and when space is limited — as in a lecture hall — or when non-QWERTY inputs are needed, as in math classes.

This mobility capability enables teachers and students to use tablets when doing field work — particularly in science classes or in various higher education environments. For instance, tablets are highly effective in situations where students are moving about, recording observations and accessing online resources. They are relatively light, durable and contain all the elements of a full PC. They carry a significant price tag, but for those classroom situations where they are appropriate, the price is justifiable. Tablets are becoming the device of choice for many community college, career-focused students in healthcare and emergency response. These students value their portability and touch screen data entry both on the job as well as in the classroom.

Netbooks — Netbooks are a relatively new PC category. The best way to define them is that they are a smaller, less expensive notebook with somewhat reduced capabilities. In fact, some manufacturers are calling them mini-laptops and are adding capabilities all the time. Netbooks are becoming a popular device for schools looking to meet their 1-to-1 goals and some are reporting success. The concern many have, however, is that once the student moves out of elementary/middle school the netbook's limitations may not support the advanced student's needs. For instance, secondary schools utilize enhanced applications that will become even more power intensive over time. In addition, these older students regularly engage in richer multi-tasking efforts in support of their collaborative learning.

Printers — Printing has evolved in classrooms as well. As the computer was becoming more widespread a decade or so ago, prevailing wisdom would have us believe that we were entering a paperless age and that printers were dinosaurs awaiting extinction. That has not been the case. What we have seen is that printers have evolved to provide schools smarter options. For instance, printers have developed better control and cost containment capabilities. No longer must each classroom computer connect directly to a printer to be able to print. Today's printers leverage school networks to provide a smart computer deployment, greatly reducing the number needed.

Furthermore, new printer management control software offers schools additional benefits. Schools can contain paper and ink costs by limiting printing functions to authorized users through pass codes. They can also control costs through pass codes to limit color printing only to those applications that require it. Pass codes can also help protect student confidentiality. When teachers or staff send a series of documents to the printer, the printer stores those requests. It will not print until the authorized user enters the pass code at the printer. This assures the right person will be there to retrieve the document, and it won't be left unattended on the printer.

The cost of consumables is being controlled through more ink options and lower cost laser options. Furthermore, printers are becoming multiple function devices that not only print, but scan, copy and fax too. This greatly expands classroom capabilities as students and teachers look for multiple options to communicate and to acquire digital content. There are additional benefits to a managed printing program that will be addressed in the Converge Q3 Special Report on Campus Infrastructures.

HANDHELD TECHNOLOGIES

Handheld devices come in multiple formats and perform an array of services. Most of these devices are single purpose and many are proprietary and can only be used in a closed software environment. They range widely in price. These tools offer enhanced learning opportunities that can enrich student learning.

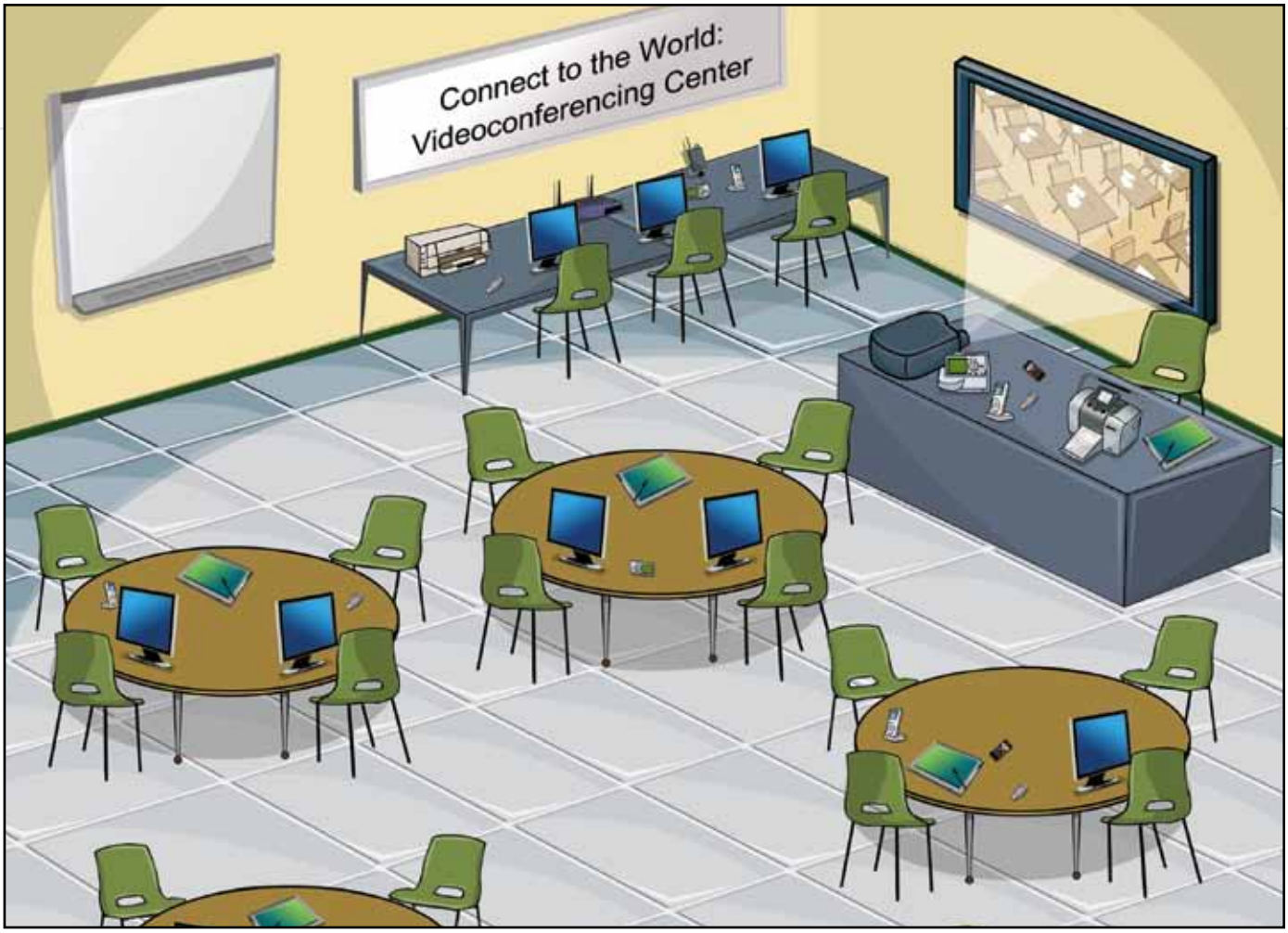
E-readers — The hottest technology topic right now has to do with the handheld e-reader. There are a growing number of such devices on the market today ranging from proprietary content delivery devices found in consumer applications and elementary schools to much more sophisticated models. Whether e-readers are helping children learn how to read and do math or they are providing a downloadable e-book platform to store and read textual materials and objects, they replace a bound paper book.

E-readers have memories that can hold large quantities of texts in a single easily portable device. Some have annotation capabilities that can assist in note taking as well as for study review. They do not, however, replace a more robust desktop/laptop/tablet computing device as discussed above. Students will choose to use e-readers to augment, not replace, their everyday computer. Without a camera, keyboard or USB port — and with few applications and limited bandwidth — this becomes a niche product for most students.

Another issue facing e-readers today is the limited courseware available for these devices. This is certainly something that can be addressed in time and many are working on it from several angles. Some are looking to enhance the flat text with interactive files. Others will provide applications like study guides and sample testing. Yet others are preparing to offer students the choice of buying only the chapters they need rather than the whole book. But for now, no textbook publisher is selling content in digital format to students.

ONCE TEACHERS UNDERSTAND HOW TO LEVERAGE CELL PHONE CAPABILITIES WHEN DESIGNING THEIR LESSONS, THEN STUDENTS GAIN A LOW-COST, HIGHLY INTERACTIVE TECHNOLOGY TO ENHANCE AND STRETCH THE CLASSROOM EXPERIENCE.

What is available to students is a subscription-based service offered by only one company. They charge students a fee for a limited time use to 10,000 textbooks including titles from the five largest textbook publishers. The real issue today on college campuses is that content is too expensive. Used books are easily accessible from multiple national vendors and compare favorably to existing e-reader options. In spite of these limitations, the technology has its early adopters. A handful of institutions have announced plans to adopt e-reader technology for their campuses, but most institutions are holding off. They want to be sure there will be sufficient content that is readily available and in a standards-based format before committing to use.



In the end there is a trade-off between flexibility, capability and cost. What will schools and students be willing to pay for the convenience of a light and portable device that merely augments a traditional computer? Will there be ample digital content available for these devices? Can these devices enable collaborative opportunities? Will that content be more than a digital version of a standard textbook? Will learning management systems support and interact with e-readers? Only time will tell how widespread their adoption will be.

Cell phones — Cell phones are probably the most controversial technology for classrooms today. Opinions range from 'they should be banned' to 'they should be embraced'. Schools and institutions have long struggled with cell phone policies and reflect this quandary as to whether they are a distraction and nuisance or can be part of the classroom learning environment. Each school and institution must draw its own conclusion and implement policies reflecting that conclusion.

Putting that discussion aside, let's investigate how cell phones are being used in schools and institutions of higher education. First it must be stated that today's cell phones are truly multi-function devices. They contain the ability to voice, text and stream video in both directions. They are truly interactive in every respect. They are ubiquitous and can operate in places where school networking may not. This set of capabilities must be fully comprehended when considering how they can augment learning.

One cell phone benefit is its ability to provide a collaboration platform. Speaking tongue in cheek, some would say students collaborate too much on their cell phones for non-academic pursuits and that is why they must be banned in classrooms. But if we take this from a positive perspective, cell phones allow students to use a device they already own and know how it can access information, share ideas,

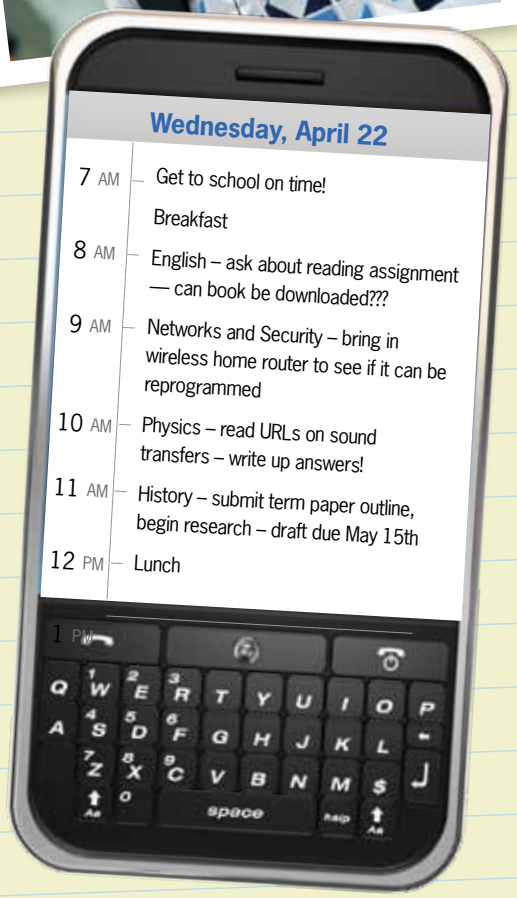
SOME STUDIES HAVE SHOWN THAT THERE IS UP TO A 30 PERCENT IMPROVEMENT IN LEARNING WHEN CELL PHONE INTERACTIVITY ACCOMPANIES LEARNING.

connect to resources, and compare results. They can use cell phones anywhere at any time. Once teachers understand how to leverage cell phone capabilities when designing their lessons, then students gain a low-cost, highly interactive technology to enhance and stretch the classroom experience.

Additionally, cell phones can serve other classroom functions whether in person or online. Some institutions are using the texting capabilities of cell phones to act as classroom clickers as described below (see personal response systems under Assessment Tools). They have further enhanced this instant feedback capability by tying cell responses to the institution's learning management system. (See the benefits described in the personal response section below.) Furthermore, some professional graduate school professors are using cell phone devices to push case study assignments to students as late as a day before a class meeting. When incorporated into a secure server and tied into the learning management system;

2. Day in the Life of a High School Student

Mike is a junior who likes technology and is taking IT career courses at his urban magnet high school. His school has a 1-to-1 program in which each high school student has a laptop. He can connect to the school's learning management system remotely, so he always has access to school resources. He has his own laptop at home and spends evenings doing homework while chatting with friends online. He wants to pursue computer science in college. He participates in baseball and track. His track coach has been using video at practice to help him with his high jump technique. He also has a cell phone with Internet access that he uses to text his friends – he sends on average 10,000 texts per month – and to check his Facebook updates. He also uses his phone for class activities when allowed.



West Des Moines Hillside Elementary, West Des Moines, Iowa
IMAGE PROVIDED BY: RDG PLANNING & DESIGN

business, law and medical students can react quickly to the material and share information in a secure manner. For many of them, this is a realistic professional experience since this replicates how business, law and medical professionals interact on their jobs.

In the K-12 environment teachers are using cell phones to drive customized material to students. As an example, in advanced high school math classes, students get problems pushed to them that are individualized per student. Students are encouraged to collaborate but since each must solve a different problem, they collaborate on the process, not the answer. This assures that they don't simply get the answer but work the process so they can get their unique answer. In another instance, a science teacher can push a video stream to the students describing a problem to be investigated. This not only better engages the student in the problem, it personalizes the learning. Some studies have shown that there is up to a 30 percent improvement in learning when cell phone interactivity accompanies learning.

An additional benefit of cell phone technology is its ability to reach beyond the classroom to engage students. This enables peer collaborations to expand in a way that can broaden and enrich the learning experience. Most of these benefits could not be attained through any multi-function device connected to the

"STUDENTS MAINTAIN A HIGHER LEVEL OF ENGAGEMENT IN CLASSROOMS WHEN THE TEACHER'S VOICE IS ENHANCED IN THE CLASSROOM OVER SPEAKERS AND THEY KNOW THEY WILL HAVE TO RESPOND TO QUESTIONS WITH CLICKERS."[3]

CONNIE BAIN, VESTAVIA HILLS CITY SCHOOLS, VESTAVIA HILLS, ALA.

Internet. What makes cell phones unique are their transportability, ubiquity and ready availability.

Some schools are even looking to cell phones as a super low-cost 1-to-1 solution. They believe that putting cell phones in each student's hands can accomplish their goals and still keep costs down. Telecommunications carriers are piloting with schools to do school-year service agreements that leverage carrier capabilities. One of these capabilities allows the student access to only school-approved resources. For those schools concerned with Internet safety, there is commercial software available that can monitor class interactions. This would require parental approval to implement.

Calculators, language translators, etc. — This more traditional set of technologies must not be ignored. Students and faculty still use a wide variety of traditional single-purpose devices to enhance classroom instruction. These range from handheld calculators to language translators to metronomes for music classes. Most have specific applications written to support particular learning environments. For instance, there are several math calculators to choose from, each designed for specific student needs, whether in the subjects of math, science or business. There are various devices that can assist foreign language learning — including English as a foreign language — that can help with translations, assist with pronunciation and deliver rich content to enliven the learning process. Many of these functions can be had on a number of multi-function devices, but the beauty of these devices are that they travel with the student and are available instantly when needed.

Portable players and MP3-type devices — Mobility is desired; rich content is expected. Schools and

institutions are finding more ways to meet those desires and expectations by leveraging devices that students already own. Multimedia lessons are being pushed to students who download them onto these personal devices for viewing and listening at their convenience. These include full lectures that have been recorded and can be viewed on a portable multi-function device whenever the student desires.

Language arts instructors are using portable device video and audio capabilities to present sketches and scenes for students to critique. Likewise, teachers are helping students sharpen their expression by encouraging them to share videos with classmates on these devices. High school history and science teachers are pushing podcasts and video content to students as they prepare for exams. In addition, community college foreign language instructors are using podcasting to support listening and speaking skills with online students. Podcasting allows the instructor to hear the student, and vice versa. Tapes don't need to be mailed and the student need not travel to a campus language lab.

AUDIO VISUAL TECHNOLOGIES

We are defining audio visual technologies as those that play and display content for a large group of students including the entire class. This paper discusses the need for technology to support student-centered learning, but it should also be remembered that there are benefits to traditional teacher-centered activities as well. Classroom technologies can enhance these more traditional experiences and make class-wide activities more effective.

Display technologies — The first group of A/V technologies we will discuss are classroom display devices. These include interactive whiteboards, handheld projection display devices, TVs, projectors and various image display technologies. Some are new and some have been in classrooms for decades. What is important to understand is how their new capabilities can enhance learning.

Interactive whiteboards — Probably the most deployed digital technology in the past decade after computers is the interactive whiteboard. The whiteboard is found in over 28 percent of classrooms in the

United States today according to a recent study. Their ready adoption can be attributed to their familiarity factor. They look like the chalkboards they have replaced; you can write on them like chalkboards (using special pens or just your finger) and they center attention to the instructor which is a comfortable teaching model for most instructors. To all this familiarity they also add the ability to interact with PCs. They interact with projected images from a classroom projector by capturing work and providing these images for student interaction onto their computing devices. They allow for full class as well as sub-class instruction. For all these reasons they have been a good way to bring PC-driven technology to the classroom for many schools and their faculty.

This is all good. However, technology adoption must not stop there. For many classrooms, an interactive

"PORTABLE ELECTRONIC COPYBOARDS HAVE BEEN DEPLOYED IN ALL OF THE COLLEGE'S TUTORING LABS WHERE STUDENTS CAN INSTANTLY COPY WHITEBOARD CONTENTS TO A FLASH DRIVE. THIS REPLACED ROLL AROUND CHALKBOARDS."[4]

MICHAEL ZIMMERMAN, MACOMB COMMUNITY COLLEGE, WARREN, MICH.

West Des Moines Hillside Elementary, West Des Moines, Iowa
IMAGE PROVIDED BY: RDG PLANNING & DESIGN

whiteboard might be all that is necessary. Only the grade level and curriculum needs can determine whether it is so or not. However, for many classrooms at all levels this is just the starting point. The interactive nature of whiteboard technology must support student learning initiatives including cooperative, hands-on, and discovery learning processes as we move from teacher-centered learning to student-centered learning. This transition requires teachers and instructors to get training on best practices in their professional development programs. Teachers must learn how to use the interactive software and its integration with the learning management system to manage activities created from the interactive whiteboard. Better training and simpler implementations will benefit heavily strapped district and campus technical support staff as well.

An adaptation of the interactive whiteboard is the wireless slate. The benefit to this low-cost technology is that it allows students working in small groups around the room to interact with each other in a similar way the class-oriented whiteboard does at the front of the room.

The whiteboard concept has been expanded by software developers to provide a collaboration technology. This collaboration platform offers the whiteboard look and feel for student peer or teacher interactive sessions. Collaborations can involve interactions like solving math problems or jointly proofreading an essay. In a similar fashion teachers can use this technology to easily communicate and share ideas with each other.

Wireless slates & interactive pens — A few manufacturers now offer a mobile handheld device that interacts with electronic whiteboard and document projector technologies. These devices come in various form factors. Some are small slate boards that can control presentations and provide interactive responses wirelessly, making them extremely useful in a mobile classroom. Other devices are referred to as interactive pens which enable teachers to move about the classroom while interacting with a projected image.

These devices can also work with document cameras to project images to any surface in the room, further supporting small group instruction. The interactive device can also be used by students in groups to assist in their collaborative learning. Both wireless slates and wireless pen technologies are quite inexpensive. They can be a way to more cost effectively equip a classroom with interactive projection technology.

Projectors — Classroom projectors have evolved from the opaque, 16mm movie, slide and filmstrip projectors of our recent past. Now projectors offer direct connectivity to computers for full video and sound derived from any digital content source on campus or over the Internet. Teachers can project video images captured live from within the classroom or streaming from an offsite location. For instance, a science class can use cell phones in the field to stream sound and images from an onsite experiment back to the classroom for projection to the entire class. When equipped with a good sound system, digital projectors can excite students by bringing life to flat topics.

Projector technology continues to improve. Cost of ownership continues to decline as manufacturers offer more alternatives. Until recently, projectors were either installed in ceilings or rolled on carts to the middle of the room in order to provide the lens distance needed. Newer technology allows for short throw projectors in which the projector can be mounted to the wall just inches away from the screen. Not only does this save space, it reduces the cost of implementation because ceiling mounting and cabling costs are eliminated. Furthermore, short

throw projectors eliminate interference shadows and light in the eyes of someone who gets between the projector and the screen.

Interactive projectors are also replacing electronic whiteboards in some classrooms. This is because they offer an increased image size and provide greater flexibility. Some schools can even save money if they don't have to purchase both a whiteboard and a projector for each room.

Instructors, particularly those in higher education, must be careful to use projector technology properly. Students have complained that slide deck presentations can be boring if they run the entire class — especially when lights are dim. Therefore, it is important to make sure projector presentations are set up properly with engaging content (embedded streaming or interactive questioning) and good environmental conditions to keep students interested and engaged. Text-laden presentations do not fly, nor do they leverage the equipment's fullest capabilities.

Another type of projector is the document camera. This can be a highly effective device when the entire class must view a small image or object. Newer imaging software enables the document camera to capture notes that were written on a screen and to save them as a digital file. These files can be available to students for further study. Document camera adoption is growing. Some classrooms are also using the LCD Projector in a similar manner. This use provides greater teacher and student flexibility to record class activities and to record individual projects.

Another camera used in schools is the handheld video camera. Teachers have found these small handheld digital devices capture HD quality video and are easy to use and are priced at under $100. Video content can be stored or fed live via a USB interface. Students can edit their shoots on a computer by adding music and to create a personalized presentation. Teachers are using these cameras to record student activities like reading, speech making and other presentations at different points of the school year and then playing them back to students to observe progress.

TVs and Large Monitors — Even before the Internet, classrooms were connecting to the outside world with technology. One of these technologies was the television set. With the diffusion of cable TV came many educational services that were run over cable to the classrooms. In fact, one of the first classroom technology modernization efforts was the effort to equip classrooms with coax cable to accommodate cable TV. Television capabilities were enhanced when VCRs were attached to the TV to play recorded devices.

> "ALL WORLD LANGUAGES CLASSROOMS HAVE VIDEO CONFERENCING CAPABILITY THAT ALLOWS STUDENTS TO INTERACT WITH STUDENTS FROM OTHER COUNTRIES IN REAL TIME. EXAMPLES INCLUDE ARABIC STUDENTS IN EGYPT AND SPANISH SPEAKING STUDENTS FROM MEXICO."[5]
>
> THOMAS GLASER, HOWARD COMMUNITY COLLEGE, COLUMBIA, MD.

Schools are still installing TVs today. However, their use is changing. The Internet connection to digital monitors and overhead projectors make the traditional use of TVs a marginal technology. What today's classrooms are using TVs for is to provide an enhanced image, especially 3D, where visually sensitive content requires excellent resolution and the ability to see in three dimensions. When connected to a classroom computer, the TV acts as a monitor for class viewing. STEM classrooms have found this useful where experiments, dissections and astronomical representations in 3D or high definition make a big difference in student interest and comprehension. Today there are two types of 3D TV technologies — both requiring viewers to wear glasses. One offers a less expensive TV but requires more expensive glasses. The second provides a more expensive projection technology TV, but requires much cheaper glasses. Each school must assess what makes most sense for its needs.

A new integrated monitor has arrived on the education scene. Designed to leverage virtual desktop applications, this monitor has USB ports to accommodate mouse and keyboard and has built-in speakers. All of the computer processing occurs in the back

rack, so there is no fan noise and limited heat at the monitor. Because there is no resident memory, it is an excellent solution for security-sensitive applications found often in higher educational settings. When the user logs off, the data is gone forever.

Smart Classrooms — A word about 'smart classrooms'. This term came up repeatedly in our college technology interviews. Although the specific technologies may differ somewhat from campus to campus, in general a 'smart classroom' is one that has been equipped with the proper baseline level of technology that an instructor can expect at that school. So, regardless of where the class meets, the instructor can expect to have a standard set of technologies that he or she is accustomed to using. These technologies generally include a multimedia podium equipped with a microphone, a computer with monitor, connection to the Internet and to the room's projector and sound system. The room will also have a ceiling mounted HD projector, pull down screen and VHS/DVD player.

Some campuses offer an 'enhanced smart room' as well. These rooms would have the equipment mentioned previously but might also offer a document camera, room camera, media control unit or other devices that the school would deem fit. What is important is that in institutions where instructors move from room to room, there is a consistency in what technology will be there for them. Scheduling becomes simpler, training is reduced and course offerings become more consistent.

AUDIO VISUAL HARDWARE AND SOFTWARE

Presentation tools — This is an area that has developed greatly in the past decade or so. Teachers are demanding better content presentation software as they are creating more engaging lessons through technology. As a result, instructor-led presentations have moved beyond the text, video and lecture. They have also moved beyond paper and texts for students. What we have today are learning presentations given by both instructors as well as students that are as varied as the subjects they are studying.

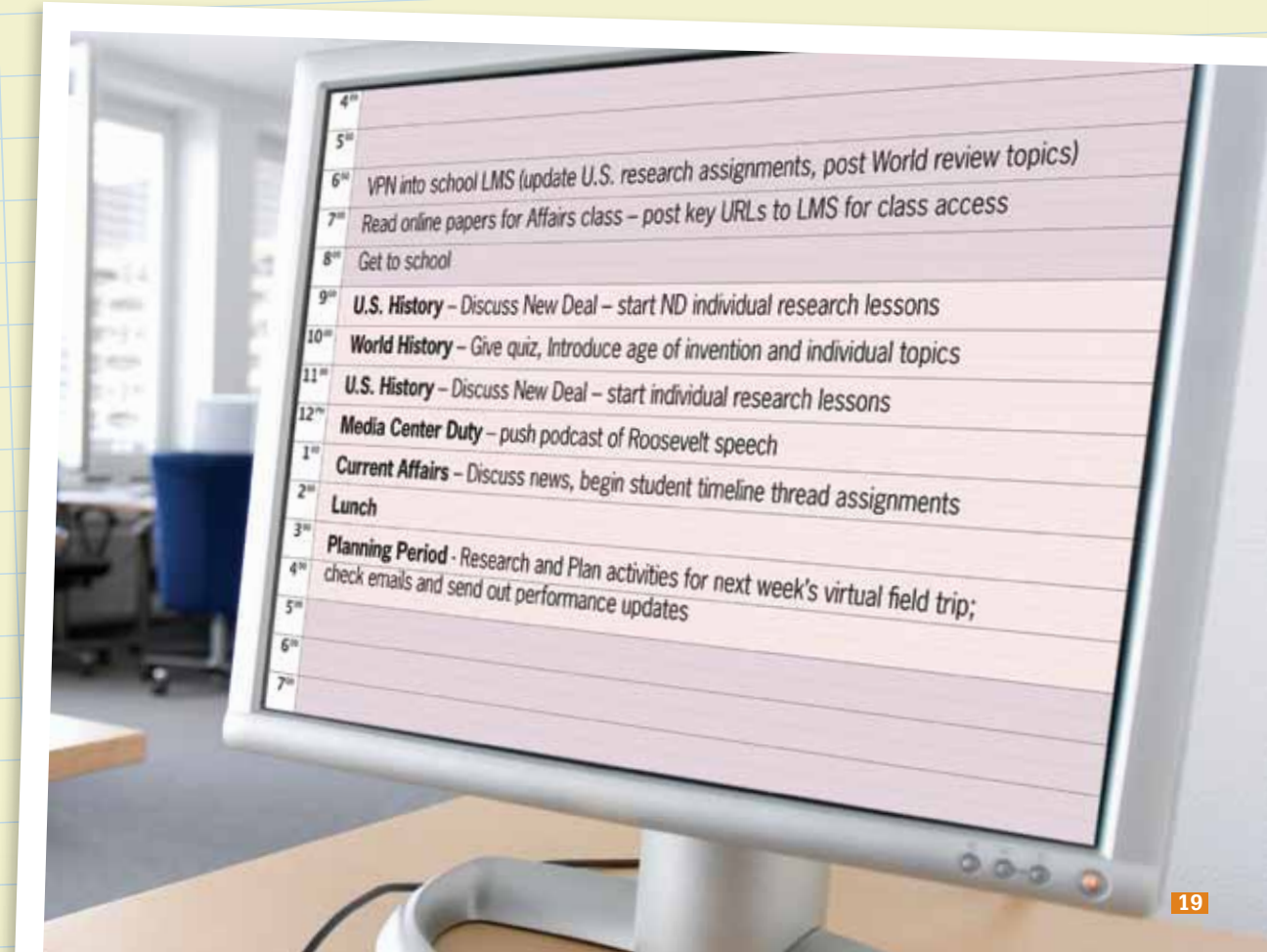
Multimedia presentations reside on computers and other multi-function devices. They allow instructors to create and present their own content or use something already created from a vast virtual vault of content on the Internet. Standard business-purposed software suites from major software manufactures are often used to enhance a lecture-driven instruction. These presentations are enhanced with embedded video clips, full sound and cool screen shots that are inserted for effect. There are software companies who specialize in education-specific presentation solutions that make this a simple drag and drop capability — allowing any instructor to produce effective presentations without technical support. Instructors are now embedding audio and video feeds into their lessons from a wide variety of sources, including student-produced work.

Likewise, students are now able to stretch beyond pen and paper to create their own presentations that not only show understanding but also facilitate peer collaboration. Inexpensive software, cameras and sound equipment are built into many of the multi-function devices to which students have ready access. Other software tools allow students to snag video and sound from various sources and utilize it in their presentations. Not only does this make learning more fun, it actually enhances their 21st-century skills by making them better ready for careers and college.

Lecture capture — Schools are adopting lecture capture at a rapid pace. They are using these recorded lectures to either stream them live or stream them on demand. In the past when high quality lecture capture was required, a school or institution would need a specially designed room that was acoustically conditioned and equipped with tilt-zoom cameras, high quality sound systems and special lighting. These well-equipped rooms also required special equipment to handle feeding images from electronic whiteboards and digital projectors onto the video stream. In addition to being very expensive, these highly outfitted rooms required special technical skills — not only for the instructor but for the post production team who put the final product together. In spite of their costs to build and maintain, when high quality productions were needed this process was worthwhile. More often these rooms were found in limited number on higher education campuses where lectures were recorded for posterity or shared among a number of other institutions.

3. Day in the Life of a High School Teacher

Paul is a middle-aged social studies teacher who has taught for 30 years in the same high school. He has seen a lot of change and is adjusting to new teaching techniques technology offers. Often feted for his content knowledge and way with students, it has been difficult to adapt his successful teacher-centric style to a more free-flowing student-centered learning style. He has enjoyed bringing new teachers under his wing. He helps them understand the teaching process; they help him understand how technology can enhance that process. He teaches two world history classes, two U.S. history classes and one current affairs class.



Technology has advanced to the point now that high quality lecture capture can be done more cost effectively. Newer lecture capture-enabled rooms come ready for an instructor to plug in his or her laptop and start the cameras and microphones rolling. The lesson can be streamed live as well as stored. Once a room is set up, scheduling class recordings can be done simply. The instructor need only pre-schedule a session on the room capture appliance and go to the room at the designated time and the room is ready for action. Once his or her laptop is connected and the session button is turned on, the lesson is captured. All lighting conditions, software interfaces and post-production tasks are captured automatically. Once recorded, students can directly access the lesson from a course management system. This high quality lecture capture technology is being used by higher education, particularly professional graduate schools.

When very high quality lecture capture is not as important as the ability to capture lectures anywhere and at any time, yet another solution is being adopted. Software now is available to make simple lecture capture easier and less expensive. This technology utilizes the power of most laptops today to be the lecture capture and post-production studio. Using this software, lectures are recorded through the built-in microphone and camera either attached to or on a laptop. These lectures can be enhanced with digital presentation materials that are fed into the laptop from any digital device like a projector or an electronic whiteboard. The key ingredient here is that any instructor can simply start the lecture recording from a laptop and then stop the recording when finished. The laptop software does all the coordination. Instructors are comfortable with this technology because it does not interfere with their presentations and it works automatically without the need for technical staff hovering about.

Once the lecture is captured it is sent to a course management system for archiving and student access. The equipment and services supporting this technology can either reside on campus in an institution-owned server, or could be provided by a service provider over a shared cloud or virtual network. Colleges have reported that lecture capture has increased student retention because they can view classes anytime their schedules allow. This is especially so for part-time students who may be juggling jobs and a family at home. In addition, this has enhanced the ability for distance learners to get a more personal classroom experience.

The most reported use of this technology has been for students that have seen the lecture live, but who wish to use these lecture captures for test review. To make this more effective, some lecture capture services offer a bookmarking capability. Students can click on a course topic from the lecture management system and get precisely to the spot in the lecture where the topic can be found. They don't have to preview the entire lecture to find it. Other uses include English as a Second Language students and science students who can slow down or stop the lecture for better understanding.

Video capture — Closely akin to lecture capture is video capture. Just as with lecture capture, great strides have been made in providing portable, easy-to-use high quality video recording capabilities. These newer video capture solutions integrate software with cost-effective hardware onto a laptop for mobile, high quality, fully functional video capture. What does this enable? How about high quality, high-definition school announcements and news broadcasts? Or TV-quality broadcast feeds of high school football games over the Internet or captured for later viewing? How about being able to insert graphic images and tagging in real time just as TV broadcasters do?

Schools are embracing this technology because it has so many uses and allows students to experience professional quality outcomes. They are inspired to write news reports. They want to video school and community events. They like to share their work with peers as well as the recognition this can bring them. At the high school level not only are classroom activities benefiting from high quality videos, but athletic teams are using video capture to raise money from sponsors from their team broadcasts.

In addition, video capture companies are making video productions simpler to use and they are providing curricula materials to get teachers started. These materials cover academic levels from elementary to college.

Sound enhancement technologies — Much of what we have discussed so far has involved visual technologies. It must be understood that proper sound amplification

is important if students are to properly stay engaged and pick up what is being said. As classes get larger and more collaborative learning takes place, there is going to be more ambient noise. Audio enhancement solutions must be able to cut through that. Studies have shown that learning is improved when classrooms have good sound conditions.

More than 30,000 classrooms in the United States now use some sort of sound amplification solution. These systems can be as simple as positioning additional speakers to amplify the teacher's voice captured from a microphone. More enhanced solutions involve integrating a speaker system with other A/V devices like visual projectors and DVD players that can automatically lower the volume when a teacher speaks. In this way, a teacher can talk over the presentation and let the system automatically resume normal volume levels once the teacher stops. This helps to avoid confusing babble when two speakers compete for air time.

Video Conferencing — Video conferencing technology is worth a mention here because it can be especially useful for distance learning. Until recently, video conferencing was only found on those campuses where its high overhead and technical support requirements could be tolerated. Generally speaking, those involved higher education professional schools, research labs and other such pursuits where real-time collaboration was needed. That has now changed. Today's video equipment is more flexible to set up and easier to use which opens the door for more widespread classroom opportunities. Since this is a limited campus-wide solution, video conferencing will be discussed further in the next Special Report when we discuss Campus Infrastructures.

ASSESSMENT TECHNOLOGIES

Assessments have come to mean more than testing in the traditional sense. They are not just a series of test questions that require answers following a course of study. They have truly become a part of the ongoing learning process. What educators need to know is what progress is being made. Is a student moving the needle from unknown to known? Does a student need additional support to comprehend a topic or does the student already grasp the idea and merely needs reinforcement before moving on to another topic? Technology has played a major role in this redefinition by making these assessments easier to prepare, deliver, score and provide feedback in a meaningful timeframe.

> "TEACHERS ARE USING TECHNOLOGY TO INTRODUCE LESSONS, TO FOSTER COLLABORATION EFFORTS SUCH AS PEER EDITING, TO TAKE ASSESSMENTS, AND TO CONDUCT REVIEWS. THEY ALSO USE IT FOR INTERVENTION AND REMEDIATION."[6]
>
> PHIL ELLIOTT, SPRING HILL UNIFIED SCHOOL DISTRICT, SPRING HILL, KAN.

Another aspect of assessment technologies is the manner in which they are taken and how they are used. Pre, concurrent and post lesson assessments can be delivered for asynchronous class activities (like online courses taken independently) as well as for simultaneous class activities — be they in a classroom, online or both. Teachers can scan pre-course testing data to determine the level of class competency for a topic and to adjust course content accordingly. Likewise, the teacher could see that even though most of the students understand the bulk of the content, instructions should concentrate on specific areas where they were weak.

Furthermore, in a student-centered curriculum, we can replace the class with an individual student when these pre-course assessments are examined. In this way, each individual student can have a course created around his or her needs. Technology can enable this assessment to get even more tightly engaged. When ongoing assessments are connected into an enriched learning management system, appropriate courseware feedback is instantaneously provided for the student. The learning management system tracks all student activity, providing a documented learning history to support the more traditional observational learning assessments teachers can provide.

In this section we will look at various assessment technologies. Keep in mind that these can be used in traditional classroom settings as well as online. Understand as well that teachers will utilize assessment devices and software that best fits their instructional model — by grade level, by subject matter and

in what format the class is being conducted — online or physically co-located.

Student Response Systems — Student response systems cover a wide range of devices and software that help teacher/student engagements whether they take place in a classroom or online. They provide feedback to both parties as to the level of understanding attained throughout the lesson. They are the most granular level of student assessment. When utilized properly, they can instantaneously assess group and individual understanding during each day's lesson, providing feedback for remediation as needed. They can catch a deficiency before it festers into a larger problem. These technologies can help students stay on track.

Sometimes referred to as clickers, student response systems are used in classrooms from elementary schools to colleges and universities. In their most popular usage, clickers enable a teacher to do simple class polling. They are used to pre-assess competency before a lesson, check progress of students' understanding of a lesson, and do post-assessment polling. When clicker inputs are tied into a computerized projector, the tabulated results can be posted to the class for comment fostering further discussion.

Both students and teachers have reported multiple benefits. Students can immediately assess their understanding of the lesson and can seek help if needed. This is important as we desire students to take a more active role in their educational progress. Teachers like the ability to assess whether the class generally understands the concept before moving on to another. After class the teacher can contact the few that did not comprehend and provide additional help as needed. Teachers also like the ability to design lessons around case studies and get interactive responses quickly from the class.

Students in higher education like the technology because it keeps them engaged even when the class follows a lecture format. Another higher education use of the clicker technology has been in recording class attendance. When tied into a learning management system, the clicker registers a student into the class upon the first poll and sees that the student remains active in class throughout the lesson. This relieves the instructor from roll calls and greatly facilitates classroom management.

Yet another benefit has been reported from a variety of institutions. Shy students and those who might feel peer pressure not to stand out in class can express their opinions and participate in class activities anonymously through clickers or other interaction-based software that might reside on a computer or other device. Since the entire class is participating, only the student and the teacher know which answers are the student's. In this way, student response systems have helped to break the stigma some students experience when they 'stand out' in class.

Challenges facing schools when implementing clicker technology involve cost, teacher adjustment and learning management system integration. The costs can be quite reasonable depending on device but can range from $20 for a numeric keypad device to $75 for the more elaborate multi-function clicker devices. In K-12, schools generally buy one per student and leave it in the classroom. In the higher education environment, students buy their own clickers and pay a registration fee to register them onto the school's learning management system.

As for teacher adjustment, the main concerns involve both understanding the technology and learning how to use it effectively. The best student response questions are conceptual in nature. They can help students synthesize and express a deeper understanding of the material. They can also be used to present outcomes of computation as in a math or physics class. But regardless of the class, teachers must learn how to properly frame questions as well as how to regularly integrate them into their lessons.

Scanners and multi-function printers in assessment — Teachers are continuing to use standardized tests to meet assessment requirements. We are all familiar with the standardized test bubble answer sheets. This technology has been utilized in classrooms for many years. Many schools and institutions continue to use special purpose scanners to correct and tabulate scores. When tied into a learning management system, grades are automatically inserted into student folders. Results are also sent to the teacher to assess how well the material was understood and where improvements are needed.

One newly evolved technology makes this process even more flexible. Newer multi-function printer technology allows teachers to create their own answer sheets — either self-generated or from templates — and use their masters as the scoring master. Multi-function printers use their scanning capabilities to compare answers and their printing capabilities to record the grades. Like single-purpose scanners, multi-function printers can send results to the learning management system. Where the savings come in is that these devices also print, scan, fax and copy classroom needs.

Plagiarism software — Student writing should be original and reflect the opinions and understanding of the author. This can be a challenge for schools and institutions as they enforce school plagiarism and copyright rules. Today information is all over the Internet. Cut and paste can be an effective note-taking tool. However, when these notes begin to appear verbatim as passages in class papers, this can be a cause for concern. Thankfully, there are resources on the market that can assist schools and institutions as they address this problem.

Plagiarism software solutions compare student work with searchable comparables and allow the instructor to make value judgments as to their authenticity and originality. Furthermore, statistics show that up to 50 percent of plagiarized papers come from peers. When a campus consistently uses the solution to check all papers, those papers become part of the searchable database.

This software can also be viewed in a more positive light. This very same textual analysis can be called upon to assist in classroom instruction and in peer reviews. By showing a class anonymous sample work, an instructor can provide an opportunity for hands-on learning. Students learn how to extract information and compose a statement properly. They witness how to analyze actual written work with the help of this special purpose software. Furthermore, they can perform this analysis with or without instructor supervision because the software highlights key areas of concern for them.

LAB TECHNOLOGIES

New technologies are being placed in all sorts of labs every day. By definition, labs are places for hands-on learning and these solutions provide that opportunity. What is especially exciting about newer lab technologies is their focus on supporting student-centered learning. They are experiential and problem based. They do their best to provide a personal experience for each student in a way that might have been impossible in the past. Additionally, with the enhancements offered by today's technologies, students get high quality experiences — working with professional quality devices, software and processes — that were not available just a decade ago. This excites students. They know that what they are doing is real and not something phony or dumbed down for a student exercise.

Scientific devices — One area where we have seen technology transform the student experience is in scientific devices. Today's classrooms are harnessing the power of computers to augment science and technology learning by connecting data gathered from measurement devices with analytical software residing on the computer. Students get to both record their observations as well as to quantify the results in real time using graphs and charts provided by the software. It may not be CSI, but cost-effective, hands-on scientific investigations give students a realistic laboratory experience that reinforces learning. Colleges

Webster Elementary School in San Diego, Calif.
IMAGE PROVIDED BY: JCJ BLACKMAN ARCHITECTURE, INC.

are now able to use quite sophisticated equipment and still stay within their budgets because of new developments. One such example is a gas chromatograph that uses air rather than a single gas. This not only simplifies the process by enabling more flexibility and mobility, but improves safety and reduces costs since separate gas tanks are no longer required.

Furthermore, there is support for teachers on how to use these ever more sophisticated devices. Manufacturers not only offer training on how to use the equipment and software, but also provide lab assignments that can plug into standards-based curricula. Some manufacturers also host a teacher exchange on their website in which teachers can share best practices and successful lessons.

Math and technology — Our recent focus in increasing student interest in science, technology, engineering and mathematics (STEM) has stirred a great response in technology-oriented learning solutions. These solutions involve content as well as more innovative ways to deliver lessons that are more interactive and engaging. Educators understand that STEM educational improvements start by creating a fun learning atmosphere. Therefore, what we are seeing are learning tools and curricula that leverage hands-on and interactive gaming modalities to expose students to concepts.

One area of new STEM education involves robotics. Why robotics? To paraphrase one industry expert: Students first learn robotics, then use robotics to learn. What does that mean? Starting with students in early elementary school, they engage in robotic activities that assist with language and literacy objectives. Students like the interface, but more importantly they will concentrate on the lessons given by robotics because it is tactile and different. In the upper elementary and middle schools robotics are used to safely show students cause and effect consequences, crucial skills for advanced learning. In high schools, robotics introduce students to computer program language and allow them write their own applications. In institutions of higher education engineering students are using programs created for robotics to bring life to theory and mathematical formulas. As an overview, a full robotics program takes students from observing behavior, to studying cause and effect, to creating behavioral involvement, to creating problem solving solutions.

Some schools have used funding from a number of STEM and general education grant programs to fund robotics in their classrooms. They are finding robotics to be a great way to teach 21st-century STEM skills and at the same time provide a platform for student-centered learning.

Another way technology is teaching STEM skills is through simulations and gaming. It cannot be lost on anyone how much students throughout the K-20 spectrum enjoy simulations and video games. Through the use of carefully crafted gaming, students can learn not only educational content but also complex thinking skills embedded in the gaming experience. Gaming excites the reluctant learner in K-12 and can help develop STEM skills.

Today's simulation games are becoming quite realistic. To be a successful game player, students must comprehend complex ideas and be able to respond using those ideas. A number of schools and institutions are creating courseware that takes advantage of these real-life experiences. By manipulating their avatars in a simulation world, students can virtually experience lessons that may be difficult to reproduce in a classroom. Another advantage of simulations and gaming is their scalability and flexibility. Our Department of Defense has plans to offer instruction for all levels of

military training through a virtualized classroom. Each student will register his or her avatar in a class and manipulate the avatar through the learning process. The avatar is programmed to learn in the same manner as the student so tactile, visual or conceptual learning styles can be accommodated.

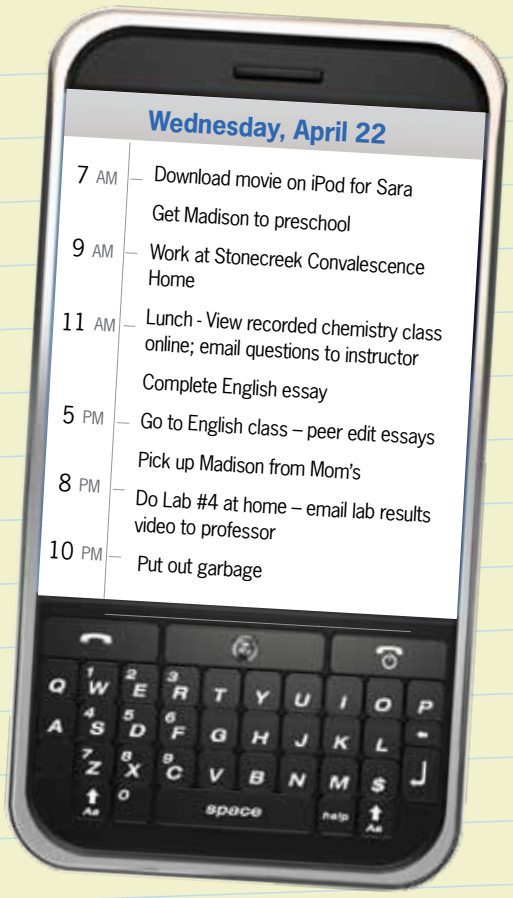
Gaming is also being used in mathematics education. At the higher education levels mathematical modeling can provide visualization to complex theoretical concepts. In the K-12 environment gaming can reinforce mathematical skills and provide a platform for learning discovery as students attempt to solve problems presented by the game. Gaming is also being used to introduce students to mathematical concepts. For instance, students could play a game where they must construct tools or improvise solutions to solve problems. After playing the game, the instructor can show them that solving the game required executing solutions to mathematical problems. Students now have a real-world experience to relate to as they examine mathematical concepts.

Taken one step further, teachers are using gaming as a way to stimulate writing skills. In one high school, students are writing their own video games to share with friends. They write the story line and then apply programming principles to embed the story and characters into a simulation. It is not only fun, but they are learning how to write, present and display 21st-century STEM skills.

Virtual Labs — Another area where simulation comes into play is in the science laboratory. Biology is one area where virtual labs are popular. Virtual dissections are inexpensive, harmless and can be done at any time. Many online and in-class biology labs are using virtual dissection software on PCs to provide each student a virtual experience. Not only do students

4. Day in the Life of a Community College Student

Jill is a working mom who wants to earn a nursing degree. She is taking two courses each semester at the local community college. She takes an English course that meets twice a week at night and a chemistry course and lab offered during the day. The chemistry course offers students the option to either attend in person or view the class online through their lecture capture program. She takes the class online and does her labs at home through their 'wet lab' program so she can keep her full-time job. Below is a sample day taken from Jill's smart phone.



not get the "yuck" factor that real dissections often give them, but each student is in control of his or her learning. Experiments or dissections are done at the student's pace and to their level of understanding.

Similarly, virtual technologies are used where space, time and expense require an alternative to the real world. Physicists have used virtual modeling in classes for decades to represent aspects of our world that could not be represented otherwise. Likewise, modeling programs are used to understand and predict natural behaviors from weather predictions to artillery projections. What is exciting is that this software is becoming more available for all levels of education and can be displayed on a variety of multi-function devices. Thus, instructors have choices as to how to use it and how to integrate it into their curriculum.

Wet Labs — Replicating a real lab experience for online students has been a dilemma. There are now two ways in which these students can experience a laboratory experience. One is the virtual lab as described above. The second is the wet lab where students actually use real chemicals, equipment and materials as if they were in the campus laboratory. What makes these wet labs special is that the student performs the experiments from start to finish themselves. How this is possible is the way in which course-specific equipment and materials are prepackaged and delivered to the student as part of the course registration. Students use microscopes and other observation and monitoring devices as well as cameras and computer software to record their experiment findings for delivery to the instructor.

Many online science instructors speak highly of the effectiveness of these wet lab experiences. They tout that each student must perform every activity for themselves. This is not usually the case in a classroom-based lab where limitations on resources and time force lab partnering with up to four students working together on an assignment. Often these groupings develop a division of labor whereby the strongest technician does the majority of the work while the others merely observe and record. This wet lab experience is particularly popular in community colleges. As the primary source of education for healthcare providers and first responders, these schools struggle with lab space limitations for science courses. Their nursing and first responder programs would be limited without this option. Additionally, even when students have the option to take either an in-class lab or a remote wet lab, they choose the wet lab. This is because it gives them more flexibility to better meet time demands as working students.

Language labs — Americans are woefully lacking in foreign language skills. Technology can help improve language learning through individualized conversational experiences afforded by the new language lab. The language lab from 20 or 30 years ago represented a fixed room with headsets and tapes whereby students repeated responses. Today's language lab experience can be a fixed room, but it could also be a mobile or an online experience. Furthermore, today's computer software offers students visual images that tell a story to augment the listen and repeat process. Lab sessions can be recorded and saved digitally for easy instructor assessment.

COLLABORATION TOOLS

Collaboration is such an integral part of today's learning. Part of this is due to the interactive nature of social networking that students have embraced and part is due to the capabilities offered by technology to integrate peer-supported learning into the curriculum. Students like to collaborate. They enjoy sharing ideas and activities with each other. They also enjoy helping each other. Many educators are using technology to tap into these attributes so that students can

learn more effectively. They are providing opportunities in space, time and content to let students share in the learning experience and to benefit in their collective energy and brainpower.

Many educators think that collaboration could be the real value in the newer types of tablets. These devices could be that Internet portal for students to social network, view videos and collaborate while sitting at a comfy chair or walking across campus. This is especially so for the higher education student who is constantly mobile and might consider using these larger screen devices instead of a smart phone for these activities.

In the more traditional classroom, collaboration applications should be integrated within learning management software platforms for greater functionality. They should be able to create sub classrooms for students to collaborate 24/7 on shared projects and concerns. The software should be flexible enough to allow students to collaborate from any device and on any operating system. As educators come to embrace peer-supported learning, these collaboration activities should be reflected in courseware and assessment systems. Likewise, greater collaboration will be a natural outcome as learning becomes more student-centered and students seek to bounce ideas and present their findings to teachers and peers. The ability to attach to the campus learning management system helps support student-centered collaborative learning.

LEARNING MANAGEMENT SYSTEMS

Some might consider learning management systems a subset of student information systems but it is mentioned briefly here because it is a vital tool in classroom technologies. It enables students and teachers to track projects, measure progress, assemble various data objects and information components for easy retrieval. For students it can become a portal to the Internet and to library resources. As K-12 schools embrace more online activities and digital content generally, learning management systems provide students a digital book bag to hold digital content and replace their 40-pound backbacks as a transport for books and other coursework. Additionally, learning management systems offer instructors a convenient interface point with students to track, assess and monitor activity.

As important to K-12 as it is, a learning management system is probably even more critical for institutions of higher education. This is because their students are far more mobile and must access, store and manipulate digital content that is even more varied. Higher education students expect that digital storage and retrieval be easy to use and accessible from a wide variety of devices and from anywhere.

A fuller examination of learning management systems will be found in our Q4 Special Report that will focus on Digital Content. In that report we will investigate LMS components, capabilities and key features. We will also discuss setting appropriate LMS expectations and practices.

PROFESSIONAL TRAINING

In preparing this report, our researchers conducted many hours of interviews with a wide range of education technology experts. We interviewed schools, colleges and vendors with varying titles. They had wide-ranging opinions on most topics. But, the one topic all heartily agreed on was the imperative that instructors receive proper training on these technologies before implementing them. When asked, each had stories about the negative consequences when training was not provided. It can be disastrous. Disastrous for the class but also disastrous for classroom technology deployment in general because once one gets a bad taste, they are not likely to try a second time.

It should be remembered that training really takes two forms. One form addresses teacher and student competency to use the software or devices. That is usually the least difficult training task. The second type of training, however, is more challenging and is where schools and institutions often fall short. That instruction involves helping the education community learn how to most effectively apply the new technology in classroom instruction. This level of training is most often not a one-time shot. Rather, it should involve discussions with curriculum experts as well as instructional peers to design lessons to maximize these new capabilities. The best programs for teacher training also add a mentor component whereby an experienced teacher shares best practices with newer teachers to the technology.

A number of vendors provide training on their products in either an online or face-to-face mode. They are keenly aware that if their solutions are to be widely adopted they must be used properly. Some even offer sample lesson plans and help teachers modify their instructional practices to better leverage the educational benefits of the new technology. We will address training more fully in our next Special Report on Campus Infrastructures.

CONCLUSION

This report has discussed a number of classroom technologies being deployed today. It is by no means an exhaustive list, but rather a representative sampling of what our students experience and our teachers implement in their classrooms. This plethora of technologies requires care to best match teaching styles and educational outcomes with appropriate methodologies. They also call for appropriate assessment tools to match this vast array of learning modalities.

Technology is changing how we learn, how we teach and how we organize our learning. It is allowing schools to redefine what an Information Age classroom is. Likewise, students expect different classroom experiences than their parents had because information is limitless and readily accessible.

What this all boils down to is educators using their professional expertise to make instructional decisions. Educators and thought leaders must create the learning environment to best address student needs. Teachers must transform their teaching styles. They must leverage technology to meet course requirements as well as to provide what will help each student reach optimum achievement. When institutions are prepared to tackle these key issues, classroom technologies can reach and even exceed expectations. Money is well spent and teachers and administrators are more fully enabled to meet students' short-term needs while preparing them to thrive in a dynamic 21st-century world.

Educators and policy-makers have the opportunity to develop different campus experiences that are more relevant to the 21st-century student, worker and citizen. As John Dewey said almost a century ago, "If we teach today as we taught yesterday, we rob our children of tomorrow." This statement couldn't ring more true today.

ENDNOTES

1 From the 2009 Center for Digital Education Digital School Districts Survey
2 From the 2009 Center for Digital Education Community Colleges Survey
3 From the 2009 Center for Digital Education Digital School Districts Survey
4 From the 2009 Center for Digital Education Community Colleges Survey
5 From the 2009 Center for Digital Education Community Colleges Survey
6 From the 2009 Center for Digital Education Digital School Districts Survey

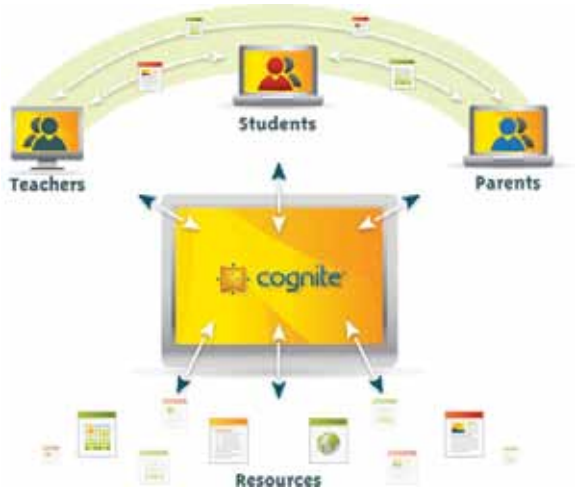
Solution Spotlight

Engage. Enable. Empower.

Learning is undergoing a dramatic evolution. Educators are striving to equip their students with the skill set businesses desire today and will demand tomorrow. These are not only the skills needed to utilize technology, but skills enhanced by technology — critical thinking, collaboration, research and problem-solving capabilities.

To empower today's learners and tomorrow's leaders, educators need to organize this world of anytime-anywhere learning, ensure access to quality instructional resources and erase the boundaries between the library, classroom and home. They need a tool that lets teachers, parents and students access your district's digital resources, library materials, user-created content, websites and educational databases and start using these materials in the same space.

The classroom made bigger. The world made smaller.
Cognite™ is a revolutionary classroom technology. It's a digital discovery and retrieval tool that allows students and teachers to collaborate more effectively and helps parents play an active role in their child's education. Ideas and educational resources can be shared among teachers while classroom management is streamlined and organized — allowing teachers more time for individualized instruction with students.



Through Cognite, district leaders have the ability to engage, enable and empower:

- **Engage:** Parent involvement means increased student achievement. Parents are engaged through Cognite and stay informed in real-time about their child's grades, assignments and activities.
- **Enable:** Cognite organizes classroom functions, allowing teachers to efficiently develop lesson plans and create assignments that align with district objectives and state and federal standards. Teachers can easily share resources and update parents on their child's progress.
- **Empower:** Cognite's highly interactive collaboration tool keeps students engaged in and out of the classroom. With an interface designed specifically for users in grades 6-12, Cognite empowers students, reinforcing the skills needed in a 21st century workforce and preparing them for a successful future.

Cognite transforms schools into a digital learning environment and brings library, Web and digital resources together in one place, allowing district leaders to maximize the resources they already have. When combined with Destiny® Library Manager™, WebPath Express™ and Standards services, Cognite creates a seamless discovery and retrieval experience, putting the power of the world's leading K-12 library management and student search tool at students' fingertips. Students have access to over 68,000 trusted websites and teachers can easily find resources that align with district and state standards.

Follett® Software Company
A Follett Corporation Company

Find out how you can use Title I and IDEA funds to help support Cognite at your school by visiting www.FollettSoftware.com/Funding

Follett Software Company helps today's educators inspire student success with integrated educational technologies. More than half of America's K-12 school districts rely on Follett's innovative management of educational content and library materials, textbooks, assets, data and other resources. Follett's powerful and proven solutions support staff and engage students in a digitally rich environment that empowers 21st century learning, discovery and collaboration.

Visit Follett Software Company at www.FollettSoftware.com or call 800-323-3397.

Connected Classrooms:
Powering the Entire Learning Experience

Teachers today have to engage students differently than previous generations. Students are immersed in technology in every aspect of their lives, and their education should be no different. We know that no single technology deployment will transform your classrooms. Education in the 21st century requires a technology strategy that enables engagement and connects students with the numerous resources they need to succeed, including parents, teachers, administrators and the surrounding community. And in today's challenged fiscal environment, you need to do that on a very tight budget.

With the right planning, you can accomplish this while reducing your operating costs. Dell has spent 25 years listening to the needs of educators, and we've been there as the demands on the learning environment have evolved. We've developed the Connected Classroom to meet these needs. The Connected Classroom provides a broad set of tools and services to keep students engaged, help teachers be more interactive, keep parents more informed, and improve the effectiveness and cost-efficiency of your technology investment.

In the classroom: Computers powered by Intel's® new 2010 Core™ processor family, digital content and resources, interactive whiteboards, audio systems and student response systems help teachers engage students, gauge their level of understanding and customize the learning environment to student needs.

Extending the learning environment: Providing secure access to school networks means kids can gain access to digital content and tools through a variety of devices wherever they are, and parents can access tools and information they need to reinforce learning at home.

The infrastructure: A strong infrastructure can support a learning environment rich in digital content and reduce costs. Highly efficient server, storage and virtualization technologies can provide a more adaptive environment and support the technologies necessary to engage today's students. In addition, preconfigured systems and automated management tools can keep costs down and reduce demand on technologists' time so technology staff can spend more time supporting student learning, and less time supporting the technology itself.

Supporting the connected classroom: The key to successfully transforming the teaching and learning environment is in providing teachers with the professional learning they need, so they can integrate technology to perform formative assessments, drive collaboration and enable individualized learning. Dell provides support and training to help teachers integrate technology into their classrooms with ease and ensure technology functions smoothly. Bringing together the resources needed to support a child's education and learning success is what the Connected Classroom is all about. Through industry standards and a modular pay-as-you-go approach, Dell lets you integrate these technologies into existing environments and grow at a pace that fits your budget and resources.

Dell is committed to enabling teachers to more effectively engage students with all types of learning styles and to prepare students to succeed in this digital age. As the top provider of technology to U.S. K12 classrooms, the company uses feedback from educators across the country to design and develop technology offerings like the Dell Connected Classroom, which integrates seamlessly with Dell's open, capable and affordable data center technologies. Learn more about Dell and education at **www.dell.com/connectedlearning**

Picture This

The phrase “A picture is worth a thousand words” has been used countless times — because it’s true. With TechSmith software, any teacher can create stimulating visuals that help students learn. Using imagination and just a few clicks, teachers can quickly and easily show students the important concepts … instead of just telling them. It makes a big difference. That’s why TechSmith gets rave reviews from teachers all over the country.

TechSmith provides several tools that enable greater learning:

Snagit — Teachers can capture any content they see on a computer screen. They can edit, combine images, add text and share. Snagit helps teachers create more dynamic presentations and visually explain what students need to know.

Camtasia Studio/Camtasia for Mac — Lessons can be pre-recorded and played back during a teacher’s absence. Instructors can demonstrate processes or ideas visually, or they can make a video for students to view before coming to class. Camtasia Studio and Camtasia for Mac both give instructors numerous easy-to-use tools to create engaging videos that help them teach.

Camtasia Relay — Educators can record a live lecture on their Mac or PC and make it into a reusable video or have it automatically published online. Students can view the recorded videos on their iPods, laptops and more — whenever they need to.

Jing — Add visual elements to lessons, both online and in the classroom. Provide video feedback to students when grading their work. Add a quick screenshot over the Web, IM or e-mail. Add narration. Capture images from the Web and copy them into handouts. Jing provides a variety of ways to share information, for both teachers and students — all for free.

Screencast.com — Create an online home for digital materials. Easily provide a link to your content and share with teachers, students and parents.

Morae — Conduct focus groups, usability tests and other research methods to see how effectively students are learning. Capture video, audio, on-screen activity and keyboard/mouse input. Analyze recordings and chart metrics.

TechSmith gives teachers a better way to reach students. And students get a fun, interesting way to learn. Adding visual content with TechSmith software brings an exciting new dimension to the educational experience — quickly and easily.

Create the engaging content students love. With TechSmith software — like Snagit and Camtasia Studio — educators can create anything from eye-grabbing images for presentations, to on-demand video lessons recorded straight from their computer screen. It’s easy to create engaging, visual content with TechSmith’s family of software solutions. See for yourself with a 30-day trial.

Find out more! Visit www.techsmith.com/edu.

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Always Connected

Classroom technology doesn't belong only in the classroom — it should be wherever students and educators are. BlackBerry smartphones let students, teachers, administrators and campus officials manage every aspect of their environment, including learning and teaching, life on campus and personal safety. Through the BlackBerry smartphone's inherent capabilities and numerous partner applications and third-party solutions, users throughout the school environment can interact with online tools, applications and each other from anywhere they happen to be.

Mobile Learning: BlackBerry smartphones enhance teaching and learning by offering a media-rich interactive device that integrates with numerous programs and applications used in the learning environment.

Students and teachers can use their BlackBerry smartphones to interact with programs used in lectures and with learning management systems. Teachers can push content, including audio, video and images, to students and use the smartphones for in-class polling. They can survey students and gauge responses individually or at a group level. With instant access to all the resources they need at their fingertips, students can be more productive and collaborate with their peers.

Campus Life: Students can check schedules for extracurricular activities, look up contacts in a campus directory, stay up to date on school news and consult a campus map as they traverse campus. They can also peruse course schedules, manage their classes and log into student information systems.

Students and faculty can access their e-mail and calendars, and track down homework assignments and other documents stored in network files whether they are in the classroom or on the go. They can connect with their peers via social networks, and keep in touch with family and friends on the same device.

Campus Safety: A number of third-party applications allow campus authorities to push alerts to students and teachers in the event of an emergency, and with the simple push of a button, users can alert authorities to their location if they are in danger. Even in remote or isolated areas on campus, students and staff carrying BlackBerry smartphones are always connected.

The BlackBerry smartphone offers educators and students a world of applications to enrich the educational environment on the same device they use to navigate their daily activities. Whether in the classroom or out and about, students, teachers and administrators are always connected to the tools they need.

BlackBerry Smartphones give users out-of-the-box functions that include e-mail, calendaring and contacts; document and file access; wireless synchronization; push technology; instant messaging; and social networking.

BlackBerry Enterprise Server Express lets schools centrally manage and support up to 2,000 BlackBerry smartphones and bring BlackBerry functions to the classroom with no additional licensing fees.

BlackBerry Mobile Voice System provides integration with campus phone systems and allows extension dialing; single identity calling; the ability to hold, move or transfer a call; and voice over Wi-Fi calling.

Chalk Pushcast Software enables the creation and delivery of Pushcasts, including video, audio, graphics, text, surveys and more. Content is secure and encrypted, and cannot be copied or forwarded. Usage can be tracked and analyzed via reports.

BlackBerry®

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

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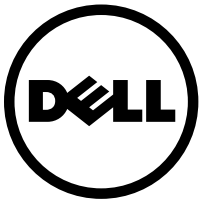

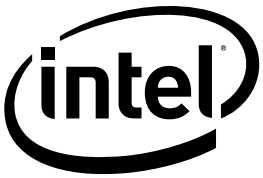

The Center for Digital Education (CDE) is a national research and advisory institute specializing in K-12 and higher education technology trends, policy and funding. Along with its research services, CDE issues white papers and conducts the annual Digital District and Digital Community College survey and award programs. CDE also supports the Converge media platform composed of the quarterly themed Converge Special Reports, www.convergemag.com and events.

The Converge media platform is composed of the quarterly themed Converge Special Reports, Converge online and nationwide events. Converge provides strategy and leadership for technology use in the K-12 and higher education market.

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