Penn State
College of
Education

Report on Technology and its Application to Teaching and Learning

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Technology and Education

Laptops. Podcasts. Digital imaging. It's the way of the world. It is also the way of education.

Technology has the potential to make substantial further improvements in education, just as it is poised to raise the quality of life to even higher levels. It has an essential role to play in teaching students, preparing the next generation of teachers, and improving assessment and decision making for education administrators and policy makers. It also holds promise for providing greater security on our physical campuses as well as on the information networks maintained by our schools.

However, we must move to avoid the temptation to use technology just for technology's sake. Instead, we need to study human interaction with technology as well as the communities we build in and around cyberspace to understand how best to implement technology into teaching and learning endeavors. By doing so, we may avoid the pitfalls that occur when we move too quickly without properly preparing teachers and students, or adopt software that is poorly planned or programmed.

Faculty members of Penn State's College of Education are conducting numerous research projects that explore the application of technology to education, and are integrating the newest technological tools in their curricula.

David H. Monk, dean of the College of Education, is deeply committed to this agenda and asserts, "Our college will maintain its position on the cutting edge of research into the development and use of technology for the improvement of teaching and learning."

Preparing Tomorrow's Teachers

Preparing Tomorrow's Teachers

Technologies will not replace teachers, but teachers who use technologies well will replace those who don't.

Kyle Peck often refers to this foretelling statement. As associate dean for outreach, technology, and international programs, he recognizes that educators need to master innovative technologies in order to meet new classroom standards. "Technologies are playing an increasingly important role in the transformation of education," he says. "A teacher who uses technology well can create compelling, interesting, motivating activities that engage students and require twenty-first-century skills like creativity, problem solving, teamwork, and global awareness."

Paper-based instruction simply doesn't reach today's learning audience. For the millennials—the generation of persons born in the past twenty-five years—technology encompasses virtually every niche of their lives, and they expect technology to be central in their classroom experiences.

"Preparing educators for today's schools involves multimodal demands," says **Jacqueline Edmondson**, associate dean for teacher education and undergraduate programs. "Students are using text messaging, e-mail, instant messaging, podcasts, iPods, the Internet, and other technologies in their daily lives. These extend into their experiences in our classrooms and in the classrooms where they teach.

"Our teacher education programs are diverse and prepare students for a variety of school positions," notes Edmondson. "Each program has its own technological needs."

In addition to preservice teachers at the undergraduate level, we are preparing all our students—including veteran teachers working toward advanced degrees or certification, graduate students aspiring to be counselors, trainers in corporate and industrial settings, and those in other professions—with the technology skills required for effective twenty-first-century instruction.

Technical Knowledge

Recently, the International Society for Technology in Education released the "next generation" of the National Educational Technology Standards (NETS) for students. These standards focus attention on six major themes: (1) creativity and innovation; (2) communication and collaboration; (3) research and information fluency; (4) critical thinking, problem solving, and decision making; (5) digital citizenship; and (6) technology operations and concepts.

The NETS are framed as, "What students should know and be able to do to learn effectively and live productively in an increasingly digital world." New technology standards for teachers are due to be released within the year and are expected to reflect central aspects of the NETS for students.

Penn State's College of Education will be leading the call for new teachers to be prepared to address the needs of twenty-first-century learners. For the past two years, there has been a pilot laptop initiative with Elementary Education and Secondary English students participating in the **Professional Development School (PDS) Partnership**. The PDS is a collaboration between the College of Education and State College Area School District in which experienced classroom teachers mentor education students throughout a yearlong internship. Mentors are actively

involved in co-planning with University faculty—and often co-teaching—methods course work and seminars associated with the program.

Education students in the PDS are equipped with a laptop and suite of powerful educational software to use during their internship year. Emphasis is placed on engaging students with technology in ways that are intended to support their development as a teacher (e.g., electronic portfolios, video analysis of teaching). In addition, future teachers learn to use technology to support children's meaningful learning. "We believe that we can't prepare our students to teach effectively in the classrooms of today and tomorrow unless we prepare them to use technologies effectively," says Peck. "We can do a better job preparing preservice teachers by providing them with a powerful computer 24/7."

The pilot laptop initiative has come to be known as EDUCATE at Penn State—Exploring Directions in Ubiquitous Computing And Teacher Education. A steering committee that includes representatives from a variety of programs and Penn State campuses is examining the implications and issues associated with expanding EDUCATE to include more teacher education candidates. Compelling evidence in support of expanding the program comes from examples of the teaching practices of students in the pilot project.

Education students in the PDS not only create multimedia teaching resources to support their children's learning, but also engage their students in digital creation and expression. For example, after having participated in a podcasting project in the PDS, one student and her mentor teacher had their third graders create a podcast show about the electricity unit. Children expressed what they learned about electricity and energy, and used evidence from experiments they had conducted in class to support their ideas. (See page 15.)

Carla Zembal-Saul, associate professor and holder of the Kahn Professorship in Science Education, has been heavily involved in all aspects of the EDUCATE project. "Our hope is that one-to-one computing will eventually result in significant changes in the education and development of not only new teachers, but also veteran teachers, teacher educators, and most importantly children," she says.

English PDS interns also incorporate technology in their training. They are creating discussion forums as part of the **Pedagogy for InterCultural Critical Literacy Education (PICCLE)** initiative. PICCLE was initiated by six partner universities in the United States and Europe with a grant from the U.S. Department of Education's Fund for the Improvement of Postsecondary Education (FIPSE).

A staple of the PICCLE initiative is PiccleForum. This online forum provides the preservice teachers with an electronic course environment in which they can hold international discussions across universities and plan discussions for their public school students when they student teach. As part of their required course work, the English PDS preservice teachers create a forum dedicated to a topic in their classroom plans. "The forums are an excellent way of transitioning knowledge and generating discussions about key topics," says **Jamie Myers**, associate professor of language and literacy education.

"PiccleForum supports thinking about the ways that cultural backgrounds shape the views of texts and media,"

notes Myers. “Students share their interpretations and cultural experiences, bringing in different opinions and cultural viewpoints.”

The asynchronous nature of PiccleForum allows students to be more deliberate in their postings, making it accommodating for any students who have a reserved demeanor. “Our mentor teachers also tell us that their

students are thinking much more deeply about different perspectives, and this promotes critical thinking," notes Myers.

In the college's **Urban Teaching Collaborative (UTC)**—another PDS program—elementary education majors use technology not only to teach, but also to build community across distances.

Located in a rural part of the state, Penn State's University Park campus faculty find it challenging to mentor teaching candidates who want to teach in urban environments. A significant part of the mission of the UTC is to find ways to use new technologies to bridge the distance gap between campus and the major urban centers in Pennsylvania.

Each of the preservice teachers receives a new laptop from the college, along with technology training in videoconferencing, podcasting, and e-portfolio development, as well as an understanding of the online curriculum at the School District of Philadelphia.

By virtue of the interns' laptops and the School District of Philadelphia's wireless connectivity at Sheppard School, **Dan Thompson**, assistant professor of curriculum and instruction at University Park, conducted weekly video seminars from his office, as well as after-school one-to-one or small-group video sessions as interns' needs dictated. Also, with the use of an attached iSight camera, Thompson could observe interns conducting classes.

"I am convinced the portability of the laptops, as well as their built-in cameras and user-friendly software, make the iBooks an effective tool for a range of intern projects," Thompson says. "The interns took to the technology quickly and thoughtfully, coming up with new uses I could not have imagined. Clearly, we are developing new understandings about how easy this technology is to integrate through the processes of supervision, evaluation, and documentation of the critical importance of field experience. The technology is getting us in the doors of school buildings that, before this year, we could only talk about."

Penn State's secondary mathematics student teachers are also developing their skills in teaching with mathematical technology through completion of a cutting-edge 3-credit course, **Technology and the Teaching and Learning of Mathematics**, in which they learn to teach using computer algebra calculators, dynamical statistical and geometric tools, and 3-D visualization tools.

In a program directed by Penn State Mathematics Education faculty member **Rose Mary Zbiek**, prospective teachers develop not only the skills in using cutting-edge software but also the understanding of how and when to use it. Zbiek, along with her colleagues **M. Kathleen Heid** and **Glendon Blume**, also Mathematics Education faculty members, has provided national and international leadership in the use of technology in mathematics instruction. They recently co-authored *Technology-Intensive Mathematics*, nine modules of high school mathematics curriculum materials designed to help students use computer algebra systems and dynamical geometry tools.

Digital Videos for Development of Professional Vision

Much like athletes will review videos of their sports performance to improve their skills, video editing and analysis helps identify strengths and weaknesses in a person's teaching. However, traditional efforts of playing through videotapes to pick out important episodes is tedious work.

Digital video simplifies the task of recording, editing, and sharing samples of teaching. Sophisticated new software allows an analyst to code recorded segments with key words and phrases. The analyst then uses the codes to easily retrieve segments from a collection of video data and instantly build a compiled movie. "New tools for digital video analysis and editing provide an elegant solution for what used to be messy and time-consuming work," says Zembal-Saul.

The College of Education is adapting digital video analysis in several of its academic departments to provide constructive feedback to its students and to allow the students to compose video essays of their own performance.

If a student teacher has, for example, been struggling with how to address student questions during class discussion, every instance of a question arising in class can be coded in a teaching example. Once the video has been encoded, the analyst searches them and calls up various segments that pertain to "student questions."

Within seconds, the software produces a customized movie composed of all instances in which those situations occur.

"This coding can all be done on the fly, even during the recording of the video," remarks **Scott McDonald**, assistant professor of science education.

"Digital video is such a powerful medium," says McDonald. "The students can analyze their own practice, research the teaching experiences of their peers and expert teachers in the classroom, and identify ways to improve their instruction."

Digital video also improves the reliability of the students' reflective inquiry. Previously, they relied on memory while reflecting on their teaching performance—and memory can offer a skewed picture. "Self-reflection of teaching was based on memory and perception," says Zembal-Saul. "Now, digital video of classroom practice offers a shared performance artifact that can provide common ground in

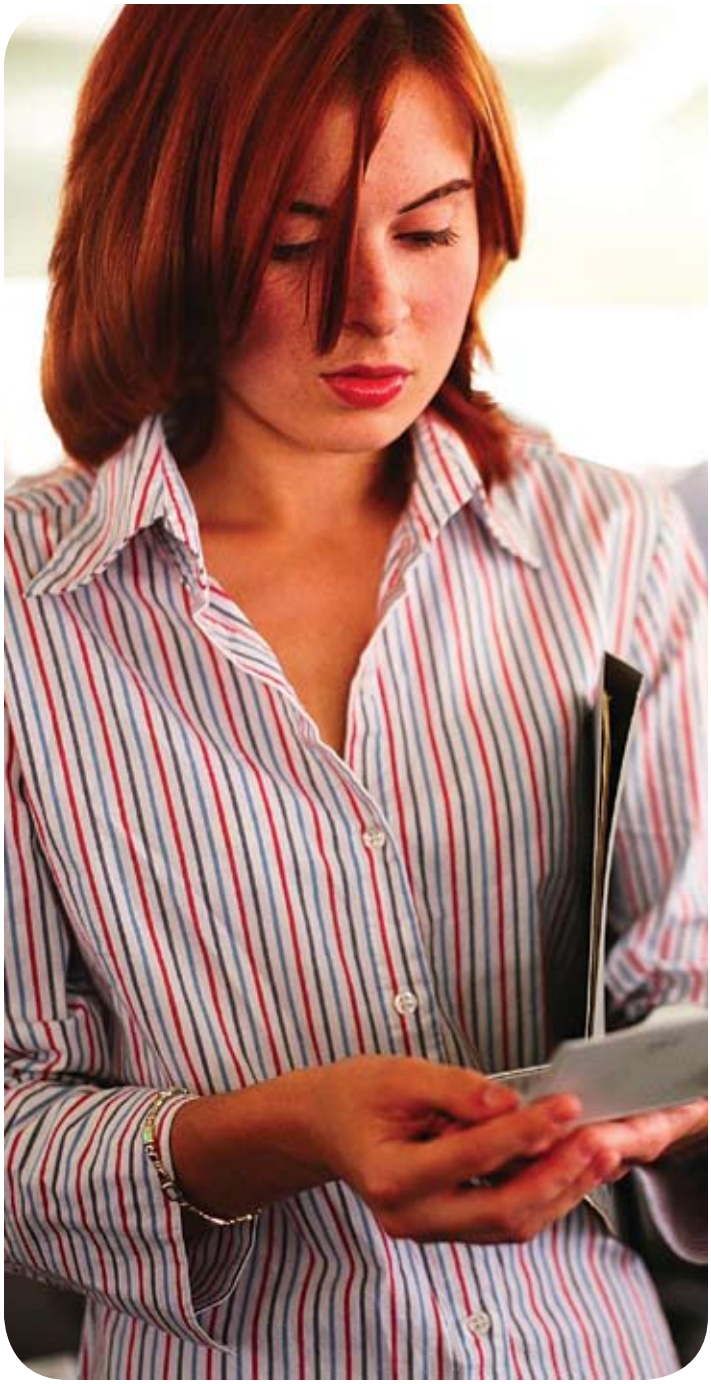
the conversations between student teacher and mentor/supervisor."

Similarly, a digitization project currently under way in Penn State's **CEDAR and School Psychology Clinic** will help future counselors and psychologists develop their counseling technique.

CEDAR Clinic is a counseling service administered and staffed by Penn State's Departments of Counselor Education, Counseling Psychology, and Rehabilitation Services (CECPR) and Education and School Psychology and Special Education (ESPSE). The clinic offers counseling and diagnostic services to students and provides supervised clinical training to master's and doctoral students of the CECPR and ESPSE programs.

With the support of the college's Education Technology Center, CEDAR Clinic is digitizing the recorded interactions between Penn State's counseling professionals and their clients. The digitized records will replace analog-based videos and will allow clinicians to pinpoint key elements of client sessions with unprecedented ease and accuracy.

"This change will definitely benefit clients as well as trainees," states **Kathleen Bieschke**, clinic coordinator for CECPR. "Because we will be better able to scrutinize client sessions, our ability to provide useful feedback will be enhanced as well."



Online Expression for Students

College of Education students are expected to produce and publish quality research on the Web as part of their course work. In doing so, they engage a larger audience, and can learn from the feedback they receive.

Students in a recent Elementary Science Education course produced and published a podcast titled *Honeybees in Crisis* (**podcasts.psu.edu/node/262**). Penn State honeybee expert **Maryann Frazier** co-teaches the course and played a vital role in connecting students with key members of the working group of scientists studying Colony Collapse Disorder (CCD). Episodes addressed the important role honeybees play as pollinators, the potential economic impact of CCD, and a variety of hypotheses being explored as possible causes for CCD.

The podcast was produced early in 2007, just as the mainstream media and policy makers were becoming aware of CCD. The research was so timely that it was referenced multiple times in a briefing document prepared for a congressional subcommittee in March 2007. It is still being cited in news articles today.

"This is an excellent example of what it means to go to school at a Research I institution like Penn State," says Zembal-Saul. "Students have direct access to researchers who are investigating relevant problems using cutting-edge methods. In this case, our students helped translate scientists' emerging findings about the honeybee crisis for the general public."

Graduate students in Penn State's online **M.Ed. with a Teacher Leadership Focus** publish their final research projects for the program's final course in a virtual portal known as the Cyber Gallery.

"It's much like what you see when you enter a museum—a handbill gives the student's name, the title of the project, and a brief description of the display," explains assistant professor **Iris Striedieck**. "By glancing at the handbill description, visitors can decide which displays they want to explore."

Dave Jagger, a student in the 2006 cohort, says he felt "a great sense of accomplishment and legitimacy. The Gallery provides the greater network of teachers, leaders, mentors, and friends with an aesthetically prominent and

fundamentally useful place for resources, research, and memories."

Another student, **Jody Markley**, says, "Knowing that I would be presenting my materials to a virtual audience made me more conscious of presenting clear and concise information that was also engaging and interesting. My experience has inspired me to seek out a means for the high school students in my program to present their research virtually."

Technology also allows students to creatively explore ideas and create commentary from their experiences. For example, English PDS preservice teachers integrate hypermedia authoring into their curriculum planning projects. Hypermedia authoring involves the creation of videos and other productions through constructive analyses of popular media.

"They take apart music, advertisements, movies, books, poems, and other media components, and juxtapose them into a sequence of sounds and words that form a single, cohesive piece," explains Myers. "Each production makes a statement about some theme: for example, freedom, justice, or love."

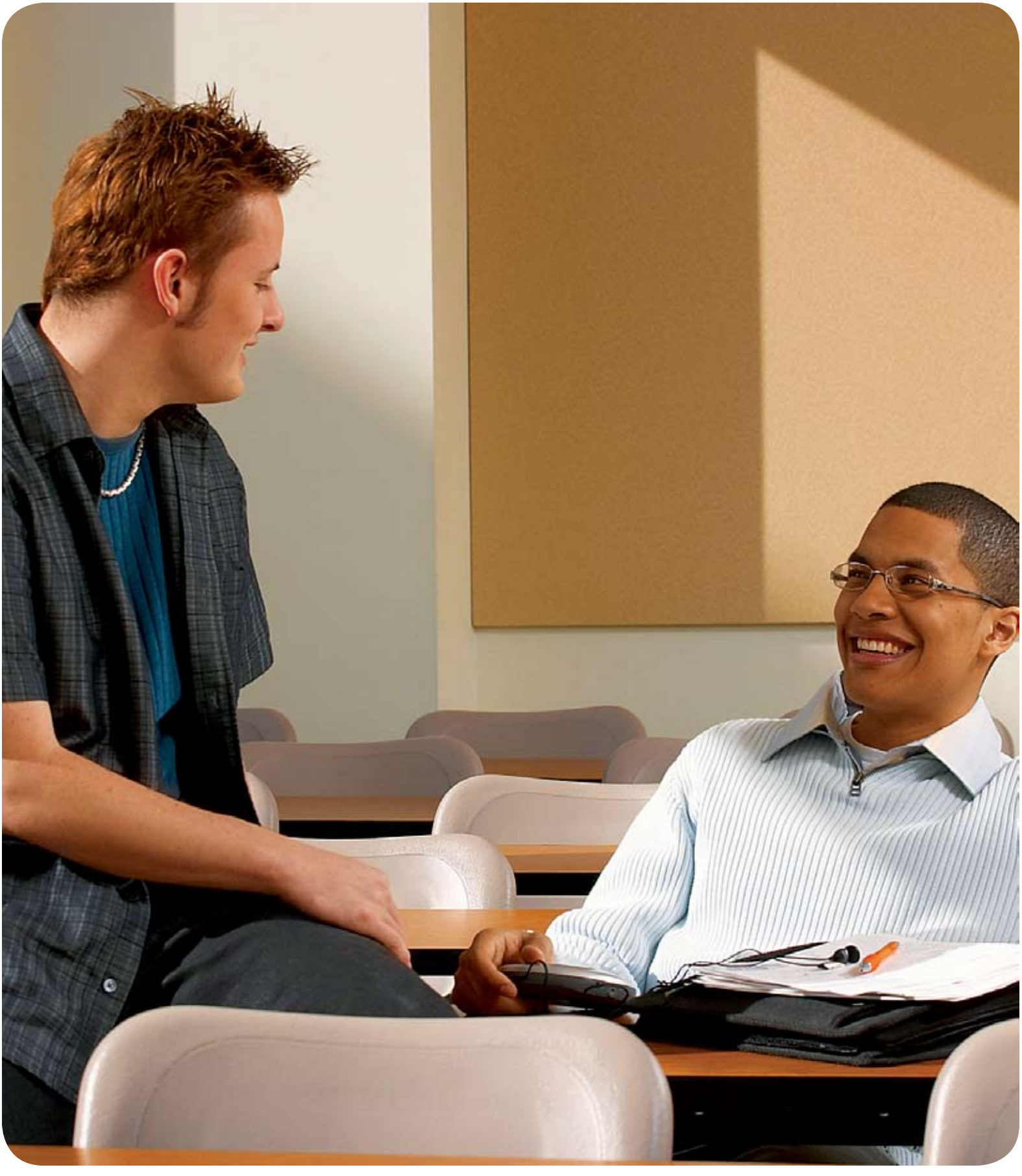
The students are drawing contents from their pop culture experience. In the end, they find that the representations they've created have relevance to their course readings in literature and language studies. "Books suddenly are more relevant to them," notes Myers. "This exercise really motivates the students."

Online Course Work

The college offers a number of online workshops, seminars, and credit courses as a convenient way for educators and workforce trainers to meet their professional development goals. Our current students, preservice teachers nationwide, graduate students, and alumni are among the many different groups who benefit from the online courses and seminars.

For example, **Teaching Elementary School Science as Argument (TESSA)** is an attempt to support education majors as they learn to teach in ways that are substantively different from how they learned science in K–12. Zembal-Saul was awarded a Career Grant from the National Science Foundation to investigate the use of electronic resources in addressing this problem.

A central component of TESSA is to develop video-based cases. Cases include episodes of science teaching that illustrates key aspects of reform, such as giving priority



to evidence and argument. Cases also include reflection questions that focus preservice teachers on important aspects of instruction; teacher reflection interviews in which classroom teachers describe their thinking and decision making during the lessons; opportunities to examine peer responses to reflection questions; and resources associated with the lesson (e.g., lesson plans, Web sites).

TESSA cases are accessible online (**tessa.ed.psu.edu**) and are assigned with intentional connections between the weekly focus of the science methods course and particular teaching episodes. The TESSA case response system has served not only as a productive instructional tool, but also as an effective research tool. Preservice teachers' thinking can be monitored over time for the uptake of important ideas and developmental progressions for learning to teach science.

Says Zembal-Saul, "Through the TESSA project, we are making significant advances in our understanding of how to support the development of beginning teachers who are able to construct learning opportunities in which children engage in authentic scientific practices and meaningful science learning."

Current teachers also have access to a number of college degrees and certificates through Penn State's World Campus. For example, teachers who wish to integrate technology more fully into their classrooms may study for a **Certificate in Educational Technology Integration**. This 15-credit program offers professionals a chance to advance their skills in the design, development, and implementation of technology-based learning experiences.

Designed as a service for College of Education alumni, **EdLion** utilizes the Web to provide free online seminars to educators, parents, and others. Regularly scheduled online information sessions cover a variety of interesting topics. Participants can interact with Penn State faculty during the live EdLion sessions or download previous sessions. Visitors can also read about online graduate-level courses and seminars, visit discussion boards, and research mentoring opportunities. (**edlion.ed.psu.edu**)

Field Experiences and Technology

Preservice teachers and their mentor teachers in Penn State's Elementary Professional Development School (PDS) program are finding interesting ways to use technology in their classrooms.

So *this* is what you did in school today!

At Corl Street Elementary School in State College, Pennsylvania, PDS mentor teacher **Lee McGann** updates the Web site of her second-grade classroom nearly every day. She posts homework and reminders, as well as photos of the students working on projects, taking field trips, and celebrating birthdays.

Parents can visit the Web page each evening and get a first-hand look at the day's happenings. "I've had parents who are busy veterinarians, emergency room doctors, waitresses, professors, and stay-at-home moms who visit weekly, or more often, because it is a way to stay connected to their children's education," says McGann. "They love it! I've had nice e-mails from grandparents who live in Maine, Florida, and even as far away as Norway and India who thank me for giving them an avenue to visit their grandchildren's classrooms."

Molly Guinane, who was McGann's teacher intern during the past school year, saw the classroom Web site as a powerful way to communicate with parents. "The Web site helped parents feel as though they were actually involved in our classroom." she said.

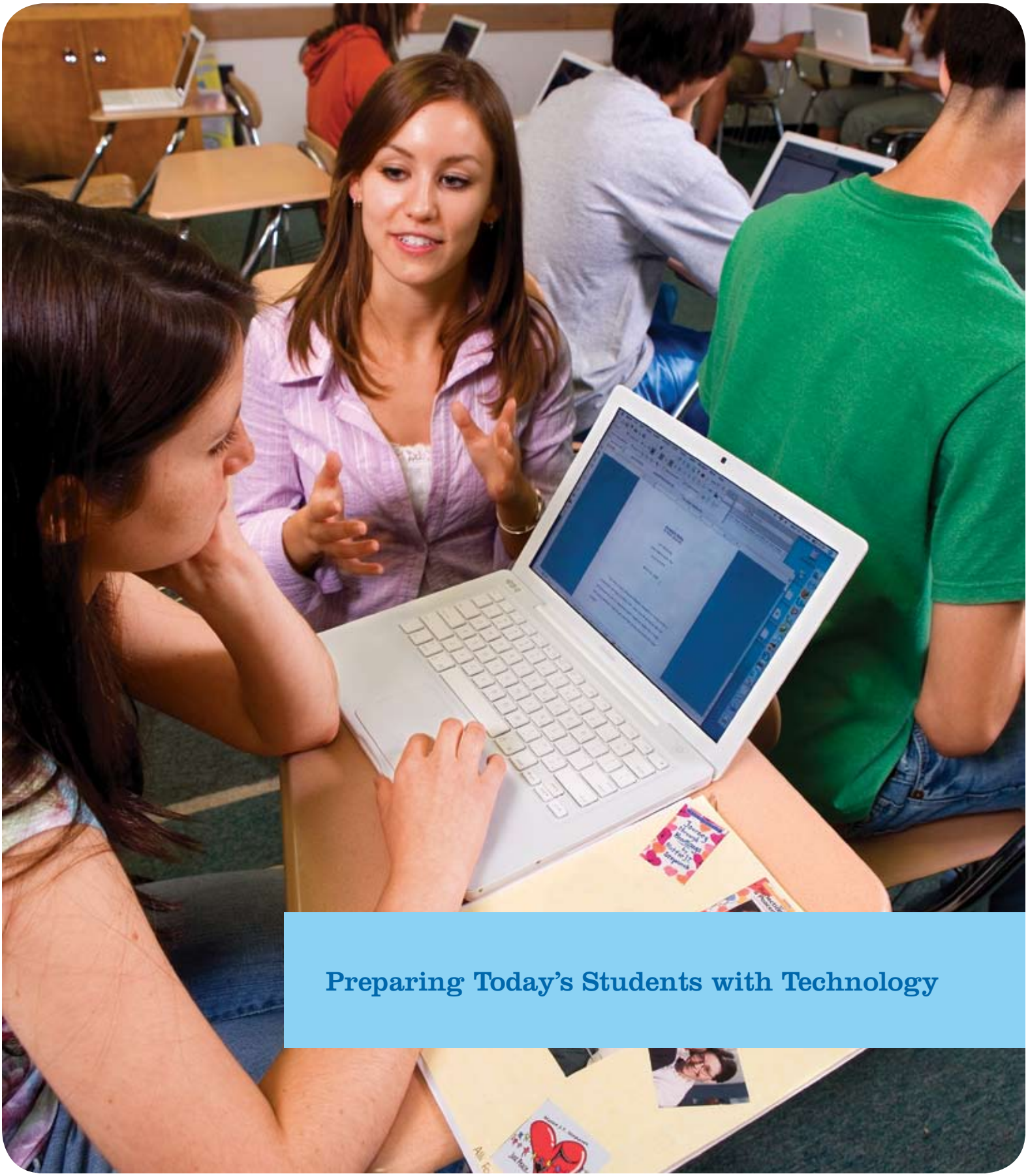
"I remember as a child my parents asking me 'What did you do in school today?' and I would simply answer 'nothing,'" continued Guinane. "But the parents of Mrs. McGann's students have commented that seeing the neat projects online helped them prompt conversation with their child. This was wonderful news for my mentor and me because that is the goal of the Web site—to make a connection between school and home."

Podcasting from the Classroom

At Radio Park Elementary School in State College, Pennsylvania, podcasting has stimulated the interest of third graders engaged in a science unit about energy and electricity. With the help of mentor teacher **Kimber Hershberger** and preservice teacher **Brittany Bird**, the third-grade "professors" wrote and produced a series of audio and video podcasts that provide supporting evidence of their scientific studies.

The podcasts featured classroom investigations and findings on a number of energy topics including the efficiency of solar cars; the principal of parallel circuits in electricity; and experiments with copper wire, a light bulb, and a battery. The background music in one of the podcasts was a piano track performed by a member of the group.

"Podcasting helped the students understand the process of using claims and evidence," notes Bird. "Engaging students in script writing encourages them to ask new questions about the science topic, deepens their conceptual understanding, and enables them to make their thinking public." (**podcasts.psu.edu/node/268**)



Preparing Today's Students with Technology

Preparing Today's Students with Technology

Students in the classroom constantly challenge teachers to keep pace with developments in technology. Teachers focus on conveyance of information and subsequent creation of knowledge. Students enjoy the freedom and scope of the technological tools available to them in the process. Future teachers in the college learn to use technology at its highest potential to make learning interesting, relevant, and fun for students.

Web 2.0 and Digital Expression

The K–12 classroom, as well as the higher education experience, is being transformed by technology, especially the World Wide Web. Technology not only makes instruction easier, but also prepares students for a future that is certain to be grounded in technologies.

The World Wide Web is undergoing a makeover. The Web has long been a global library of information, its sites standing as islands cemented in a static, logical order. The new-look Web is an interactive social network filled with blogs, podcasts, and wikis.

"Web 2.0 is about user participation," says **Cole Camplese**, director of Education Technology Services at Penn State. "Students today are into digital expression: 50 percent of them have MySpace accounts, most of which were created when the students were between the ages of 15 and 18."

Instructing the children of this digital age requires a new approach. "The evolving and emerging Web 2.0 technologies warrant strategies for incorporating them into Penn State's IT landscape," says Camplese. "Students will move their course work into these environments with or without us."

Many directly involved with younger students have observed how technology can engage students who are not otherwise enticed by the traditional books and paper of the classroom. These students are comfortable in cyberspace, and we must attempt to engage them there. To generate such engagement, our faculty have researched tools such as digital imaging, social networking, and blogs.

Digital Imaging

Susan Land and **Brian K. Smith**, faculty members of Penn State's Instructional Systems program, collaborated on a project to incorporate digital cameras and photo-journals into elementary school curricula. "We want to get technology into the everyday world of kids for the purpose of learning about nutrition and healthy lifestyles," says Land.

Land and Smith use the context of children's everyday eating behaviors, captured through imaging technology, as the anchor for the nutrition lesson. The students are given cameras to take home so they can photograph what they eat and how they exercise. They record their food choices and fitness activities over a short period of time. Then the students analyze artifacts developed from their photos in photojournals to perform food-group analyses, serving-size calculations, explanation building, and reflection.

"This provides the children with an experience-based approach to observe dietary choices and activity level, interpret their significance using nutrition concepts, and take action to practice healthy behaviors," notes Land.

Social Networking

Video games can be a valuable learning tool.

Doctoral candidate **Joey Lee** (information sciences and technology) and **Chris Hoadley**, associate professor of instructional systems, co-authored a study of fourteen high school students engaged in an MMOG (massively multiplayer online game). MMOGs are Web-based computer games that can be played simultaneously by large numbers of players from different locations around the world.

The fourteen students in the study carried out in-game activities in an MMOG as part of a five-week summer course. Within virtual worlds, the students interacted with both classmates and random strangers from other countries. They created online avatars (digital representations of their physical forms) and posed as someone different from themselves, a condition that helped them gain firsthand learning experiences with discrimination, sexism, and stereotyping. In the end, the students exhibited improved sensitivity toward diversity issues.

"We believe virtual worlds will find a place in classrooms to help students' understanding of human nature, how technology can bridge cultures, and how we can find unity amid differences," says Lee. "They serve somewhat as an equalizer, as anyone can create a new self online and perhaps face less prejudgment because of qualities like race or gender."

Lee believes that the opportunities afforded by virtual worlds are exciting from an instructional point of view. "The possibilities for learning are limitless," he says, "as you have a lot more control over the experiences students get to have. Students are using these virtual environments to learn about themselves and others, and because they're actively engaged, they're more willing to learn the content as well. For example, we use a virtual environment known as Second Life, in which students can explore, experiment, and learn everything from computer science, economics, architecture, medicine, politics, physics, math, and so on."

In another study on learning in online communities, Smith and **Priya Sharma**, assistant professor of instructional systems, are studying the use of strategies and tools in informal learning environments. In a project sponsored by the National Science Foundation, Smith and Sharma are looking at the informal mathematical and decision-making practices used by participants in an online fantasy basketball league.

Participants assume the role of team owners, trying to build winning teams by selecting quality athletes while working with limited salary assets. The Shaquille O'Neals, Tim Duncans, and other big names are more apt to help a team win, but they carry pocket-depleting salaries.

The study has important implications. "We hope to enhance everyday mathematical practices by augmenting existing activities with tools for reflection and data analysis," says Smith.

Sharma adds that studying fantasy leagues "may reveal knowledge use and learning that bear little resemblance to formal educational practices. We'd like to understand how game players' online discussions of strategies and techniques provide insight into their informal knowledge use and learning, specifically in decision making and resource allocation tasks."

Blogs

Blogging, or keeping an online journal, is an ideal technological tool for students in higher education. The concept fosters reflection thinking and writing skills in an informal way.

Sharma is working on a project that examines student use of personal Web publishing. The project implements a new tool that uses PHP programming code and open source codes and allows students to generate concept maps—diagrams similar to flow charts that show relationships among ideas. The concept maps are based on topics identified in the students' blogs. "The students have access to archived versions of reflections and organizational patterns within the concept maps," explains Sharma.

"We're trying to identify the progression of student thinking and reflection as illustrated by the concept maps and the Weblogs," she continues. "If we find evidence of reflection and organization, we will try to identify the level of reflection being illustrated."

Online Resources for Teachers

Teachers have more ways to access resources and share ideas through the World Wide Web. Several projects at Penn State seek to engage teachers at all levels of education. Through these resources, teachers are learning how to implement technological resources appropriately to engage students. They are also finding a number of online resources about different subjects, curriculum, and teaching techniques.

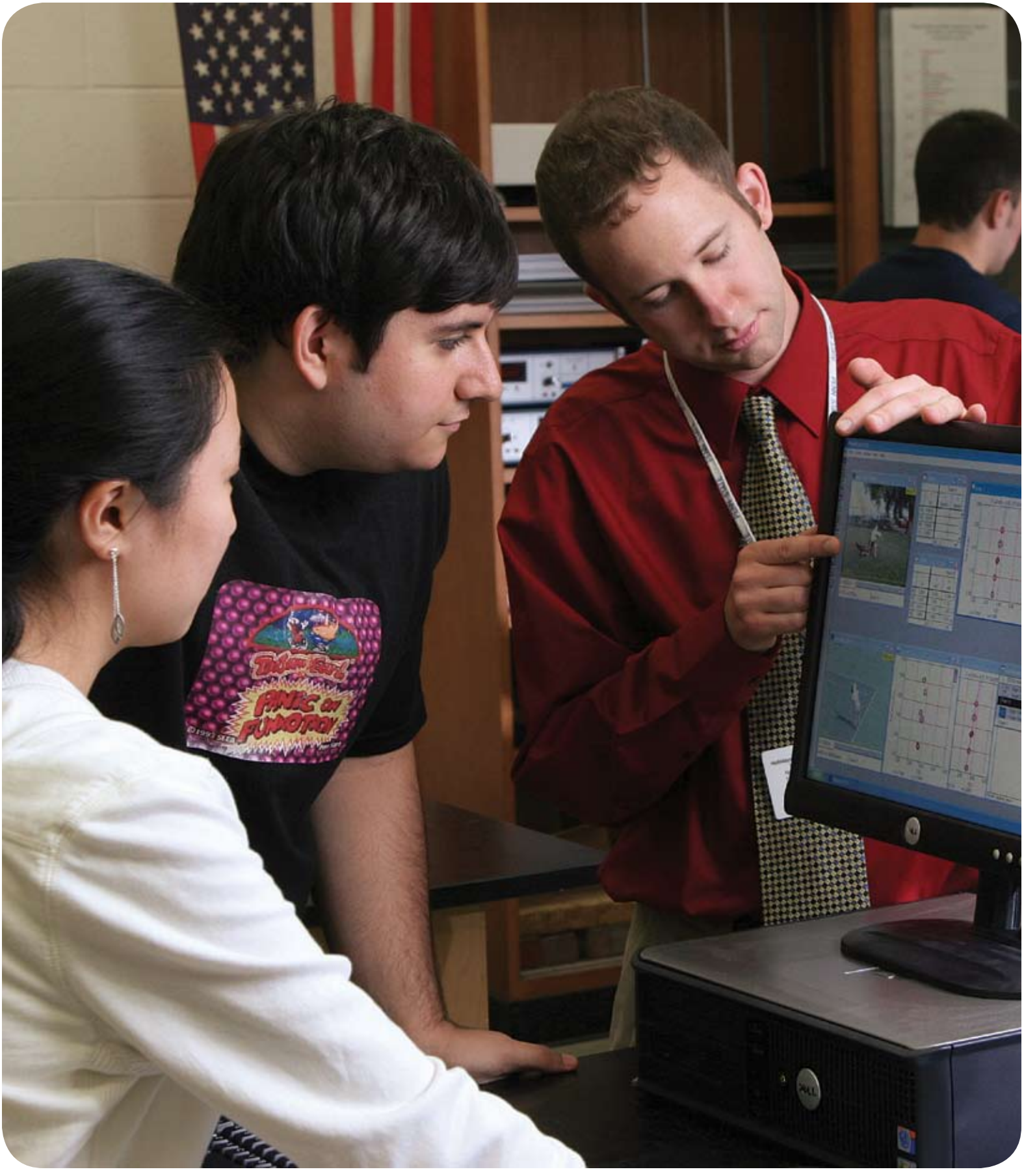
Penn State's **Center for Science and the Schools** (CSATS) connects Penn State scientists and educators in the K–12 field. Collaborations include work related to sustainable energy sources, hybrid vehicles, deep-ocean science, and gamma ray astronomy.

CSATS (**csats.psu.edu**) utilizes the Web to deliver useful resources to science teachers. "We must keep integrating technology to maximize the number of people we can reach," states CSATS Director **William Carlsen**, professor of science education.

CSATS was recently awarded a $27 million contract over five years from NASA to modify and manage a large part of its K–12 Education and Outreach initiative. Key to this program will be opportunities for professional development for current K–12 teachers in STEM (science, technology, engineering, and mathematics) areas related to NASA research projects, as well as a host of online resources and course materials.

In a current project supported by the West Penn Power Sustainable Energy Fund, CSATS has collaborated with Penn State Public Broadcasting to create multimedia instructional materials related to sustainable energy production. Science teachers and students can visit E21: Energy Education for the 21st Century (**www.pspb.org/e21/**) to download a wide variety of lesson plans, videos, and virtual activities.

Similar to the resources CSATS provides to K–12 teachers, the **MOCHA** (Modular Curriculum for Hydrological Advancement) project seeks to develop an interface and community to support teaching in higher education.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Sharma is collaborating with engineers at Penn State and elsewhere to find ways to use technology to enhance teaching practices and broaden the availability of well-designed teaching materials and resources to interested faculty.

"We're creating a Web-based interface where instructors can submit modules for a specific topic," explains Sharma. "The instructors log in and use a set of templates to guide good design and then upload a final module that can be accessed by other faculty once it's approved."

The researchers are currently designing the interface and the templates. Their plans include feedback process about the modules so they can continually improve the materials offered.

Recent developments in technology provide teachers with powerful technological tools for teaching mathematics, inevitably raising questions concerning the effectiveness of technology for teaching and learning mathematics.

M. Kathleen Heid, Distinguished Professor of Education, and **Glendon Blume**, professor of education, are currently co-editing two volumes on technology's impact on the teaching and learning of mathematics at the K–12 and postsecondary levels. With chapters authored by international technology leaders from seven countries, the first volume focuses on research results concerning technology use in the teaching and learning of various mathematical content areas (e.g., geometry, algebra, calculus) and broader issues such as equity, teaching, and mathematical modeling. **Rose Mary Zbiek**, also a Mathematics Education faculty member, has co-authored one of the chapters in the first volume.

The second volume presents developers' descriptions of research conducted in the process of their development of a variety of software and technology-intensive curricula for mathematics education. The second volume also addresses research issues related to the development of technological tools for mathematics instruction and implications of national policy on technology and education for mathematics education research.

One-to-One Computing Conference

Several hundred K–12 teachers gathered in June 2007 at Penn State University Park for the third annual One-to-One Computing Conference. The annual event connects teachers working with one-to-one educational technologies

One-to-one computing refers to programs where each student receives a computer to use in his/her studies and courses.

"The pioneers in effective one-to-one learning environments face many important questions, which serve as the focal points of this conference," says **Kyle Peck**, conference director and associate dean for outreach, technology, and international programs in Penn State's College of Education.

"The teachers who attended this conference are genuinely interested in transforming what they do with the technology that's at their fingertips," says **Cole Camplese**, director of education technology services at Penn State. Camplese delivered the keynote address, "Enabling the New Classroom Conversation."

In his address, Camplese called today's learners "the digital natives" who "expect administrative, educational, and entertainment technologies to be seamlessly integrated with personalized content. And they expect their instructors to integrate technology into learning in meaningful ways. It should be part of our mission to integrate something from their world every time we teach them."

Camplese referred to traditional education as "School 1.0." In this platform, teachers deliver prepared instruction while students sit in rows of desks and act as "mirrors" reflecting content back to the teacher. "But now that we've evolved to 'teaching and learning 2.0', expertise is gathered and shared by everyone in the classroom," explained Camplese. "The students are not mirrors; they are amplifiers."

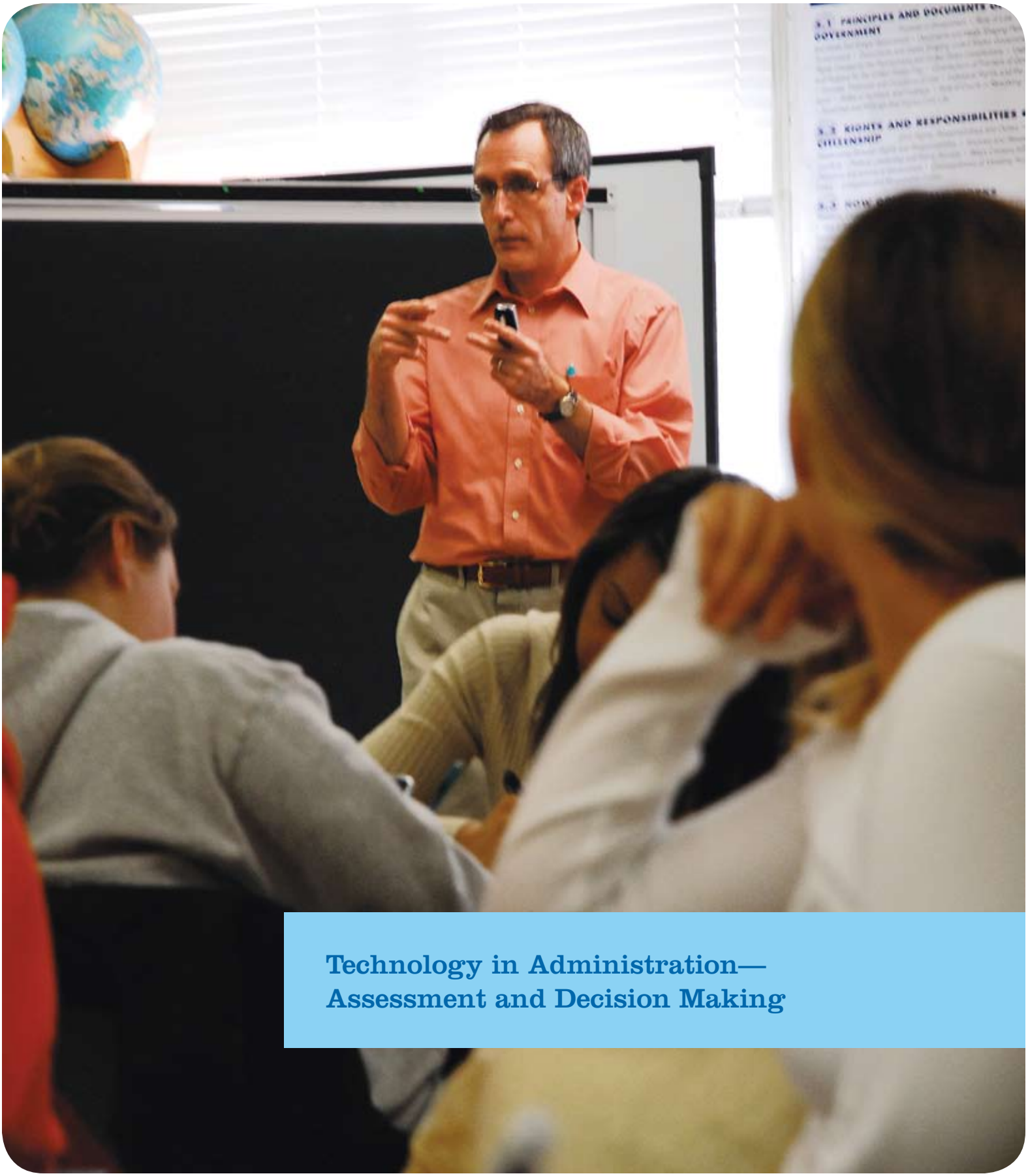
Camplese urged the teachers in attendance to "understand the technology tools. Encourage your students to use digital expression and provide platforms to support it. Create learning spaces that inspire fun, collaboration, and discussion."

Jeanette Black was one of four educators from various Pennsylvania school districts who engaged in an open panel discussion on how one-to-one computing has changed their classrooms. "Our school had positive results after only several weeks," revealed Black, a teacher and technology coach at Penn Cambria High School in Cresson, Pennsylvania. "The students' learning attitudes improved tremendously. Students saw the relevance of using technology in the classroom. Also, as teachers started to move toward more constructivist teaching methods, students were working hard and thinking critically."

One of the largest hurdles in one-to-one computing implementation is the possible misuse by students of computers and open networks while at school. Black noted that potential student misuse must be strongly discouraged at the onset. "You have to let them know up front that the laptop is a privilege and is meant to be an educational tool, not a game machine," she said. "And that has worked for us. Our students are not misusing their machines."

Teachers at Central York School District in York, Pennsylvania, have started using laptops in their classrooms and have noticed an improved educational quality. "The teachers report more student engagement—the work is more authentic and the quality is better," said **Sue Sheffer**, technology support teacher. "Two of our English teachers did a major poetry project and truly believe the students' understanding of poetry and the poems they wrote have never been better."

Sheffer added, "Those teachers involved in our one-to-one program have totally embraced it. They would never want to go back to teaching without the laptops."



Technology in Administration—Assessment and Decision Making

Technology in Administration—Assessment and Decision Making

Technological innovation is making it possible to more accurately assess students. Administrators and policy makers are also using technology to more accurately interpret data to make better decisions regarding curriculum and policy.

Assessment of Students

A problem facing teachers and administrators at all levels of education is that student achievement can be intangible to measure. Schools need an ongoing assessment of students' knowledge and capabilities. Reliable data must come from more sources than standardized tests. Through technology, we are finding new ways to assess students and understand the data provided by both traditional and nontraditional assessments.

Authentic assessment is a form of evaluation that engages students in real-world tasks that show their ability to apply their knowledge. It calls for administrators to assess student achievement by means of a rubric, a scoring device that can help measure subjective criteria against benchmarks. Teachers and administrators can measure the quality of student work more accurately, and the students become more precise and raise their expectations.

Rubrics, like many other evaluation tools, can burden teachers with a heavy workload. But rubrics have been undergoing constant improvement amid technological advances. **Kyle Peck** and several of his graduate students developed the user-friendly Rubric Processor, a refined evaluation and communication system.

The Rubric Processor is a Web-based point-and-click program that enables teachers to create online rubrics that automate the assessment-and-feedback process. It is a quick means of assessment across broad categories of knowledge. It aligns assessments with performance-orientated environments and paves the way for individual progress.

Electronic portfolios (e-portfolios) are quickly replacing cumbersome typewritten papers as a means for students to report their educational experiences.

An e-portfolio is a personalized, Web-based collection of materials that points to evidence of what a student has learned. It captures the elements of a student's reflective learning process through use of blogs, links to artifacts, and annotations.

E-portfolios are an easy-to-use instrument for PDS faculty to assess the performance of the student interns. But they are much more than an assessment tool. "The portfolio is an evidence-based philosophy statement from someone who is learning to teach young children," says **Carla Zembal-Saul**, a faculty member in science education. "When done right, assessment is indistinguishable from supportive learning."

Collecting and Reporting Data

Accountability in the schools requires proof in the numbers. For teachers and administrators, gathering

accurate data on students is a prerequisite to making important decisions about curriculum, discipline, and other matters.

Hard-core data reduces subjectivity. Decisions that are based on valid data are much more likely to be the right ones—and are much easier to make. Data-based decision making is practical now that technologies have become more powerful, less expensive, and increasingly available.

The **Regional Education Lab—Mid-Atlantic** is working with teachers and administrators to generate data about the schools and their students and to help administrators use that data in their decision making. The Regional Lab, housed in the College of Education and funded by the U.S. Department of Education, is a $34 million collaboration between Penn State, Rutgers University, and three consulting entities.

The lab enlists laboratory extension specialists living throughout a four-state region to gather questions directly from teachers and administrators. These specialists relay the schools' concerns to the lab's researchers. "The needs of the schools drive our research," says lab director Peck.

The Regional Lab's researchers review existing research related to a school's particular needs and returns a summary of findings in a timely manner. The lab also conducts experimental research to answer important questions for which research does not exist.

The College of Education also has a strong need for accurate data and reports. The college and its programs are frequently evaluated by the Pennsylvania Department of Education, by national accrediting organizations, and by our college's own internal mechanisms. Like other higher education institutions, Penn State is required to report the performance of its students. Technology can help improve our data-collection efforts and allow us to make better decisions about curricula and programs.

"Reporting to our accrediting agencies becomes an extension of the work that our students are doing, and technology provides us with tools to capture that work in ways that demonstrate to program reviewers the experiences and abilities of our students," states **Jacqueline Edmondson**, associate dean for teacher education and undergraduate programs. "As faculty members, we need to capture and analyze students' multimodal work in order to better understand the challenges and possibilities in their efforts. Technological methods including e-portfolio systems and electronic course-management systems provide us with tools to consider the complexities of teacher education so that we can deepen and extend student learning."

Classrooms for the Future

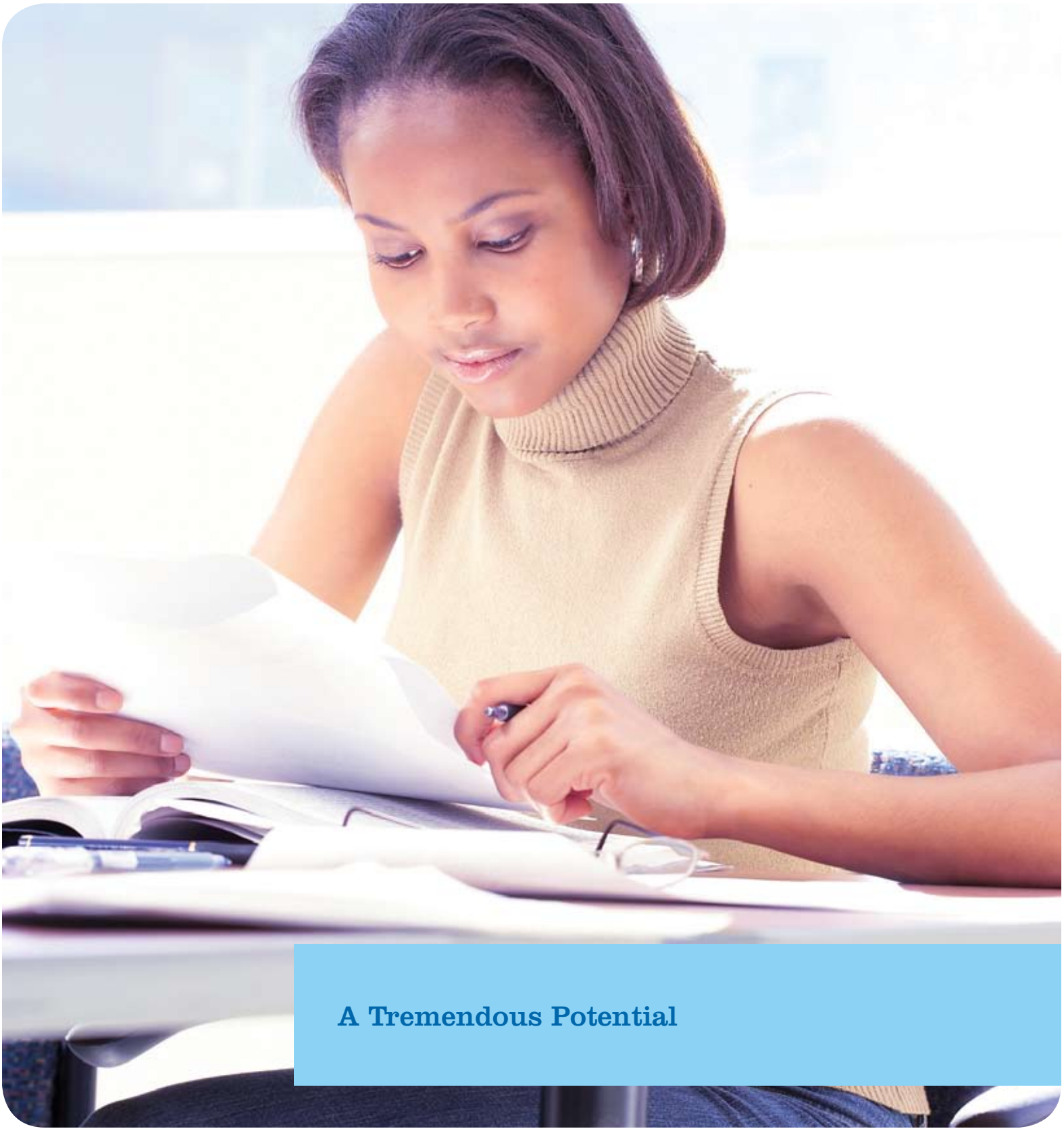
In recent years, widespread agreement has developed around the notion that twenty-first-century learners are different from those of past generations. Participating actively and collaboratively in learning experiences, creating digital artifacts, and engaging in online social networks are second nature for many of today's PreK–12, and even undergraduate, students. Couple the changing nature of the learner with our global economy, which is technology-rich and knowledge-driven, and there has never been a greater need for change in our education system.

One approach to addressing this issue is through thoughtfully planned and implemented one-to-one computing initiatives in which students are equipped with a digital toolset that includes a laptop computer and powerful software to support digital creation, interaction with others (locally and globally), and meaningful learning in the core subject areas. In some cases, the laptop is part of the students' learning experiences 24/7; in other cases, it is provided for use during the school day. The latter approach is consistent with Pennsylvania's Classrooms for the Future (CFF) project, which calls for a laptop computer on every public school student's desk in the four core subject areas by 2009. Professional development of teachers and school leaders is a fundamental component of the program, and is expected to contribute significantly to its long-term success.

To assess the CFF initiative, the Pennsylvania Department of Education has enlisted Penn State to gather and interpret data from participating schools. A thirty-eight-person team is interviewing principals, CFF coaches, technical coordinators, and grant administrators on topics related to evidentiary-based policies, and analyzing data from teacher and student surveys as well as classroom observations conducted by trained observers. "We are noticing promising early findings regarding the effectiveness of the CFF program," says **Robin Clausen**, co-director of the data collection effort.

As more states and school districts implement one-to-one computing programs, some problems have arisen. Some school districts across the nation have abandoned their technology initiatives, citing laptops as a distractive force that encourages children to go off-task. Furthermore, opponents to one-to-one computing cite a recent federal study that found no significant difference in standardized test scores between students who used reading and math software in their classrooms and those who used traditional study methods.

At Penn State, we feel that proper implementation is key to success. One-to-one computing, when appropriately managed and monitored, is a powerful educational tool that stimulates learning and is vital in preparing students for a highly technical future. Says **Kyle Peck**, associate dean of technology, "It's not what you have, it's how you use it. At Penn State we are dedicated to preparing teachers who can and will use technologies well."



A Tremendous Potential

A Tremendous Potential

We see in technology a tremendous potential for educating and engaging our students in new ways. Through the Internet, we are building online learning communities where our students are introduced to new ideas and our teachers are collaborating across geographical boundaries.

Robust computer programs promise to collect and report data more efficiently and more effectively, which will enable us to assess more completely the performance of both students and schools more accurately and with fewer disruptions in the classroom. Decisions about both curriculum and class sizes will soon be supported by stronger statistical evidence.

Technology will also be a key component in making our school buildings, campuses, and networks safer and more secure. Already, we are discovering

unique ways to protect our school communities. For example, some schools run visitor identification through law enforcement databases before granting access to the building. Other schools and universities are installing system-wide alert systems to notify teachers and students immediately of dangerous situations on campus.

Just as technology holds out potential for good, it can also be a part of the problem. For example, in addition to securing their physical campuses, administrators must protect their school networks from online hackers whose activities range from changing grades and stealing tests to stealing personal data on students, faculty, and staff. They must also protect networks and school machines from malicious computer programs, including viruses, spyware, and poor programming.

And as more and more schools introduce ubiquitous computing programs, or one-to-one computing, where every student receives a laptop, they need to be prepared to teach students about staying safe online.

One-to-one computing programs offer great promise, but some districts are realizing that successful implementation requires a great deal of planning. Teachers must be trained to incorporate the technology into the curriculum to improve the classroom experience— not to use technology just for technology's sake. Policies and restrictions regarding computer use must be communicated to students to minimize abuse of the privilege and to maximize learning.

It will take time for the education enterprise to learn how to use technology to its greatest advantage. Throughout this process, Penn State will work to recognize problems and limits, while continuing to prepare educational professionals to take full advantage of technology's promise to improve teaching and learning for future generations.

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