

Learning to Teach With Technology



Yolanda Mercer holds a beaker of water under a suspended weight as lab partner Megan Grady, right, collects data on the procedure during an Interactive Video Management course at North Carolina State University in Raleigh, N.C.

—Sara D. Davis for Education Week

More teacher colleges are incorporating technology education directly into math and science courses, rather than offering such training separately.

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Over the years, a common school science experiment involving an egg and a bottle has held a certain fascination for students and teachers alike.

A teacher lights a piece of paper, drops it into a milk bottle, caps the bottle with a boiled egg, and presto! Within seconds, the egg slides into the bottle, whole, and everyone is awe-struck.

Then comes what is far too often the hard part: explaining and understanding the complex science that lies behind this seemingly magical trick.

In his class to train preservice teachers in the use of instructional materials in science, John C. Park, an associate professor of science education at North Carolina State University, in Raleigh, uses a tool that breaks down the mystery of the experiment into digestible morsels: a digital video of the experiment that students can pause, rewind, and watch again, alongside a graph of the air pressure inside the bottle.

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They can watch as the pressure rises when the heat of the flame causes the air in the bottle to expand; as the increased pressure pushes the air out of the bottle, past the egg; and as the air pressure drops inside the bottle, causing the external air pressure to push the egg in.

Park is one of a growing number of teacher-educators who have in recent years started integrating technology into their courses on the science of teaching, or pedagogy, and to make learning in content areas such as mathematics and science easier, for both teachers in training and the students they will eventually teach.

Proponents point out that infusing technology into subjects like math and science makes it easier for students—both college students training to become teachers, and children in K-12 schools—to absorb and retain what they have learned, as in the egg-in-the-bottle experiment.

"They come to the understanding themselves and not by rote," says Glen L. Bull, a professor of instructional technology at the University of Virginia, in Charlottesville.

Trend Toward Integration

In years past, and even today in many cases, technology training in teacher colleges has been insulated from pedagogy and content courses. Usually, any classes in technology have been stand-alone offerings.

"Colleges of teacher education required more skill-based classes in technology: word processing, spreadsheet, and database classes that focused more on productivity," says Thomas Brush, an associate professor of instructional technology at Indiana University, Bloomington. "What you are seeing more of now in schools and colleges of education is a desire to integrate technology in the methodology portion and coursework."

In the 1980s, teachers and teacher-educators alike started to experiment with devices such as motion detectors to help explain the concept of acceleration.

"Some of the early studies back in 1988-89 that looked at this found out that it is quite effective, because the student's would collect the data and take time to analyze the data," Park says. "There seems to be a large difference in the student understanding of a concept" when a student can do so.

The technology has advanced by leaps and bounds since then. Data that once took two days to collect now takes a few seconds, Park says, making the use of technology in teaching content even easier.

That progress has led more colleges to work hands-on with their teachers-in-training to introduce technology into content areas.

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74 %	Download PDF ↓
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42	67
63	62
54	84
70	76
77	71
↑	↑
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"We work all the time with our science-methods faculty and math-methods faculty to look at new technological innovations," Brush says. He points to such gadgets as the Geometer's Sketchpad, a software program that allows students to build and investigate mathematical models, objects, figures, diagrams, and graphs, which he introduces to his teacher education students.

"It's a wonderful tool that allows students to conceptualize geometrical concepts," Brush says.

A hand-held computer to measure, for instance, water quality is another example of the kind of tool that teacher-candidates are introduced to in some science-methods classes at Indiana. "They can then download the data on a computer and do an analysis of the water quality," Brush says.

Brush and his university are now conducting a nationwide study that looks at how current and emerging technologies are being used most effectively in classrooms, and how best to prepare new teachers to use such tools.

Opening Vistas

At the University of Virginia's Curry school of education, science teachers in training can learn how to use a software program called Starry Nights to look at the configuration of stars over a period of 1,000 years—something that would not be feasible without technology.

Randy L. Bell, an associate professor of science education at the university, points out that it is also not possible for schools to hold a class in the middle of the night so students can study the stars. The program, he says, lets students actually observe the night sky, even if only virtually.

Bell works with other faculty members and students to develop technology-based materials at the education school's center for technology and teacher education. At the center, aspiring teachers have access to a range of software that can enhance teaching in an array of subjects, including math and science.

At the Massachusetts Institute of Technology's Undergraduate Research Opportunities Program, in Cambridge, Mass., students create computer games that will make math, science, and other subjects interesting for students and teachers.

"Entertainment and education in the past were entirely different worlds, but this new vision of education games is to make them one and the same," says Eric Klopfer, the director of the program.

One example is a game called Labyrinth, in which the player is lost in a frightening labyrinth, looking for a lost dog. The player—or the student—has to find a way out using such concepts as ratio, proportion, number sense, data, and geometry.

For technology to be most effective, teachers have to learn to use it well first. Yet getting professors, and even students, at teacher-training programs on board is often a tough sell, says Punya Mishra, an associate professor of educational technology at Michigan State University, in East Lansing, who has written several papers on the subject.

Mishra says faculty members at his college were initially more than a little wary when he and other colleagues began talking about integrating technology into pedagogy and content.

"They said the teacher education curriculum was already packed, and adding one more thing meant something else had to be taken away," he recalls. Part of the challenge for him and others working with him, he adds, was to integrate technology into existing courses without taking away current aspects of those courses.

National Standards

The National Council for Accreditation of Teacher Education, which accredits more than half the 1,200 teacher-preparation programs in the nation, has worked with the International Society for Technology in Education to come up with a set of technology standards that colleges seeking its imprimatur have to meet.

Among other provisions, the standards require teacher-candidates to exhibit knowledge, skills, and dispositions that equip them to teach technology applications.

Candidates also have to show they can use technology to support student learning of content.

There appear to be no data on how well developed most of the existing programs are, and what sort of technology education is offered at those colleges that don't seek accreditation from the Washington-based NCATE. Teacher-college advocates, however, say there is a growing awareness that the movement toward integrating technology is a step in the right direction.

Teacher colleges are now "deeply involved in integrating technology into teacher education," says Jane West, the director of governmental relations for the Washington-based American Association for Colleges of Teacher Education.

In February, AACTE's committee on innovation and technology released a handbook on using technology to enhance learning: a concept its creators call by the tongue-twisting title of Technological Pedagogical Content Knowledge, or TPCK. The book includes chapters on how colleges and districts can integrate technology into specific content areas, as well as professional development of teachers.

Joel Colbert, who heads the committee on innovation and technology, says the handbook seeks to make the point that stand-alone technology classes are now obsolete.

"We are saying that's not the way to integrate technology into teacher training, because each subject area uses technology differently," Colbert says.

Finding the Funding

Given that teacher colleges have always complained of being cash-strapped, a major hurdle for some colleges has been funding. In 1999, a federal grant program, Preparing Tomorrow's Teachers to Use Technology, or PT3, gave the fledgling movement to integrate technology into pedagogy and content a boost.

Donald G. Knezek, the president of the International Society for Technology in Education, located in Washington, says hundreds of colleges received help in getting their technology programs off the ground with the help of the grants. The last of those typically three-year grants were made in fiscal 2003. The program gave out a

total of \$400 million over five years, including \$125 million awarded in 2001 alone. When the program was first initiated, it was those colleges that already had begun work in teacher technology that benefited the most, Knezek says. "Others were just getting poised to write proposals and win funding for their programs when it was dismantled," he says.

Knezek says a number of colleges, despite the lack of funding after the PT3 grants ended, have continued to work on their technology-integration programs. Some have received other federal grants, including from the Fund for the Improvement of Postsecondary Education, while others have kept going with help from private donors.

At North Carolina State, Park not only teaches his own students about integrating technology into content, but also has been working with a science teacher and her 8th grade students at the Centennial Campus Middle School, located on the university campus.

Experiments using technology that they have worked on together have had a powerful effect on students' understanding of the material being taught, says teacher Ada Lopez.

For example, when Park brought in equipment such as conductivity probes to measure the rate at which crystals of various sizes would dissolve, students were able both to handle the equipment and successfully interpret the data collected during the experiment.

"We are giving the children ownership of their own education," Lopez says. "They are moving from memorizing facts to knowing how to find information and research it themselves."