Using Technology to Dig for Meaning

The Teaching for Understanding framework helps teachers select and wield the technological tools that hold the most promise for deepening understanding.

Stone Wiske

Teachers face a tremendously difficult job. They are expected to achieve a host of challenging and somewhat contradictory goals with large numbers of diverse students: Leave no child behind, cover a vast curriculum mandated by standards in every subject—yet differentiate instruction in response to each learner's particular interests and needs. Now these requirements are further complicated by demands that students learn "21st century skills," including effectively using new technologies; solving problems and applying higher-order thinking skills; collaborating with peers; and becoming continuing learners (NCREL & Metiri Group, 2003; Partnership for 21st Century Skills, 2003).

Preparing students to use digital technologies in particular adds a new layer of challenge to a daunting mission. Learning to read and write text is not enough; students must also be able to communicate and learn with multiple media and with networked, hyperlinked technologies. Considering this welter of responsibilities, it is no wonder that many teachers and administrators lack a clear consensus about what high-quality teaching—particularly teaching that incorporates new technologies—entails.

The Teaching for Understanding Framework

Teachers need a clear vision of—and agreed-on criteria for judging—effective practice. Teaching for Understanding is a pedagogical framework that provides such criteria, and can guide productive use of digital technologies. Teaching for Understanding and new education technologies are mutually beneficial partners (Wiske, Rennebohm Franz, & Breit, in press); the elements of the Teaching for Understanding framework guide teachers in evaluating and using technology to promote deeper learning in all disciplines.

New technologies can make learning interactive, engaging, collaborative, and linked to the world outside the classroom.

From 1989 to 1996, a group of teachers and researchers collaborated in the Teaching for Understanding Project at the Harvard Graduate School of Education. Their goal was to formulate a clear and coherent pedagogy of understanding. (For more extensive information on the history and applications of Teaching for Understanding, see Blythe, 1998 or Wiske, 1998.) They began by defining the kind of learning they hoped students would achieve. Students need to understand what they learn deeply enough to apply knowledge flexibly and in "real-world" contexts, not just on formal tests (Perkins, 1998).

Using Technology to Teach for Meaning

The five elements and their criteria do not dictate teaching any particular curriculum but serve as a design guide and assessment rubric. Teachers in a wide range of settings have worked with the Teaching for Understanding framework to develop curriculum, plan lessons, and integrate new technologies into their practice. The framework provides clear and specific criteria that...
teachers can use in analyzing the effects of new technologies on learning. This helps educators avoid digital applications that are educationally ineffective, trivial, or irrelevant to key goals.

In many schools, teachers are pressured to integrate computers or other technologies into their lessons and wonder how to blend students' "computer work" with the regular curriculum. The framework reminds educators to pose and answer a core question when considering a particular piece of software or an appealing Web site: How will this technology help students develop and demonstrate deep understanding of key curriculum goals?

New technologies can also make each element of the Teaching for Understanding framework more engaging and manageable for both teachers and learners. Such technologies as basic computer tools, e-mail and other forms of Internet-based communication, graphing calculators, and multimedia resources extend the teacher's repertoire of traditional tools to make learning interactive, engaging, collaborative, and linked to the world outside the classroom. The following examples show ways in which teachers have used technology to meet the criteria embodied in the Teaching for Understanding framework.

**Frame Generative Topics**

Linnie Regan, a teacher in Watertown, Massachusetts, used the Internet and electronic spreadsheets to help her 6th grade class explore the generative topic "Feeding the Family: Balanced Diet/Balanced Budget." Regan taught her class some nutritional information and reviewed mathematics skills related to unit pricing. She assigned small groups to purchase groceries for a week of balanced meals within a specific budget. The teams examined the database of an online shopping service to gather details about nutrition and prices. An electronic spreadsheet allowed students to organize, compare, and analyze information.

Data from many other online sources, such as the Bureau of Labor Statistics and the National Space Administration, can make curriculum more generative for students by connecting schoolwork to issues that matter in the world. Through interactive multimedia, students can approach a topic from more entry points than traditional textbooks permit.

**Focus on Understanding Goals**

Mary Teixiera at Tech Boston Academy used computer software called the Geometer's Sketchpad (www.keypress.com/sketchpad) to inspire high school students to conduct mathematical inquiry rather than reproduce mathematics proofs discovered by others. Her students constructed geometric figures and then analyzed such data as angles, side lengths, and ratios among different measures. They developed and tested their own conjectures by measuring, dragging, reshaping, and comparing geometric objects. The software, which records and displays the mathematical relationships of objects, allowed students to examine a set of similar cases, observe patterns, and
make generalizations. The accuracy and speed of the computer program freed students from the tedium of construction with traditional tools yet enabled them to experience the process of arranging and analyzing shapes.

New technologies help students understand concepts, methods of reasoning, and effective ways of presenting their ideas in many subject areas. Graphing calculators that instantly relate the graphic and symbolic representations of mathematical expressions can help students appreciate the nature of variables and functions. Computer-based simulations enable students to "see" and manipulate abstract concepts—such as density—and to model complex ideas like predator/prey relationships.

### Enliven Performances of Understanding

Professor Cesar Nunes at the University of São Paulo in Brazil increased his university students' understanding of physics concepts and programming languages by helping them create computer-based simulations of common events in the physical world. Students in his mechanical physics class made Newton's laws visible by simulating the motion of an elevator. Working in teams, they gathered data about the elevator in their classroom building: the height of each floor, the time it took the elevator to accelerate and decelerate between floors, and the capacities of the elevator motor (including power, energy, and consumption). Nunes showed the students how to analyze and represent their data in relation to forces and velocities and taught them to use a computer programming language like Macromedia's Flash to create animations.

Meanwhile, Nunes's computer science students employed Java, another programming language, to write interactive computer programs accessible on the World Wide Web. Finally, students from the two classes collaborated to craft a detailed simulation of the elevator. Their work became part of an archive of simulations that other students can tap to understand the application of physics to everyday objects.

Software that allows learners to create and present their ideas with multiple media (images, text, sound, video, dynamic models) can enrich performances of understanding.
Learning to read and write is not enough; students must also be able to communicate with networked, hyperlinked technologies.

Technologies help students produce rather than simply consume ideas—a fundamental part of understanding.

**Integrate Ongoing Assessment**
Miranda Whitmore and Janet Jehle of Lexington High School in Massachusetts worked together to enrich an American studies unit on the Harlem Renaissance using several new technologies. They identified numerous Web sites about the historical events in the 1920s as well as the creative works of architecture, poetry, music, drama, art, and literature produced during this period. The teachers organized this hotlist of resources with a set of guiding questions using an online tool called Filamentality to keep students' investigations focused on their understanding goals. Whitmore and Jehle created a study guide and an assessment rubric (based on student-generated questions) that students used as they conducted research online with the hotlist. An online shared journal became a forum where students reflected on their research findings and questions. Students used the assessment rubric as a basis for commenting on one another's journal entries and exchanging ideas in preparation for writing a critical essay.

Computer tools facilitate cycles of ongoing assessment. They capture work in forms that make revision much easier than it is with traditional composing tools. The Web allows students and teachers to post their work in places where they can get feedback from a wider range of critics, including authentic audiences who really care about learning from the students' work. Archives of student work, assembled as electronic portfolios, help students, parents, and teachers recognize and support student progress from year to year. Online projects engage students and their teachers in collaborative inquiry and social action initiatives with peers around the world, which also helps students develop a deeper appreciation for their own and others' cultures.

**Build Collaborative Learning Communities**
Kristi Rennebohm Franz of Pullman, Washington, tapped new technologies throughout her classroom to help 1st and 2nd graders participate in civic projects. Her students focused on local and global issues as they learned literacy, mathematics, science, and social studies. In one longitudinal research project conducted by successive classes over many years, students investigated a local water habitat that appeared to be deteriorating. They gathered data about the water pH, made observations about plants and animals living in the pond, and combined their findings with graphs, photographs, and carefully reasoned arguments. Using word processors, spreadsheets, and presentation software, they developed a Web site to document their research and prepared presentations for their City Parks Commission.

On the basis of the students' presentation, the Commission approved funding to restore the habitat and asked students to continue collecting data as a way of tracing the impact of this work. In subsequent years, the students shared the results of their local work with other classes and with peers around the world through an online program called the International Education and Resource Network (iEARN; www.iearn.org).

These are only a few ways teachers can use technologies to enhance the elements of Teaching for Understanding. As educators review potential technologies with an eye to the elements of effective teaching, they will see many more ways in which interactive, multimedia, networked, and hyperlinked technologies can spark active inquiry within students.
Bringing Teachers Together Online

In learning to use new technologies to teach for meaning, teachers themselves need to go through a learning process that reflects the Teaching for Understanding elements: identifying topics that intrigue them, choosing goals for their own learning, seeking multiple opportunities to apply that learning, and collaborating with other reflective professionals.

The WIDE World project at the Harvard Graduate School of Education (http://wideworld.pz.harvard.edu) brings educators together over the Internet to exchange ideas and resources on using research to improve teaching. This project supports a free interactive Web site called Education with New Technologies (http://learnweb.harvard.edu/ent). It includes examples (complete with multimedia pictures) demonstrating teachers' effective technology strategies. The site also offers an interactive Collaborative Curriculum Design Tool that helps teachers plan lessons with colleagues structured by the Teaching for Understanding framework. The interactive design tool provides examples of scaffolding and links to curriculum standards and other resources. A built-in message board enables lesson-planning design teams to exchange ideas and materials online.

Educators need a clear, coherent, and compelling model of effective teaching that holds them true to course through the turbulent crosscurrents of competing demands. They require common criteria for talking about the elements of good teaching—and for integrating technology in ways that inspire teaching for meaning. The Teaching for Understanding framework provides those criteria. New technologies help teachers apply the elements of this framework—making learning more generative, focused, active, reflective, and collaborative—in ways that would be more difficult with traditional school materials. This combination of a guiding framework and a rich toolkit of education technologies promotes the ongoing experimentation, reflection, and collaboration that lead to authentic learning.

References


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