Realizing Technology Potential through TPACK

This report was prepared by SIGTE leaders: Arlene Borthwick, president; Mike Charles, president-elect, and Melissa Pierson, immediate past-president; as well as NTLS representatives Ann Thompson, John Park, Mike Searson, and Glen Bull.

By the SIGTE Leadership and NTLS Program Committee

A participatory culture driven by user-generated content has emerged in the world outside schools. Each day, more than 100,000 videos are uploaded to YouTube alone. According to the Digital Ethnography group at Kansas State University, 80% of the two-minute video clips are created by the users who post them teenage authors working outside school (See Resources on page 26).

As this engagement with media and technology increases in youth culture, it encourages educators to consider ways to connect this enthusiasm to school content. With increased computer access by the digital natives in our classrooms and homes, many of us may be scratching our heads and asking the question: "Why is it taking so long for technology to be regularly used as an instructional tool?"

In most instances, uses outside school are not directly connected to school subjects or content. Connection to content is an important and non-trivial step. Instructional strategies (i.e., pedagogy) play a key role in connecting participatory technologies to content.

Technology, Pedagogy, and Content Knowledge (TPACK)

People are becoming aware that technology, pedagogy, and content are equally important in making connections to instructional objectives in school. Koehler and Mishra (2008) have highlighted the crucial role that these three elements contribute to realizing the potential of technology.

Each year, a coalition of educational associates, including ISTE, meet for the annual National Technology Leadership Summit (NTLS) (See *L&L*, Feb. 2008, p. 5.) The most recent summit focused on technology, pedagogy, and content knowledge. Prior to NTLS IX this was abbreviated as *TPCK*, but this abbreviation proved to be difficult to remember and pronounce. The acronym was changed to *TPACK* at NTLS IX to capture the idea of technology, pedagogy, and content knowledge as the "total package" of elements that are addressed in effective technology integra-

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Figure 1.

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tion. TPACK represents a unified way to better understand the role of digital technology as an educational tool.

NTLS provides an opportunity for leaders from ISTE's Special Interest Group for Teacher Educators (SIGTE) to meet with their counterparts from teacher education content area associations. For example, John Park participated as a representative of the Association of Science Teacher Educators (ASTE), exploring instructional strategies for use of emerging technologies in science teaching in conversations with SIGTE representatives and others at the summit.

As depicted in Figure 1, each area is represented as a distinct body of knowledge. Scientists and science educators work together at the intersection between content and pedagogy to address pedagogical content knowledge. Science educators and educational technology specialists, in turn, work together at the intersections of technological content knowledge and technological pedagogical knowledge.

We envision the heart of the teaching process at the intersection of the three as technological pedagogical content knowledge, or TPACK. As described by Melissa Pierson, "A teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge. The intersection of the three knowledge areas could be defined as effective technology integration" (p. 227). This, notably, is the point at which ISTE and ASTE might most profitably collaborate. This same concept could be extended to similar collaborations in other content areas.

TPACK as a Strategy for Technology Integration

A specific example may illustrate the value of TPACK. NTLS participants considered the application of the TPACK framework in the context of one technology—digital video—across several different content areas. Representatives from each subject area were able to explore possibilities with their counterparts from educational technology.

Digital video provides opportunities to rethink the instructional paradigm, and the best uses of it can vary substantially from one content area to another. The framework of TPACK provides a mechanism for exploring the best ways to employ emerging capabilities in each discipline and content area. Ways in which the same technology might be employed for different objectives in different subjects are illustrated in Table 1.

Each row of Table 1 represents an example from one discipline. Pedagogical goals vary, even within specific disciplines and content areas. Koehler and Mishra note, for example:

> In mathematics the pedagogical goals (and concomitant pedagogical strategies) for learning the multiplication tables are very different from those involved in learning algebra (such as the idea that *x* can stand for the unknown) or in understanding the trigonometric concepts of a sine function. The multiplication tables may be best learned through drill and practice or tutorials, algebraic variables through analogy, and trigonometry through simulations.

The actual solution space is far richer, with multiple technological approaches, but this table of examples suggests myriad possibilities. Our point here is that the full range of possibilities should be employed, matching the tool to the pedagogical goal and need.

Digital technologies make it possible to select and refine tools to address pedagogical needs in each discipline. For example in science, data acquired with sensors and probes can be synchronously displayed with video of an experiment (See Figure 2). The ability to provide linked representations in this manner can allow students to

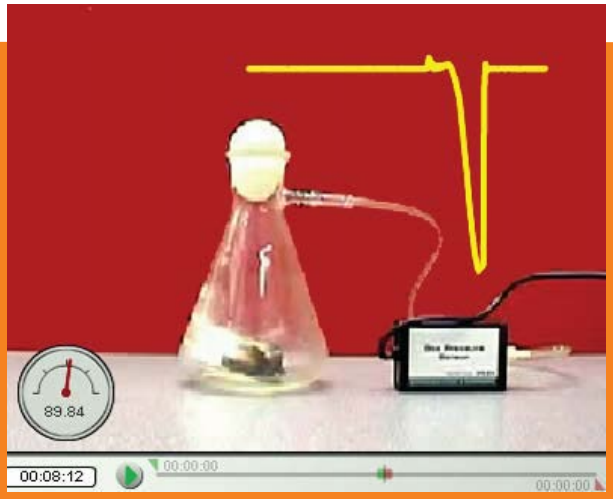

Figure 2. Computer screen synchronizing video of a science demonstration with pressure data displayed on a line graph.

visualize the meaning of a graph and connect the graph to pertinent features of the phenomenon studied.

In contrast to this use of digital video in science, Primary Access is a digital video tool developed to address the needs of social studies classes in a school environment. Primary source documents are at the heart of historical inquiry by scholars. Consequently, a media browser provides access to an archive of annotated links to primary source documents. A drag-and-drop interface allows students to mix photographs, maps, and documents with their own scripts in an online Story Editor to create short historical documentaries. (See "Learning by Remixing" in the May 2008 issue of *L&L*, p. 10, for a more detailed description.)

These two examples illustrate differing ways digital video tools can be designed to meet pedagogical goals in specific content areas (e.g., using experimental data in science and primary source documents in history).

One key to effective use of digital video is the recognition that the skill of the teacher, and not just the quality of the video, will determine whether these new capabilities make a difference in learning outcomes. For example, a comment tool in Primary Access allows teachers to view and provide feedback as students construct Web-based historical documentaries. In pilot trials, it appears that the students who achieved the greatest gains on unit tests were in classes led by teachers who provided specific feedback as students developed the digital documentaries.

All three aspects of the TPACK framework are in play when teachers develop instruction integrating digital video.

What's needed are examples of effective use of digital video within a TPACK framework. Development of a Screening Room with separate sections for each content area is one outcome of NTLS IX. The Screening Room was conceived as an online resource that allows educators to submit, view, and discuss applications of educational digital videos in a variety of content areas (See Figure 3). The

Figure 3. The SITE Screening room provides a space for a discussion of the effective uses of digital video in each content area.

project is supported by the Society for Information Technology and Teacher Education (SITE) in concert with partners from a variety of subject areas. The SITE Web site for support of digital video is freely available to any educator. If you have a digital video that portrays effective use of this technology in a specific subject area, SITE invites you to submit it.

Moving the Framework Forward

Advances in technology combined with widespread user participation clearly create opportunities in education that did not exist previously. We can assist teachers in reflecting, planning, and enacting instructional strategies based on the TPACK intersection.

For example, ideally, the science coordinator or lead teacher and the educational technology coordinator might work together to identify effective approaches.

The TPACK framework reminds us that effective integration requires deep understanding of content, pedagogical content knowledge, and thoughtful exploration of ways in which new capabilities of emerging technologies may intersect.

Recommendation

One answer to the question, "Why is it taking so long for technology to be regularly used as an instructional tool?" may be found in the observations of Koehler and Mishra, who realize the potential of the technology will require skills and knowledge not just of technology, pedagogy, and content in isolation but rather of all three taken together, requiring collaboration among those with expertise in each area. Accomplishing this will require leadership at multiple levels—both national and local. Just as representatives at the annual NTLS are working together to apply the TPACK framework, schools will need active leadership and participation of teachers, technology coordinators, curriculum directors, students, and other stakeholders for true integration of sustainable innovation.

Resources

Kansas State University Digital Ethnography group: Mediated Cultures, http://mediatedcultures.net

Koehler, M. J. & Mishra, P. (2008). Introducing TPCK. *Handbook of Technological Pedagogical Content Knowledge* (TPCK) for educators (pp. 3–9). New York: Routledge.

Pierson, M. (1999). *Technology integration practice as a function of pedagogical expertise*. Dissertation Abstracts International, 60(03), 711. (AAT9924200)

Primary Access: http://www.PrimaryAccess.org

Screening Room (developed by SITE): www.aace.org/site/sitevideo/

Society for Information Technology and Teacher Education (SITE): http://site.aace.org/