

Technology as an Agent of Change in Teacher Practice

~by Mark Girod and Shane Cavanaugh

As avid readers of *Technology Horizons in Education* (T.H.E. Journal), we were both disappointed to read the November, 2000 issue on the changing role of the teacher. As teachers ourselves we expected a discussion of the unique challenges and opportunities that teachers face as they and their schools embrace technology rich teaching and learning. We believed the editorial comments leading the issue foreshad-

Abstract:

This article was written in response to the November 2000 issue of *THE Journal* discussing the changing role of the teacher. Disappointed with the feature articles in that issue, we offer our own perspective on changes in teacher practice (thought and action) in the face of technology rich teaching and learning. Our paper suggests that rather than extend current practices, teachers must push for radically new and different practices as afforded by technology integration. Our discussion is organized into three sections discussing changes related to epistemology, psychology, and social and relational issues. The article ends with a call for teachers to apply creative and pragmatic tools in the re-crafting of technology to suit the needs of their own pedagogical styles, students, and contextual demands.

owed a rich discussion but instead, the four feature articles spoke very little to our work as teachers. Boice (2000, pgs. 86-91) discussed how technology has enabled better training for reading specialists in the diagnosis of children's reading difficulties. Klopfenstein et al. (2000, pgs. 73-76) modeled the thought processes involved in deciding to hire an outside firm to develop web materials. Zirkle (2000, pgs. 62-68) described steps to improve distance learning delivery systems. Granted, each assumes a more broad definition of teacher and speaks to issues relevant to educators in general. But as most teachers are still those in classrooms, with real and not virtual students in our charge, these articles weren't particularly useful or thought provoking. Herr (2000, pgs. 28-34), on the other hand, was the voice of the classroom teacher and offered insight and reflections on technology integration across the last ten years. However, even Herr's discussion lacked the forward-looking enthusiasm of most previous T.H.E. feature articles. Rather than discuss precisely how her pedagogy had shifted as a result of technology integration, she spoke broadly about changes in available technology, perceived student motivation, and attempts to provide more individualized instruction. Herr did address, albeit briefly, a few surface changes in her own role as the teacher from the sage on the stage to

the cliché guide on the side. Because we felt the concerns and issues of the common teacher were not addressed, we now respond with our own thoughts on the changing role of the teacher and teaching practices in technology rich learning environments. We have worked hard as teachers to adopt the changes in practice we offer.

From amplification to radical change, Pea (1985) wrote that we could think of technology in two ways:

(1) As a set of tools that amplify or extend what we currently do (make it better, faster, and stronger),

Or

(2) As something with the potential to radically change what we do and how we do it.

For example, the technology of a better saddle allowed riders to travel further and longer but the technology of a car completely revolutionized the way we even conceive of travel. Perhaps the argument is one of quality and not quantity. A similar argument exists in

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describing educational technology. Extending what we currently do as teachers only amplifies our current practices while using technology qualitatively differently affords radical change in the lives of teachers and the learning of students. The fact remains that using technology to amplify what we currently do describes the most common uses of technology in schools today. Common amplifications, such as the ones that follow, are often described as excellent uses of instructional technology.

- ❖ Using a laserdisc to supplement information and images from the text
- ❖ Using the web to find interesting facts to spice up existing curriculum content
- ❖ Using on-line or networked grading programs
- ❖ Using computer assisted instruction to supplement traditional instructional practices
- ❖ Using desktop publishing to make more pleasing class materials and handouts

Similarly, Boice's discussion of using technology to teach the diagnosis of reading difficulties is an amplification argument. Granted, using technology to help learn to diagnose reading difficulties is something we should explore but we ought to also stretch the bounds of technology and our minds in ways that might lead to radically new ways for reading specialists to diagnose and remediate students' learning. We found most of the discussion in the November issue to be arguments for amplification. We believe this line of thinking, an extension of the technology as tool notion, is shortsighted and only serves to limit the thinking of educators and innovators.

For these reasons, we've responded with a discussion of the changing role of

the teacher with a focus on the ability for technology to act as an agent of significant, and perhaps radical, change in teacher practice by significantly altering the way teachers, pupils, and schools operate. We are not arguing that amplification uses of technology are poor uses. We are simply arguing that amplification uses do not capitalize on the full potential and power of most technology resources. Asking to consider how technology can radically change what we do as teachers pushes our thinking to new levels and challenges us to re-organize, re-invent, and re-build our pedagogical practices, routines, and thinking in ways that reflect the changing technological and sociological climate in which our children are learning. We realize that in framing our discussion as a push for radical change we risk being viewed as techno-zealots and readers may consider our ideas as too different from their own. However, we firmly believe that successful technology integration comes in small steps. If amplification uses serve as

small steps toward more radical or profound change, then we support that. We hold, however, to our claim that eventually teacher practices will emerge as radically different than prior to technology integration. Individually, probably none of our points seem radical but taken collectively, they add up to significant changes. Our ideas can be viewed as suggestions for facilitating this transition.

The Breadth of Teacher Practices

Our discussion of technology as agent of change in teacher practice is organized as descriptions of change in three areas:

- (1) changes in epistemology;
- (2) changes in psychology as applied to learning, and;
- (3) social and relational change.

Each section discusses these changes and provides examples from our own experiences, as well as others, which exemplify these new ways of thinking and acting.

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Changes in Epistemology

Epistemology is the branch of philosophy associated with the nature of knowledge. This section discusses changes in the organization of subject matter and the kinds of knowledge that qualify as school-worthy. Most teachers allow textbooks to frame their discipline as neat and clean, with bold-faced words, clear definitions, staged photographs, and overly obvious real-world examples. In science, Gerald Holton has referred to this "sterilization" of curriculum as only teaching public science. The science of textbooks and journal reports - the logical, well-ordered side of science

What is hidden from nonscientists is private science; messy, disordered, exciting science in the process of being done. Public science is objective and factual; private science is subjective and emotional (in Flannery, 1991, pg. 585-586).

Technology rich classrooms can free teachers from the bounds of textbooks. Asking both teacher and student to venture out onto the web to find the most up-to-date, current, and cutting-edge content available. Students can often gain access to the same kinds of information practicing professionals have available. Moving outside a textbook to see subject matter in its more "private" form is liberating but also dangerous. It puts a great deal of pressure on both teacher and student to make sense of data, to filter extraneous information, focus on important subject matter ideas, and demands that both teacher and student become good consumers of knowledge. We return to this notion of learning to be knowledgeable consumers in the next section.

A great deal of information and opportunity exist on the web but

teachers must learn how to access it, use it in effective and efficient ways, and frame it for their students so they will find it useful and productive in their learning. The teacher must change from one who walks the predetermined bounds of the text and subject matter to one who pushes new boundaries of knowledge, resources, and content organization. This is a daunting task for most teachers, one which teachers must learn to be comfortable doing. In a recent conversation with a teacher who had worked in a charter school in which teachers and students were not given texts, and curriculum was to be found in primary sources existing on the web, he argued that any attempts such as this were bound to fail as, in his words, "Worksheets, vocabulary lists, and regular tests do not exist in abundance on-line." Most teachers have come to similar conclusions as they consider ways to use the web. Searching for worksheets and such only allows the web to amplify current curriculum, not moving it beyond its "public" image. Rather, teachers must begin to reconsider what course content is or should be. Couldn't one teach a great portion of a weather unit using real-time weather data from cnn.com? Raw weather data is knowledge of a very different sort than knowledge found in a weather chapter in a textbook.

Teachers must learn to first recognize this knowledge as useful and then learn to utilize it and other alternative forms of knowledge in their efforts to facilitate learning. Teachers must shift their thinking from bold-faced words and questions at the end of the chapter to situated activities and subject matter ideas, real-world tasks, and authentic performance tests. For example, using

primary sources found at a site called Valley of the Shadow (<http://jefferson.village.virginia.edu/vshadow2/>), the second author has helped to guide student inquiry around notions of gender, social class, and ethnicity in and around the Civil War. Because students read actual articles from actual civil-war era newspapers, the issues are often not nearly as clear and the nuance of voice and political stance greatly varied but the educative power of these sources is unmatched by textbook accounts of the same period. Primary sources offer a sense of real-world messiness that can be used in pedagogically powerful ways. However, teachers must begin to view these sources as not quantitatively "lesser" than existing texts but qualitatively different requiring different methods of use, interpretation, and outcome.

Changes in Psychology

As alluded to in the previous section, we believe technology suggests a significant change in our thinking about student learning. In traditionally low-tech environments students are often viewed as receivers of knowledge (in the worst case scenario) or constructors of knowledge (in the best case, constructivist fashion). We believe the unprecedented access to information that technology affords, demands a shift to more forward-looking notions of students as consumers of knowledge (in addition to knowledge constructors). Teachers must model methods for judging the trustworthiness of information such as checking it against other sources, executing mental experiments to investigate the logic

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of purported claims, and asking critical questions about the origins of claims. Students should be taught to scrutinize knowledge carefully and hold all information as suspect until a reasonable level of certainty can be established. This is difficult and time consuming for both teachers and students as it demands skepticism first. However, becoming a good consumer of knowledge and information are skills we'll all need as the web continues to expand. We recognize that this is not necessarily an issue related to technology as the sheer volume of media messages continues to increase. We do believe, though, that the web, with its complete lack of standards for integrity, serves to magnify this problem.

In addition to viewing the learner differently, technology asks teachers to view learning tasks differently. Rather than asking students to complete pre-determined and well-defined tasks such as worksheets, step-by-step lab experiments, and projects designed with a single goal in mind, teachers must embrace learning activities that are ill structured, ill defined, and open-ended. Useful here is the concept of design, teachers must design learning activities and students must design learning projects that make use of technology resources and subject matter ideas. For example, rather than completing a set of worksheets on moon phases students may be asked to investigate on-line tide tables and real-time video, make sense of data and observations, and represent their sense-making using tools that allow them to express what they have learned in different media. Design activities, from the perspective of the student, can be transformative as they lie at the inter-

section of subject matter ideas, personal strengths and motivations, and objects and materials for communication. Design is inquiry as it asks students to investigate phenomenon in ways individually relevant and interesting. Design is expressive as it asks students to engage with materials and subject matter ideas to produce a product. Design is authentic as the intent of design-based activities is to communicate or persuade (Mishra and Girod, 2000). It has been argued that design-based activities, afforded by expanded technology, has moved conversations about communications media and aesthetics to the foreground in many learning contexts (Ohler, 2000). Teachers must come to embrace the act of design and design-based activities as important tasks to facilitate learning in technology-rich environments.

Lastly, using technology, students can engage in activities and investigations that would otherwise be too difficult, dangerous, or expensive. Students can virtually mix volatile chemicals, melt pounds of gold, or split atoms all without the worry of cost and efficiency that may inhibit inquiry. Technology can also be used in ways that manipulate scale, to literally allow students the opportunity to see inside molecular structure and to speed up or slow down processes that may take generations or perhaps only nanoseconds. Technology affords very different opportunities that may spark a line of inquiry previously unimagined. Teachers must embrace these affordances and realize the implications for student learning. Rather than having a class full of students locked into a series of activities, a technology rich learning environment allows un-

limited avenues for inquiry. Teachers must learn to be comfortable with students working on different projects, at different levels, toward different outcomes, using different tools within the same class period.

Social and relational changes

In her article reflecting on changes brought about by technology, Herr does comment on the social and relational changes she's made in her own practice and pedagogy. Herr described how she has become more a facilitator of learning rather than a dispenser of knowledge (pg. 30) but this could also be attributed to general shifts in constructivist practices, not necessarily indicative of more technology rich learning experiences. Regardless, this shift is welcomed and noted. We would now like to expand on similar shifts.

Related to the notion of facilitating learning rather than dispensing knowledge are issues of power and social politics. If, for instance, the teacher and text are displaced as the sole arbiters of subject matter knowledge, ramifications follow for power relationships in classrooms. Many students may feel empowered by the freedom to learn, explore, and critique knowledge as it comes to them (or is created) in new media. Students are often thrilled to realize that, perhaps for the first time, they know more about the topic at hand than their teacher. Whether true or not, topics defined by texts and teachers limits the potential for students to experience feelings of expertise beyond that of their peers and teachers. Arguably, students who feel empowered as learners

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are more highly motivated to learn and generally more successful in their efforts to do so (for an excellent example see Girod, 1998). A great example is the act of publishing written products to the web. Upon realizing their work is now accessible to literally millions of people, students cannot help but feel a sense of pride, ownership, and expertise as their words and ideas are shared publicly. Teachers can capitalize on this power easily if

goals are shifted to empowerment of the learner.

Another issue related to social and relational contexts is exemplified by the practice of the second author. In this case, she has used technology to expand notions of “community” in her classroom. Her elementary students have on-line pen pals in various countries around the world, converse with NASA scientists about topics of interest, and contribute local wildlife data

to a global database accessible by scientists and students around the world. Her students think it quite odd that her grandmother never traveled further than 50 miles from her place of birth. Again, technology affords a shift in world-view to a more global notion of community and collaboration. Teachers must embrace this shift and capitalize on it pedagogically.

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Table 1 is a summary of the ideas presented in the preceding three sections.

Table 1: Changes in teacher role

Nature of change	Change from . . .	Change to . . .
Epistemological Related to curriculum and the reorganization of subject matter, content, and course materials	<ul style="list-style-type: none"> • Subject matter as ideas previously defined and delineated • Subject matter as represented in texts • Subject matter represented in familiar forms such as text, charts and graphs, and static models 	<ul style="list-style-type: none"> • Subject matter as tentative, authentic, and situated in real world contexts • Subject matter as represented in primary sources • Subject matter represented in unfamiliar forms such as databases, narratives, real-time video and audio, and dynamic models
Psychological Related to notions of student learning and how to design environments which facilitate learning most effectively	<ul style="list-style-type: none"> • Learners as receivers or constructors of knowledge • Learners as ‘completers’ of predetermined tasks and assignments • Learners engage in pre-designed and delineated inquiry 	<ul style="list-style-type: none"> • Learners as constructors and consumers of knowledge • Learners as designers of alternative representations of subject matter ideas • Learners engage in open-ended, unbounded inquiry afforded through simulation and virtual environments
Social and Relational Related to social norms, values, and power structures between teachers and students	<ul style="list-style-type: none"> • Teacher as keeper of knowledge, order, and power • Teacher as definer of learning contexts • Student situated in local learning community 	<ul style="list-style-type: none"> • Teacher as guide, subject-matter learner, and mediator of power • Teacher as pusher of contextual boundaries • Student situated in global learning community

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Finally, and also related to arguments made above, technology has the potential to dramatically alter learning contexts. It has been documented that most children do not view television as a media that demands much cognitive attention (Solomon, 1997). As a result, when watching instructional television in school, children simply fail to engage their full cognitive capacities in efforts to learn. All technology has the potential to fail similarly. Teachers must first begin to define contexts for learning differently and then treat technology resources as serious contexts for stimulating learning. Using technology only for games, drill and practice activities, and web-browsing reinforce the notion that technology and alternative media are less valuable as sources for learning than textbooks, the teacher, and other more commonly used materials. Why do we place this argument in the category of social and relational change rather than psychological change? Because we believe that broadening contexts for learning once again usefully undermines the power and authority of the teacher. We want students to view technology as on an equal footing with the teacher and their textbook when considering options for learning.

Conclusions

If we have led readers to conclude that technology holds the key to fundamental change in teaching, learning, and schools, then we have misled. Technology is not the key to radical change, teachers are. As the technology boom continues, teachers will continue to be faced with increasing pressure to integrate technology into their pedagogical practices. However, little will change as long as the per-

ceived pressure is uni-directional, meaning technology will not significantly transform the role of the teacher until teachers begin to also transform technology. Teachers are necessarily pragmatists. They seek means to desired ends and often find solutions in diverse and unlikely places. The average teacher, we argue, is a highly resourceful, intelligent, and creative person. Until teachers bring these powers to bear on technology to re-tool and re-orient technology resources in ways that make sense for their own students, contexts, and subject matters, technology will only be used as a tool to amplify current practices. Teachers must be given the time, support, and creative space to use technology in new ways, ways that will eventually significantly change their role in the classroom. Our goal was to briefly discuss a few of these changes.

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