Removing obstacles to the pedagogical changes required by Jonassen’s vision of authentic technology-enabled learning

Peggy A. Ertmera,*, Anne Ottenbreit-Leftwichb

aPurdue University, 3144 Beering Hall of Liberal Arts and Education, 100 N. University St., West Lafayette, IN 47907-2098, USA
bIndiana University, Wright Education Building, 201 North Rose Avenue, Bloomington, IN 47405, USA

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ABSTRACT

Educators have been striving to achieve meaningful technology use in our K-12 classrooms for over 30 years. Yet, despite significant investments of time and money in infrastructure, training, and support “we have few assurances that [educators] are able to use technology for teaching and learning” (NEA, 2008, p. 1). In this article, we call for a shift in focus from technology integration (and the tools used to achieve it), to technology-enabled learning (and the pedagogy used to support it). Building on the early work of Jonassen (1996) in which he proposed using technology as cognitive tools, we suggest that future technology integration efforts should focus on helping teachers engage students in authentic technology-enabled learning environments. As such, technology integration is no longer an isolated goal to be achieved separately from pedagogical goals, but simply the means by which students engage in relevant and meaningful interdisciplinary work. Implications for supporting teacher pedagogical change, from a system’s perspective, are discussed.

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1. Introduction

Although computers have been in the schools since the 1980s, the majority of teachers have yet to use them to support meaningful student outcomes (Keengwe, Onchwari, & Wachira, 2008; National Education Association, 2008). This is true despite ongoing, extensive efforts to eliminate key barriers believed to impact teachers’ uses including access, support, and training (Hew & Brush, 2007; Keengwe et al., 2008). It is not that teachers don’t recognize the importance of using technology in the classroom. As stated by Roblyer (1993), almost 20 years ago: “The greatest problem we face with educational technology has little to do with recognizing that it must be an essential part of teaching and learning. Rather it is a lack of clear vision as to its real purpose and usefulness in shaping the educational system of the future” (p. 13, emphasis added). Now, nearly 20 years later, we seem no closer to envisioning and achieving the kinds of powerful, purposeful uses needed to support meaningful student outcomes. In this paper, we urge educators to adopt an approach to technology integration that builds on Jonassen’s 1996 vision of using computers as cognitive tools to serve as partners with students during the learning process. This vision, then, focuses our technology integration efforts on the pedagogy that technology enables and supports, rather than on the technology itself. As such, our efforts in both teacher education and professional development must emphasize how, not what, technology should be used to achieve meaningful learning outcomes.

2. Background/literature review

The call for a pedagogical, rather than a technological, goal for technology integration is not new. Early work by Hadley and Sheingold (1993) and Becker (1994) laid the foundation by describing the ways computers were being used in teachers’ classrooms at that time. For example, based on the results of their survey of 608 teachers, Hadley and Sheingold concluded that computers were not being integrated into teachers’ core classroom practices but were serving, instead, as a supplemental activity. Becker (1994) reported similar results: the
majority of the 516 teachers he surveyed used computers for fact reinforcement and enrichment. And in 1996, the National Educational Assessment Program (cited in Cuban, 2001) reported that only 5% of the eighth grade math teachers they surveyed used technology to demonstrate new concepts in math, with the most predominate software application (18%) being drill-and-practice.

The publication of these results highlighted the fact that simply placing technology in teachers’ classrooms did not automatically lead to the kinds of uses envisioned and promoted by many at the time, which comprised using technology to achieve student-centered learning (Hooper & Rieber, 1995; Solomon & Perkins, 1996). Researchers for the Apple Classrooms of Tomorrow (ACOT) concluded, after their initial efforts to infuse classrooms with ubiquitous state-of-the-art equipment, that the most difficult effort related not to securing technology for the classroom but to the subsequent need for teachers to apply new ideas about teaching and learning (Fisher, Dwyer, & Yocom, 1996).

Educators have been advocating new ways to think about technology since the early to mid-1990s. For example, Derry and Lajoie (1993) proposed using technology as a mind-extension tool, becoming, as Solomon and Perkins (1996) termed it, “a partner in cognition with learners” (p. 124). Hooper and Rieber (1995) suggested that educators design environments that advanced students’ learning potential by maximizing available technological capability. Similarly, Fisher, Wilmore, and Howell (1994) proposed using technology as a tool to facilitate new interaction patterns and activities that could simultaneously alter both the means and the ends of classroom practice.

In 1996, Jonassen penned what has become a common way to categorize how students interact with technology: learning about technology (technology as a subject), learning from technology (technology as a delivery tool) and learning with technology (technology as a cognitive partner). In his seminal work on mindtools, Jonassen encouraged teachers to go beyond the typical uses of computers to engage students in, what we term in this paper, technology-enabled learning. That is, according to Jonassen and Reeves (1996), technology is best used when students, not teachers, use it as a cognitive partner or tool to access and analyze information, interpret and transform that information into their own personal knowledge, and then represent that knowledge to others. As defined by Jonassen and Reeves (1996), “Cognitive tools are essential components of a learning environment in which learners are required to think harder about the subject-matter domain being studied or the task being undertaken and to generate thoughts that would be impossible without these tools” (p. 697).

As expressed in his early work (1996) and elaborated on in his later writings (Jonassen & Carr, 2000; Jonassen, Howland, Moore, & Marra, 2003), Jonassen’s vision for technology integration focused on preparing students to use technology as a tool to accomplish authentic tasks and/or solve authentic complex problems (Howland, Jonassen, & Marra, 2012). As such, Jonassen recommended that technology be placed in the hands of students to serve as intellectual partners during activities requiring problem-solving or critical thinking. It is important to note that Jonassen, himself, never presented his ideas for technology integration in terms of a vision statement, per se. Rather this vision has been extracted from the large body of work he published, much of which coalesces around two or three key themes related to meaningful, student-centered learning and authentic technology use (Howland et al., 2012; Jonassen et al., 2003). Key to many of these publications, and central to the theme of this paper, is the idea of authenticity. That is, Jonassen promoted the idea that technology is best used when it enables learners to do real work; in fact, it is the authenticity of work that makes technology necessary. This, then, is the vision we propose as the basis for this paper: technology as a cognitive tool to facilitate authentic student learning, or technology-enabled learning.

3. Changing technology tools; unwavering pedagogical goal

Although the technology tools have changed since 1996, the goals outlined by Jonassen’s pedagogical vision for those tools remains the same. As just one example, in 1996, Jonassen described how educators might use socially shared cognitive tools, such as asynchronous and synchronous computer conferencing software, to engage students in collaborative, informal reasoning. At the time, these tools included email, listservs, and bulletin boards, which Jonassen proposed as the means to create global classrooms and to facilitate electronic mentoring and virtual field trips. Since the time these ideas were first published (1996), technology has evolved dramatically (Cormode & Krishnamurthy, 2008; Deans, 2009) and Web 2.0 tools now offer almost unlimited opportunities for students to collaborate and problem solve together (Bull et al., 2009; Schrum & Levin, 2009). As noted by Greenhow, Robelia, and Hughes (2009), Web 2.0 tools have the capacity to connect learners to a wide network of critical others who can offer feedback or support.

It is important to note that the goals that Greenhow et al. (2009) indicated could be achieved through the use of Web 2.0 tools are similar, if not identical, to those Jonassen (1996) suggested over 15 years ago. Because Jonassen’s technology integration vision focused on using technology as a cognitive tool to facilitate authentic student learning, his vision remains relevant today. As noted by Prensky (2010), it is more important to consider the “verbs” of learning than the “nouns” (or tools), simply because tools continually change: “The verbs of learning (e.g., understanding, communicating, presenting, persuading) are unlikely to change for 21st century students. They are the ‘stuff of education, the skills we want all our students to have’” (p. 97). Unlike the verbs, however, the nouns/tools constantly change as technology continues to evolve. And by turning our attention to the verbs of learning, we align more closely with what Jonassen urged us to do in 1996 – to shift our emphases from technological tools to pedagogical goals in both significant and impactful ways.

4. Teachers’ efforts to achieve technology integration

Despite concerted efforts of educators at all levels (U.S. Department of Education [U.S. DOE], 2010), we have yet to achieve meaningful technology use in the majority of American classrooms. Although most teachers have shifted away from implementing classroom activities designed for students to learn about technology, students in today’s classrooms still tend to learn from technology, using it primarily as a delivery tool. Based on the results of the 2007 Speak Up survey (Project Tomorrow, 2008), 51% of responding K-12 teachers reported that their primary uses of technology to facilitate student learning comprised (a) requiring students to complete homework assignments (e.g., writing reports, researching online) and (b) assigning practice work (e.g., using drill-and-practice software). These results were verified by the large percentage of students who, during the same time period, reported using technology to (a) write assignments (74%), (b) conduct online research (72%), and (c) check assignments or grades online (58%). In a 2008 follow-up survey (Project Tomorrow, 2009), teachers reported using digital resources primarily as teaching aides (66%). More recently, Project Tomorrow (2011) reported that the percentage of teachers who are using technology primarily for student homework increased by 61 percent from the previous year.

As concluded by the National Education Association (NEA-AFT, 2008), “We are still woefully short of classroom environments that permit students to engage with technology in a way that prepares them to use technology in the real world” (p. 12). More specifically, the majority
of teachers have yet to achieve the kinds of classroom uses recommended by Jonassen: technology as a cognitive tool to facilitate authentic student learning. In order to understand the potential causes for this gap, we examine the current status of technology integration enablers and barriers.

5. Technology enablers and barriers

In 1999, Ertmer distinguished between first-order barriers, which are external to the teacher (e.g., resources, training, support) and second-order barriers, which are internal (e.g., attitudes and beliefs, knowledge and skills). Since that time, a number of researchers have outlined the various barriers and enablers that impact teachers’ classroom uses of technology (Ertmer, Ottenbreit-Leftwich, & York, 2006–2007; Hew & Brush, 2007; Lowther, Strahl, Inan, & Ross, 2008; Zhao, Pugh, Sheldon, & Byers, 2002). In a review of 48 research studies published in the previous ten years (1995–2006), Hew and Brush (2007) found that resources were the most commonly reported technology integration barrier (40% of the studies). Lack of resources included limited hardware, access, time, and technical support.

However, recent statistics suggest that a great deal of progress has been made toward addressing the first-order barriers that seemed to hinder teachers’ technology integration efforts in the past: access has increased to an average ratio of 3.8 students to every Internet-connected computer (National Center for Education Statistics, 2006); training opportunities have improved with 95% of reporting school districts offering professional development related to integrating technology into instruction (Gray & Lewis, 2009); and school districts and policy makers have invested significant amounts of time and money in infrastructure, training, and support to facilitate teachers’ efforts (NEA, 2008). On the surface, at least, these efforts appear to have been effective: in 2008, 76% of educators reported daily use of technology at school (NEA, 2008). In addition, responses to the Teachers Talk Tech survey (CDW-G, 2006) confirmed the development of teachers’ technology skills: 63% (n = 630/1000) rated their skills as “somewhat advanced” to “advanced,” while only 2% rated themselves as beginners. Although there is room for growth in terms of access to resources and opportunities, given the relatively large gains made in recent years, one would expect to see a corresponding increase in teachers’ instructional uses – specifically in terms of students learning with technology.

And yet, we continue to wait for this to happen. Why is that?

Drilling down into the NEA (2008) data, specifically related to professional development opportunities, we find that the majority of teachers’ technology training has been geared toward administrative uses, research, and communication. Only slightly more than half (57%) of responding teachers felt adequately prepared to use technology directly with students, and there was no report of how, or the extent to which, teachers are allowing students to use the technology tools directly, as recommended by Jonassen (1996). In general, teachers reported feeling much more prepared to complete administrative tasks using the computer than instructional tasks (NEA, 2008).

In addition, although teachers reported using technology to facilitate student learning, only a third of the respondents to the NEA, 2008 survey required their students to use computers more than a few times a week. Furthermore, ‘facilitating student learning’ typically translated into teacher-centered, or traditional, uses of technology (e.g., PowerPoint presentations, use of drill–and–practice software) – a far cry from Jonassen’s vision, which advocated that students use computers as cognitive partners to facilitate authentic, higher-order learning. Sadly, the types of classroom uses reported by recent surveys (NEA, 2008; Project Tomorrow, 2008; 2009; 2011) rarely include those that engage students in the kinds of authentic inquiry-based, problem-solving activities envisioned by Jonassen (1996) and advocated by best practice (Lawless & Pellegrino, 2007; Partnership for 21st Century Skills, 2007). Thus, in order to facilitate these types of technology practices, it is imperative to consider the role second-order barriers and enablers play in the integration process (Ertmer, 1999, 2005).

Although first-order barriers, historically, have played a significant role in teachers’ integration efforts (Hew & Brush, 2007), second-order barriers are currently recognized as the true gatekeepers (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). That is, while some teachers with few resources (those who have a high level of first-order barriers) have been observed to achieve high levels of integration (Ertmer, GopalaKrishnan, & Ross, 2001), teachers with many resources but strong traditional beliefs have been observed to limit their students’ technology uses (Palak & Walls, 2009). In fact, Palak and Walls found that even in technology-rich schools, the majority of teachers continue to use technology in ways that support their existing teacher-centered practices.

This is not to suggest that a lack of technology resources cannot act as a gatekeeper, but that teachers with strong beliefs in the pedagogical value of technology have been observed to overcome these barriers (Ertmer et al., 2012). Given this, we reiterate the urgent need, expressed earlier, to shift the focus of our technology integration efforts from one that emphasizes obtaining more technology resources to one that emphasizes the development of the pedagogical beliefs that enable teachers to work with current resources to achieve meaningful technology use, as advocated by Jonassen (Jonassen & Reeves, 1996).

5.1. Teacher beliefs

There is recent evidence (Sang, Valcke, van Braak, & Tondeur, 2010) to suggest that one of primary reasons teachers have not enacted the kinds of authentic, student-centered practices promoted by Jonassen (1996) relates, in general, to teachers’ underlying beliefs about teaching and learning (Ertmer, 2005; Overbay, Patterson, Vasu, & Grable, 2010) and, more specifically, to their beliefs about the role technology should play in the classroom (Tondeur, Hermans, van Braak; & Valcke, 2008). Recent studies (Andrew, 2007; Hermans, Tondeur, van Braak, & Valcke, 2008; Inan & Lowther, 2010) have demonstrated a strong relationship between teachers’ pedagogical beliefs and technology practices. More specifically, teachers’ student-centered beliefs tend to result in more authentic uses of technology while traditional beliefs tend to have a negative impact on the integrated use of computers (Hermans et al., 2008). Unfortunately, it is our students who suffer from this shortcoming. A recent survey of over 400 U.S. employees indicated that our high school graduates are lacking most of the 21st century knowledge and skills they will need to be successful in their future careers (Lowther et al., 2008).

Based on the results of two recent studies by the authors (Ertmer et al., 2012, 2006–2007), student-centered beliefs were perceived to act as a facilitative factor in teachers’ technology integration efforts, enabling them to circumvent first-order barriers typically encountered in schools and classrooms. This suggests that the best way to bring more teachers on board is not by eliminating more first-order barriers, but by addressing the second-order barriers of attitudes and beliefs. Although efforts are still needed to provide ubiquitous technology access to teachers and their students (U.S. DOE, 2010), little will be gained if second-order barriers are not addressed. By starting with, and building on, Jonassen’s vision, we believe that we can effectively initiate the required change process.
6. Building on Jonassen’s vision to promote pedagogical change/ transformation

Although not in the majority, there are many teachers who have successfully used technology to enable and support meaningful student learning, such as those recently described by Ertmer et al. (2012, 2009). When teachers embrace a vision similar to the one expressed by Jonassen (1996), the resulting classroom practices often comprise a form of transformative pedagogy (Keengwe, Onchware, & Onchware, 2009). For example, in our study examining the beliefs and practices of 12 award-winning technology-using teachers (Ertmer et al., 2012), we found that the three teachers with the most student-centered beliefs were also the ones implementing the most innovative and authentic classroom practices. In order to provide current examples of how Jonassen’s vision might be implemented using new technology tools as ‘cognitive tools,’ we offer a brief description of these three teachers here. For more details please refer to Ertmer et al. (2012).

According to these three teachers, technology offered the means by which they could experiment, implement, and refine a student-centered, technology-enabled approach to teaching and learning. In other words, these teachers didn’t use technology in their classrooms as a means to deliver traditional instruction; rather they had changed, or were in the process of changing, their instructional approaches to enable student-centered uses, such as those described by Jonassen (1996). As noted by Garcia, a middle school science teacher, “You cannot use traditional methods to teach the 21st century student.” Barnes, a middle and high school language arts teacher with 19 years experience, stated that his pedagogical changes were, “not a technology thing, but [more about] changing [my] philosophy.” Our third example, Crosby, a fifth grade teacher with 30 years experience, stressed that “technology leverages [a project-based approach] to the max” and allowed him “to give people a taste of what a classroom with 21st century pedagogy could look like.” It is important to note that the primary focus for these teachers was on enacting student-centered pedagogical approaches. Contrary to how technology is typically used by the majority of teachers, technology played a secondary role, simply providing the means by which these 21st century learning goals could be achieved. In other words, these teachers were enacting Jonassen’s vision of technology-enabled learning.

According to Jonassen and Reeves (1996), cognitive tools enable learners to represent what they know. As one example, Crosby’s students used Web 2.0 tools to collaborate with other students across the United States. Each small group, consisting of students from both classes, was responsible for researching a specific energy source (e.g., wind, solar). The groups used Google Docs to establish their research questions, form outlines, and organize information gathered from the Internet. The groups were also charged with developing and executing two experiments that corresponded to their energy source. Both of these tasks were designed to use technologies as cognitive tools as they were “situated in realistic contexts with results that [were] personally meaningful” (Jonassen & Reeves, 1996, p. 704). Furthermore, Crosby described how his students used blogs, Skype, and a wiki page to communicate and solve the problems across distances. Both with classes ‘in attendance,’ they used CoverItLive to virtually conduct the energy experiments with both classes. The observing students posted their hypotheses and recorded the results as they watched the experiments being conducted. Amazingly, the groups collaborated on the development of their final products for the project, creating a myriad of products ranging from VoiceThread projects to Glogster posters. Throughout this project, students used Web 2.0 tools to collaborate with other learners to develop a shared knowledge base. As such, this project enacts the ideas proposed by Jonassen and Reeves (1996) who contended that students learn more when they create instructional materials as opposed to when they study materials created by others.

In another example, one of our teachers illustrated how current tools can function as mindtools to represent students’ knowledge (Jonassen & Cho, 2008). Barnes encouraged his students to blog to both construct and demonstrate their knowledge: “instead of notebooks and copying notes from the board and regurgitating it, [I said to the students] ‘I’d like you to show me how you learned it. You can use a blog, podcast, video, slide show program … think how you can use these tools to demonstrate what you’ve learned.’” In his class, students used a wide range of technology tools to represent their knowledge growth. Through the use of a year-long project (RAY – Reading All Year), students established a goal of reading at least 25 books. Readers, then, reflected on those books, creating a representation of their new knowledge. Because students were allowed to select the methods by which they would demonstrate their knowledge, the projects became personally meaningful to the students, as advocated by Jonassen. With the wide availability of Web 2.0 tools today, it has become relatively easy, especially compared to using Web 1.0, for students to represent their growing understanding of new and complex concepts. Due to their ease of use as well as their availability, current Web 2.0 tools have the potential to increase teachers’ abilities to utilize technology as a cognitive tool to facilitate technology-enabled learning.

What can we learn from these teachers, and others like them, who use technology as cognitive partners in students’ learning? First, these teachers have adopted attitudes and beliefs that support transformative approaches to teaching and learning, as noted earlier (Ertmer et al., 2012; Hermans et al., 2008; Overbay et al., 2010). This goes beyond simply understanding what technology could do, to understanding and embracing 21st century pedagogies that leverage the technology to facilitate authentic student learning, as suggested by Jonassen.

Second, these teachers have successfully applied their visions within a system that both influences, and is influenced by, them as individuals in the system. Although Jonassen didn’t explicitly discuss how his vision might be enacted within our current K-12 systems, it is important to consider the key role systems play in pedagogical adoption and change, if his vision is to be achieved (Straub, 2009; Zhao & Cziko, 2001; Zhao & Frank, 2003). Jonassen’s vision, if teachers embrace Jonassen’s vision, may be unable to implement authentic technology-enabled learning due to first- or second-order barriers. Therefore, in the next section, we discuss ways in which the elements of a school system can be enlisted to support the kinds of transformational change necessary to achieve technology-enabled learning. We describe specific experiences of the three expert teachers mentioned previously to provide examples of how authentic technology practices can be supported by contextual, cognitive, and affective factors within our school systems.

7. Systems support for embracing 21st century pedagogy

Individual teacher adoption is “a micro-perspective on change, focusing not on the whole but rather pieces that make up the whole” whereas “diffusion theory describes how an innovation spreads through a population…consider[ing] factors like time and social pressures to explain the process of how a population adopts, adapts to, or rejects a particular innovation” (Straub, 2009, p. 626). It is important to understand that although individual teacher’s adoption decisions make up the change, each instance of adoption is only a part of the larger change. Likewise, adoption does not happen in a vacuum – there are contextual, cognitive, and affective factors that impact it (Straub, 2009).
Thus, to achieve our goal of teacher pedagogical change we need to examine how these sets of factors potentially impact the change process, as either barriers or enablers. As noted earlier, we include brief examples from our three teachers to illustrate the importance of these factors in the implementation of technology-enabled learning.

8. Contextual factors

As Straub (2009) stated, “Understanding or controlling any one factor [in the adoption process] will not guarantee success; even if an innovation is perceived as being highly useful, contextual factors can lead to non-adoption” (p. 641). Contextual elements include the school setting as well as individuals external to the teacher (e.g., facilitators of change, mass media; Straub, 2009), or what Ertmer (1999) referred to as first-order barriers (or enablers).

According to several researchers (Lumpe & Chambers, 2001; Zhao & Cziko, 2001), one of the conditions necessary for teachers to adopt student-centered technology use is their perception that external factors, or first-order barriers, will not impede their efforts. Thus, systems need to ensure that teachers feel supported by external factors. In one example, the Tennessee EdTech Launch program purposely provided solutions to typical first-order barriers to technology integration (Lowther et al., 2008) such as access to resources, curriculum materials, and support (technical, administrative, and peer). Each barrier was specifically accounted for, providing substantial funding for resources and a technology coach to assist in the creation of curriculum materials. To address the issue of support, a part-time computer technician was placed at each school, administrators participated in training/mentorships, and teachers supported each other during regular meetings. Lowther et al. (2008) reported that after only three years, clear progress had been made in changing the school culture to incorporate uses of technology in support of student-centered practices.

In the Ertmer et al. (2012) study, Crosby described that although he currently has to find ways to work around the administration in his school, in the past, he has worked with administrators who “really kind of got it and would get as excited as we did.” With supportive administrators, Crosby was able to embrace a pedagogical approach that emphasized inquiry-based learning, utilizing technology as a cognitive tool. Furthermore, the school district was relatively supportive by keeping websites open and available (e.g., Twitter, blogs, Flickr, wikis).

In another example, Garcia discussed how his principal supported his use of technology: “I had the encouragement from the administrator... the principal encouraged us to think outside the box. He allowed us to play around with our curriculum and our lessons, as long as we were doing what we needed to do for the state standards. And so that kind of freedom allowed me to start thinking, “How can I integrate this technology?” “How can I make my lessons engaging?” Due to the administrative support Garcia received, he was able to experiment with innovative pedagogical approaches, which resulted in a dramatic increase in his students’ achievement scores on the state standardized test.

As shown through these examples, as well as previous studies (Lowther et al., 2008), supportive administration can positively impact teachers who are trying to adopt pedagogical innovations. When considering technology adoption, context is probably the easiest factor for systems to address as it involves increasing resources and support. As noted above, a lot of progress has been made on this front (U.S. DOE, 2010). However, when considering pedagogical adoption, contextual factors also include the school or system culture – a factor not so readily addressed. As noted by Somekh (2008), “Teachers are not ‘free agents’ and their use of ICT for teaching and learning depends on the interlocking cultural, social and organizational contexts in which they live and work” (p. 450). Unfortunately, most school cultures have not embraced a definition of effective teaching based on students learning with technology. In general, schools that successfully implement school-wide pedagogical changes aimed toward technology integration report: 1) having ample technology resources, 2) focusing on changing pedagogy with technology, 3) developing teachers’ skills within authentic contexts, 4) providing support, and 5) providing opportunities for teachers to discuss problems with peers and facilitators and explore solutions over time (Somekh, 2008). If administrators are interested in supporting teacher pedagogical change toward technology-enabled learning in their schools, implementation of these strategies provides a useful place to begin.

9. Cognitive factors

Cognitive factors impacting pedagogical change include teachers’ knowledge and skills related to technology-enabled learning, which comprise one of the key second-order factors or enablers (Ertmer, 1999; Ertmer et al., 2006–2007). Clearly, teachers must have basic technology knowledge and skills in order to use technology in the classroom (Ertmer & Ottenbreit-Leftwich, 2010; Lawless & Pellegrino, 2007), but the more important capability lies in teachers’ knowledge for using technology to support authentic student-centered instruction (Polly & Hannafin, 2010).

When asked to name the one thing that made the biggest difference in his ability to use technology to support student-centered instruction, Barnes, one of the teachers in our previous study (Ertmer et al., 2012), emphasized the importance of knowledge: “You have to know what the tools are capable of... You have to know what you are doing and you have to be willing to put in the effort that it takes to learn it. Knowledge is king.” Similarly, Garcia claimed that gaining knowledge through his graduate work was key to his changing pedagogy: “I returned back to graduate school ... And that’s when the magic started happening because I learned so many things we didn’t get as undergrads, like multiple intelligences research. And that’s when my lessons really started evolving.”

So, how can the system support and facilitate these critical changes in teachers’ knowledge? In their synthesis of empirically based learner-centered professional development research, Polly and Hannafin (2010) identified the following five essential components for enacting teacher change: focus on student learning, teacher-ownership, emphasis on developing knowledge of content and pedagogies, ongoing, and reflective. Using this framework, Polly and Hannafin (2011) examined the practices of two teachers during their participation in a year-long, learner-centered professional development program. The authors found that, over time, teachers’ practices aligned more with the learner-centered practices advocated by the professional development framework, particularly when they were able to co-plan the lesson with an experienced professional developer. In another example, Um and Gravemeijer (2011) provided elementary teachers with science and technology design-based learning professional development. They measured the attitudes, subject matter knowledge, and pedagogical content knowledge for three groups of participating teachers and found that engagement in practical activities, as well as coaching by a teacher educator, led to positive changes in participants’ knowledge.
In addition, some of the most worthwhile professional development activities referenced by our three teachers (Ertmer et al., 2012) involved participation in online personal learning networks (Twitter, blogs, etc.). Teachers could select the information they wanted to learn (teacher-owned, develop content and pedagogy knowledge) on a continual basis (ongoing) and reflect on the state of their current pedagogies through interactions with other teachers (reflective). By helping teachers select and participate in online personal learning networks that emphasize student-centered instruction, systems can employ additional means, outside traditional professional development avenues, to encourage and support teacher pedagogical change toward using technology as a cognitive tool to facilitate authentic student learning.

Based on these studies, systems can support the growth of teacher knowledge of technology-enabled learning pedagogies by providing professional development training that incorporates the five components identified by Polly and Hannafin (2010). As exemplified by the Garcia example, as well as other studies (Keengwe & Onchwari, 2009; Uum & Gravemeijer, 2011), being able to practice these new pedagogies solidifies teacher knowledge and supports pedagogical change.

10. Affective factors

Affective factors include teachers’ beliefs about teaching and learning as well as their beliefs and attitudes about the value of technology-enabled learning (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). These factors, like cognitive factors, often serve as critical second-order barriers or enablers to pedagogical change (Ertmer, 1999). Many have reported that teacher attitudes and beliefs are among the most critical influences on actual teacher practice with regards to technology-enabled learning (Hu, Hu, Clark, & Ma, 2003; Inan & Lowther, 2010; van Braak, Tondeur, & Valcke, 2004).

Researchers have previously examined teachers’ adoption of pedagogy and technology during top-down mandates (Berrett, Murphy, & Sullivan, 2012; Inan & Lowther, 2010). However, these types of changes often negatively impact the affective factors in the system, making teachers more resistant to change. Straub (2009) cautioned against this approach: “Top-down mandated change may be quick to proclaim the benefits of a change without understanding the deeper affective variables that may be shifted with any change” (p. 637). Instead of mandating teachers to change their pedagogy and technology use, it is more important that the system encourage change by aligning the school’s culture and overall vision with one that incorporates technology-enabled learning, as advocated by Jonassen (1996).

One of our teachers, Barnes, described the impact that the vision of a school district’s administration can have on teacher change and technology use: “It would be nice if everyone is using technology in the same way but they just are not. I don’t know if my school district is unique in this way. I think this is a [national] problem. You are going to find some school districts with savvy administrators… If you have a superintendent with beliefs on social media and beliefs on all the Web 2.0 tools and how you can successfully apply them to teaching and learning, (then) you are going to walk into school buildings and you will see it everywhere. You will see teachers using it because they probably had professional development on it.” According to Barnes, if schools and administrators share a vision for technology-enabled learning (Jonassen, 1996), teachers will be more likely to adopt the same vision and, subsequently, to implement it effectively.

In a review of three schools, Somekh (2008) found that school-wide innovation occurred in situations in which the principal provided a strong vision and motivation for change. Furthermore, by promoting a model of collaboration and mutual support, positive changes in teacher–teacher relationships occurred. Additional elements supporting teacher change toward technology-enabled learning included 1) the change focused on the process of learning using technology, 2) learning skills were directly integrated into classroom practices, and 3) teachers had the opportunity to collaborate with others over time. Somekh’s work (2008) illustrates how the system can address affective factors by providing a vision and the necessary support structures to promote teacher change (Ertmer et al., 2002). Furthermore, as noted by Ertmer and Ottenbreit-Leftwich (2010), this shared vision, while not focused on technology per se, should include a definition of good teaching that incorporates the idea of students learning with technology.

11. Technology-enabled learning

To answer the question, “How should we use technology?” we need to look beyond the technology itself to our current understandings of what “good” learning is and how we can facilitate its development. Thus, to achieve technology-enabled learning our efforts must focus on teachers (not technology); what they believe comprises good instruction and good learning; how they put those beliefs into practice; and how they can be supported by the contextual, cognitive, and affective factors that exist in their school environments. This draws directly from Jonassen’s vision. According to Howland et al. (2012), the acquisition and implementation of technology should be directed, not toward supporting “outmoded and ineffective methods of teaching,” but toward the primary goal of helping teachers “adopt new teaching practices and new methods for managing their classrooms” (p. 273).

Despite the fact that today’s teachers are likely to use technology for a variety of personal and professional uses, we have yet to see an abundance of uses that support the kinds of instruction advocated for preparing students for the 21st century (e.g., NEA, 2008; Partnership for 21st Century Learning, 2007). As noted above, this raises the question as to whether it’s really about the technology at all. We propose that it is not. Rather, we believe we need to help teachers restructure their classroom instruction in ways that are more problem–focused and student–centered, as initially suggested by Jonassen (1996) and continually re-emphasized in his more recent work (Howland et al., 2012; Jonassen et al., 2003). As noted by McCain (2005), “the use of technology in the classroom is not the critical issue facing education in the 21st century. [Rather], the issue of foremost importance is to develop thinking skills in our students so that they will be able to utilize the power of technological tools to solve problems and do useful work” (p. 84). This, then, translates into the requirement that technology be placed in the hands of students, who are encouraged and enabled to utilize it in the same ways, and for the same purposes, that professionals do – that is, to communicate, collaborate, and solve problems (Ertmer et al., 2012; Jonassen & Reeves, 1996). If technology is to be used effectively in schools, it must be combined with a different type of pedagogy, one that allows technology to be used fully by students (Frensky, 2010).

While we hesitate to suggest educators should decrease their efforts to facilitate teachers’ technology integration practices, at the very least, we urge those who are engaged in teacher technology professional development or teacher education programs to include an equal, if not greater, emphasis on how to implement powerful instructional methods that promote higher-order learning, such as problem- or project-based learning (Park & Ertmer, 2008). In these approaches, technology integration is not the ultimate goal; rather the goal is to
engage students in authentic problem-solving, using the most effective and efficient tools available. As such, technology plays a supportive rather than a starring role, enabling the successful achievement of both instructional and learning goals. This recommendation is supported by findings from a recent study by Walker et al. (2012), who demonstrated that teachers, who simultaneously learned about technology and problem-based learning (PBL), showed substantial gains in PBL knowledge and use.

Promoting best practice and effective pedagogy are at the very core of effective technology integration. Technology alone cannot improve teaching and learning. Technology use must, first and foremost, be designed to support learning goals, not the other way around. In summary, we suggest that the best way to achieve technology integration is by shifting our focus from promoting technology integration, per se, to promoting technology-enabled learning, aimed at preparing students for their 21st century careers. Although this is unlikely to be any easier to achieve, it places the emphasis where it needs to be—on the pedagogy rather than the tools used to implement it. As noted by the U.S. DOE (2010), “Just as technology is at the core of virtually every aspect of our daily lives and work, we must leverage it to provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, and meaningful ways” (p. 3). We believe that by adopting, and building on, Jonassen’s vision—that students will use technology as a cognitive tool to develop critical thinking and higher-order thinking skills—we have a greater chance of achieving this important goal.

References


