Traditional models of technology integration can be classified into three general categories or perspectives: (a) learning about, (b) from, or (c) with technology. However, the increase in networking technologies has given rise to virtual communities, cultures, and worlds. This article proposes an additional perspective that acknowledges emerging technological trends associated with learning in technology. From this view, technology is not considered to be a topic or tool, but the environment in which learning takes place. A short historical perspective on the integration of technology is presented. Examples are drawn from existing virtual spaces (i.e., the WWW and Multi-User Virtual Environments). Implications for educators and researchers are discussed.

In the modern world, education is influenced by a number of different, and often independent, factors. While legislation such as No Child Left Behind serves as one source of educational change (Apple, 2007; U.S. Department of Education [USDOE], 2006), contemporary theoretical understanding (Brown, Collins, & Duguid, 1989; Greeno, 1994; Lave & Wenger, 1991; Wilson, 2002), availability of resources (Cuban, 2000), and cultural climates (Shaker & Heilman, 2004) also influence how education is viewed and practiced. These factors (e.g., social policy, funding, or the understanding of cognition) not only govern who is taught, how, and with what tools, but also under what conditions. For these reasons, and because the fluid use of these
tools is vital in a posttypographic world (Leu, 2000; Leu & Kinzer, 2000),
the integration of technology is one aspect of teaching and learning that
receives a great deal of attention. However, pedagogical approaches using
technology have varied widely, a fact that can be partially attributed to
disparate beliefs and understandings about the role of technology in educa-
tion and partially attributed to the profound technological advancements in
the last century (Reiser, 2001). This article describes some of the more
influential technological innovations and addresses some of the perceived
roles of technology in education. Classical views have examined learning
about, from, and with technology (Jonassen, 2000; Salomon, Perkins, &
Globerson, 1991). However, advancements in technology and our under-
standing of learning have prompted a new perspective: learning in technolo-
gy. From this perspective, technology is valued as an immersive environ-
ment or context in which learning takes place rather than simply content
/about), a delivery mechanism (from), or a tool used in learning (with).
Implications for research and education are presented.

**TECHNOLOGY INNOVATIONS**

Reiser (2001) defined instructional technology to include “(a) the use of
media for instructional purposes and (b) the use of systematic instructional
design procedures (often simply called instructional design)” (p. 54).
Instructional media includes various artifacts linked to delivery such as
computers, CD-ROMs, videos, projectors, and other software and hardware.
There is little dispute that instructional technology has changed dramatically
in the last century. For example, in the early 1900s, school museums used
visual media like stereographs, slides, and photographs to deliver instruction
(Reiser). By the 1920s and 1930s, technological advances in audio (radio
broadcasting and recordings) and visual mediums (motion pictures) were
credited for corresponding changes in education. Two decades later, the
Federal Communications Commission (FCC) and the Ford Foundation
nurtured the next major educational innovation with funding for an allocation
of several channels dedicated to instructional television, now known as
Public television (Reiser, 2001). Although the technological advances were
significant during this early period of development, associated approaches to
instruction remained relatively unchanged.

The development of the computer and related technologies sparked the next
period of change. Unlike earlier forms of media, the computer has remained
a permanent fixture in education and continues to influence practice. During
the 1980s, rapid improvements to hardware and software at reasonable costs
enabled their widespread use in education. Some of the major early contrib-
utors included Gordon Pask (adaptive teaching), Richard Atkinson and
Patrick Suppes (Computer Assisted Instruction), Seymour Papert (LOGO),
and Don Rawitsch (Oregon Trail; McLester, 2005; Papert, 2002; Reiser,
2001). Since that time, computers have rapidly increased in both speed and
power. Based on an empirical observation, Moore (1965) suggested that the
number of transistors on an integrated circuit would double roughly every
year, yielding 65,000 transistors per integrated circuit by 1975. This
prediction has remained accurate and has been extended to describe
processor speed and storage capacity (Moore, 1995). As a result of in-
creased power and capability, the role of the computer in education has
changed. Papert acknowledged, “sooner or later the new media [computers]
will pervade schools as they are systematically pervading all knowledge
work” (p. 9).

This observation is relevant considering that it is through the computer and
related technologies that users access the Internet and the World Wide Web
(WWW). As early as 1945, Vannevar Bush (1945/n.d.) described the notion
of a network of networks in his widely read Atlantic Monthly article, “As
We May Think.” Although this network (i.e., the Internet) had been avail-
able in modern form since 1983, it wasn’t until the first graphics friendly
Mosaic browser was introduced in 1993 that the WWW emerged as the tool
we use today (McLester, 2005). Currently, researchers estimate that the
WWW is comprised of over 60 million servers housing more than 11.5
billion indexed pages (Gulli & Signorini, 2005). These statistics do not
include database served pages that are not indexible by search engines such
as Yahoo or Google. According to estimates, these “invisible pages” exceed
the amount of indexed content by 400 to 550 times (Lyman & Varian,
2000). This growth reflects a 60,000% increase in pages in less than 10
years.

The increase in the number of pages and the information available on the
WWW has corresponded to an increase in use. From September of 2001 to
October of 2003, the percent of households in the United States with
Internet access increased from approximately 50% to nearly 55% (U.S.
Department of Commerce, 2004). The most recent statistics indicate that
about 70% of all North Americans use the WWW and more than 1 billion
people worldwide actively participate in online activities
(www.internetworldstats.com/stats.htm, 2006). According to the data, school age children (9-17 years old) are the fastest growing segment of the population who embrace the WWW. In 2001 nearly 17 million students were regularly using the Internet, however, by 2005 that number grew to 21 million students (Pew Internet & American Life Project, 2001; 2005b). Of those 21 million, 78% students reported they use the Internet at school (Pew Internet & American Life, 2005a). In education, the WWW has been used to create WebQuests, virtual reality environments, streaming media, digital portfolios, and so forth. (Barab, Squire, & Dueber, 2000; Canada, 2002; Dodge, 2001; McLester, 2005).

Over the past century, the trends associated with instructional technology reflect a shift from objects in the environment (e.g., overhead projectors, televisions, and computers) to environments within virtual contexts (e.g., webpages, virtual reality, etc.). Contemporary researchers have examined the interactions within multimedia contexts (Mayer, Heiser, & Lonn, 2001), hypertext spaces (Dillon, McKnight, & Richardson, 1990; Lawless, Schrader, & Mayall, 2007), and virtual gaming worlds (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005). Researchers have argued that the nature of virtual worlds provides unique educational opportunities as well as a valuable context to study cognition (Squire, 2006; Young, Schrader, & Zheng, 2006). Overall, this progression suggests that researchers should focus their analysis on interactions within a dynamic, immersive context rather than on the physical user-technology interaction. Similarly, educators should examine the potential for instructional opportunities that take place in fully immersive environments, rather than within the confines of a traditional, physically bounded classroom.

**LEARNING AND TECHNOLOGY**

The historical trends in technology and their influence on educational practice cannot be considered independently from advances in our understanding of how people learn. Modern notions of learning have evolved considerably from empiricist and behaviorist traditions established by early scientists. Decades of research have indicated that learning is a complex interaction among cognitive and noncognitive factors (Murphy & Alexander, 2002; Pintrich & Schrauben, 1992). For example, individual characteristics such as domain knowledge (Alexander, Jetton, & Kulikowich,
1995) and interest (Murphy & Alexander, 2002) have been linked to learning. Additionally, environmental characteristics the nature of the learning context and environment have also been linked to learning (Lave & Wenger, 1991; Gibson, 1986). According to the perspective of situated cognition, the learning process is always contextualized; the dynamics of learning are mutually informed by users’ attributes and intentions and the immediate circumstances (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Wilson, 2002). Learning is not simply enabled by using any array of technological tools, but as a result of the interaction within these environments.

However, as technology developed over the last century, many educational reformers attempted to link technology mediated instruction with specific learning gains and outcomes (Cuban, 2000; Reiser, 2001). These studies adopt a “what works” philosophy with respect to technology and compare mediated instruction with non-mediated (i.e., traditional) instruction. One goal was to demonstrate the beneficial effect of an instructional tool when compared to another. Unfortunately, while many innovations were once touted as revolutionary with respect to education and technology (e.g., closed circuit television, overhead projectors, etc.), there has been little empirical evidence to support this the use of one tool over another (Clark, 1983; Oblinger & Hawkins, 2006; Phipps & Merisotis, 1999). Clark (1983, 2001) viewed this trend as evidence that the nature of the medium was unimportant, deferring instead to the instructional content. According to Clark (1983, 2001), the media serves the purpose of delivering the instruction much like medicine delivered by “…different brand names carrying the same generic drug to users” (2001, p. 9). It follows that modifying the delivery mechanism has little to no influence on instructional outcomes. Teachers or researchers looking for the best technology for the job are simply asking the wrong question.

From another point of view, researchers argued that instruction and pedagogy are inseparable from delivery (Jonassen, Campbell, & Davidson, 1994). Jonassen et al. described the need for advanced pedagogy that aligns with contemporary technologies. Specifically, Jonassen et al. refuted the claim that the “no significant difference” phenomenon was due to a lack of differences among approaches, rather, they asserted that the influence of instruction was eliminated from the research designs. The argument suggested that by creating an experimental condition that controlled for extraneous variables, the research design restricted the influence of technology related
pedagogy and could not be expected to demonstrate any significant difference. Further, any meaningful influence of instruction through any medium is and should be informed by theory. Technology and pedagogy are not mutually exclusive or independent.

Although investigations continue, years of research, theoretical developments, and technological innovations, have addressed the same question: given certain objectives and tools, which instructional practices are appropriate? While this question is far from answered and continues to evolve as theory and technology advance, reframing our perspective might help researchers and practitioners more completely understand educational technology. In particular, existing views of technology as instructional supplement (Reiser, 2001), simple delivery mechanisms (Clark, 1994), or mindless tools (Jonassen, 2000) do not align with contemporary learning theory or current technological innovations. Given three classical ways in which teachers and researchers have examined educational technology (i.e., learning about, from, and with technology), there is a fourth perspective that views technology not as a medium or tool, but as the context for interaction (i.e., learning in technology). In this role, technology provides tremendous opportunities for educators and researchers.

**LEVELS OF INTEGRATION**

**Learning ABOUT Technology**

Technology literacy is a topic that is prevalent in many school curriculums. Researchers argue that technology skills, including literacy skills, are vital in a post-typographic world (Leu, 2000; Leu, Kinzer, Coiro, & Cammack, 2004). However, much of the approach involves rudimentary information about hardware and operations that do not involve thinking, critical evaluation of content, or performance with the tool (Jonassen, 2000). At this basic level, technology is the topic rather than the mechanism or context for learning. Because technology serves as nothing more than content at this level, the unit of analysis becomes any change in knowledge and the evaluation of corresponding cognitive and affective variables associated with technology. For teachers working from this perspective, learning about the tools (e.g., how to turn them on, execute functions, navigate programs) is the most important aspect of the technology. As a
result, the presence of technology does not imply any special pedagogical changes. Existing pedagogies and instructional approaches designed to maximize performance and learning of any content are both viable and appropriate. Specifically, no significant modification to teachers’ approaches or perspectives is necessary given that only the information (i.e., technology operations vs. mathematics) has changed.

**Learning FROM Technology**

Historically, Artificial Intelligence (AI) was considered tremendously valuable educational applications of computers (Beck, Stern, & Haugsjaa, 1996). Computers’ capabilities were thought to be advancing at a rate that would permit instruction without the intervention of a living instructor. Applications developed as a result of this view were some of the first attempts to teach using the computer. Although this notion was often appealing, the problem of artificial cognition was never adequately solved. Even the most sophisticated models of AI failed to account for individual student needs and were unable to adapt to instructional changes like their human counterpart. As a result, AI never materialized as a major reformation in schools (Reiser, 2001). However, several programs that are designed to function as instructors (or instructor proxies) for students remain in use. These include Drill and Practice software, Intelligent Tutoring Systems (ITS), and Computer Assisted Instruction ([CAI]; Beck, Stern, & Haugsjaa, 1996; Jonassen, 2000).

Overall, these tools along with others adhere to an underlying principle that students learn from the technology. From this perspective, the role of the technology might serve as the instructor or more fundamentally, the delivery mechanism for content. Similar to learning about technology, learning from technology implies a change in knowledge as a consequence of technology use. Similar to learning about technology, the unit of analysis associated with learning from technology relates to common cognitive and affective variables associated with learning (e.g., motivation, knowledge, or affect). However, the principal difference is that technology takes on a slightly different role from an instructional sense. Specifically, the technology is the medium of instruction, whether it is mathematics or technology, and not merely the content. In this regard, the technology can be construed as the vehicle of a change in knowledge or associated cognitive attributes. For
teachers using technology from this view, relatively few changes to their practice and curricula are necessary. The best description is that the technology serves as a supplement or addition to existing curricula and materials. At this level, educators should be familiar with the tools that they are using but don’t necessarily need to adopt any special or additional pedagogies in order to integrate technology into their practice.

**Learning WITH Technology**

Salomon et al. (1991) distinguished the learning effects of technology (i.e., learning from tools) and effects of learning with technology. From their perspective, “effects of occur when such partnerships have subsequent cognitive spin-off effects for learners working away from machines” (Salomon et al., p. 2). According to this view, effects of technology are related to transfer as a consequence of cognitive residue that remains from the human-machine interaction. For example, a math student using a calculator might have increased skills associated with thinking, problem solving, or even arithmetic as a result of repeated, instructional use.

However, Salomon et al. (1991) also described a more sophisticated implementation of technology. From their perspective, intelligent technologies can be used in partnerships with humans. As a result of these partnerships, humans can engage with content, think, and achieve goals that were otherwise impossible individually. Using the mathematics example, a student using a calculator as an “intelligent” tool in computation also frees valuable cognitive resources so that the student is capable of achieving significantly greater outcomes than they would independently. In this example, the student would be able to attend to high-level problem solving approaches and thinking rather than laborious computation algorithms. From this perspective, learning goals are achieved through the real-world interactions in a human-technology system.

In terms of cognition as it relates to education, learning with technology has many possibilities. Jonassen (2006) described several pedagogical applications of technology from the “mindtools” perspective. While educators have used tools like concept mapping applications, spreadsheets, databases, and visualization software, Jonassen described the nature of cognitive engagement with these tools and the pedagogical application of the process.
Drawing from another example, researchers have argued that learning from hypertext is more involved than understanding content (Lawless & Schrader, 2008). Specifically, the process of interacting with the information (i.e., navigation) is argued to represent the same types of cognitive interactions described by Jonassen (Schrader & Lawless, 2007). Learning with technology implies that the outcomes are relevant only in conjunction with the process of interacting on a cognitive level with the technology. As a result, data such as concept maps as they develop over time, navigation logs, and narrative discourse serve as units of analysis and evaluation.

This shift in focus may seem subtle, but the implications for educators and the potential for change are significant. From an instructional sense, this level of integration requires new roles for the teacher as well as different tools and application of those tools. However, Papert (2002) cautioned that technology cannot be added to or used as supplements into existing curricula without meaningful changes to pedagogy and teaching philosophies. In this case, educators would need to focus less on the cognitive outcomes of technology use and more on process. Educators should also place an additional emphasis on the deep engagement with concepts as a constructive activity. Unfortunately, even though this approach aligns with the very nature of contemporary students as users of technology (Prensky, 2001, 2005/2006), one of the greatest challenges to this level of integration is that it is predominantly opposed to our existing system of education and the principles and factors guiding that system (e.g., No Child Left Behind [NCLB]; Apple, 2007; Papert, 2002; USDOE, 2007). In other words, “today’s students are no longer the people our educational system was designed to teach” (Prenksy, 2001, p. 1).

**Learning IN Technology**

While researchers and educators may be familiar with the first three levels of integration (about, from, and with), advances in technology have made another alternative possible. In the past 10 years, the use of Internet technologies (e.g., the WWW) has exploded. As a result of this increase, an online culture of users has emerged who use virtual tools in ways previously unforeseen. Many authors have described this “net generation” or group of “digital natives” as users who have never known life without digital and networked technology (Prensky, 2001; 2005/2006; Tapscott, 1998). As
digital natives, contemporary students spend significant amounts of time engaging in electronic tasks like emailing, chatting, and creating online profiles. Some argue that digital natives have intertwined technology as a part of their personae, using it as a natural and automatic extension of their minds and physical selves (Prensky, 2001). Modern examples of online culture (e.g., MySpace, YouTube, or Blogger) support this view and suggest that students no longer view the Internet as something separate from their own lives and identities. Overall, digital natives interact with virtual spaces in meaningful ways using the physical and virtual technology as an extension of their cognitive intent (Prensky, 2005/2006). It would follow that because the net generation’s cognitive engagement is so heavily intertwined with virtual spaces and content, the two are inseparable; their actions with the technology and cognitions are truly seamless. Another way to describe this immersion, integration, and depth of use is to suggest that users function, learn, and interact within the technology.

While several websites serve as an example of contemporary students’ seamless use of technology and the ways in which they interact with virtual spaces, there exist more obvious examples of learning in technology. More than 10 years ago, researchers described significant educational and training benefits of Virtual Reality ([VR]; Psotka, 1995). According to Psotka, the technology (sensory-based, simulated worlds) and the effects upon the user (a sense of immersion and an ability to interact with the world) were defining characteristics of VR. Although efforts to bring VR and similar technologies to students continue, the gaming industry has already created several popular, interactive virtual worlds such as EverQuest, Star Wars Galaxies, and the World of Warcraft (WOW). In general, these worlds (a.k.a., Multi User Virtual Environments or MUVEs) are similar to other virtual realities (i.e., immersive, visual, and sensory), but they also present players opportunities to engage in goal directed behavior with thousands of other players. Unlike traditional immersive environments, MUVEs persist with or without the intervention of the player. Further, many types of changes made to the environment endure after the player leaves the game (e.g., virtual structures, crafted items, etc.).

While there are many commercial applications of MUVEs, there is some reluctance to accept these environments as learning contexts. Admittedly, most MUVEs and similar virtual spaces have been created and sold for entertainment purposes, but many researchers have argued that they are also environments in which meaningful learning takes place. Specifically,
MUVEs present opportunities for expert apprenticeship, collaboration, and goal-oriented problem solving (Gee, 2003; Forman, 2005; Squire, 2003; Young, 2004; Young et al., 2006). MUVEs can also be viewed as designed experiences that are either built from a set of instructional objectives or adapted to fit a set of objectives (Squire, 2006). In general, researchers have argued that MUVEs provide a context to understand the dynamics of intrapersonal collaboration (Steinkuehler, 2005), authentic perception-action dynamics within a constrained system (Young et al., 2006), and the development of competence and skill (Schrader & McCreery, 2006). Regardless of the types of interactions or learning outcomes, MUVEs require high levels of reading, critical thinking, and social skills to successfully negotiate the content and landscape (Schrader & McCreery, 2007). As such, contexts like these are not only widely popular entertainment mediums, but they also represent authentic, complex environments in which profound cognitive activities take place.

While there are many views regarding the nature of the learning that takes place within virtual spaces like MUVEs, their most notable attribute is virtuality. That is to say, interactions within multi-user virtual environments (e.g., with other players, the world, etc.) have no physically observable counterpart. This presents a challenge to those evaluating learning within this context. As a result, teachers and researchers might continue to examine gains in knowledge (about or from) or human-computer interactions (with) as possible units of analysis. However, because the environment affords a profound degree of interaction otherwise unaccounted for using these levels of analysis, researchers must evaluate performance and learning in other ways. Although traditional measures might be useful (e.g., outcomes), they would be relevant at this level only if linked to data representing the interactions within the environment. For example, Schrader and Lawless (2007) acknowledged the value of multidimensional strategies for evaluating learning. However, they also described the use of server logs as a means to observe and describe navigation, which they viewed as the very nature of interaction within a virtual space. Similarly, Steinkuehler (2006) used a cognitive ethnography of inter-personal communication as an indication of the dynamic interactions within a virtual space (i.e., Lineage). Regardless of the supporting data, learning in technology implies focusing on dynamic interactions within the virtual world where actions represent the extension of user intent (Schrader & McCreery, 2007). For researchers and educators, some indicators of user interaction within virtual spaces might include: conversations or user dialog, the flow of information, the number and type
of interactions, the nature of inquiries, and users’ navigational behavior (Lawless & Schrader, 2008; Steinkuehler, 2006).

Similar to a shift in research paradigms and the corresponding unit of analysis, educators must also reconsider the pedagogical implications when adopting the view of learning in technology. Because the learning process is no longer directly observable, the formative and instructional cues in teaching change. Virtual cues like the ones mentioned become relevant. Further, the role of the instructor shifts from existing metaphors (i.e., coach, guide, disseminator of information, etc.) to less well-defined roles. These might include developers of designed experiences (Squire, 2006), facilitators within virtual spaces, guides, or even peers within the virtual space. Educators might also adopt the view that virtual worlds like MUVEs represent an authentic context in which they might constrain the rules to promote goal directed behavior. As such, the educator no longer delivers instruction in the virtual world. Rather, they create and provide the circumstances by which students engage in learning. Admittedly, because there have been relatively few educational applications of MUVEs and similar virtual spaces, the roles of educators are not yet established. However, regardless of the difficulty in conceptualizing the environment, students regularly engage in these worlds whether through the WWW or through commercial MUVEs products. As a result, our philosophies and pedagogies must come into step with their actions.

**Technology Across the Perspectives**

By definition, a tool is an instrument used in performing an operation at the service of the user. In education, the same technological tool can and has been applied from numerous pedagogical and theoretical perspectives. For example, an electronic spreadsheet can be the subject of a course (about), read for information (from), or used to create advanced mathematical models in ways unattainable by an individual without the technology (with; Jonassen, 2006). Similar arguments can be made for nearly any technology (e.g., audio and multimedia, presentation software, or online virtual spaces). The characteristics or affordances of the technological tools do not imply or suggest a particular application; rather their use is completely dependent upon the perspective adopted by the researcher or instructor. It is possible to teach a student about a Wiki, what it is, and how it works. But it is also
possible to use a Wiki as an immersive, socially constructed space in which the level of interaction is observable through the changes tracked by the software. Although the tool is constant, the implementation changes (about vs. in) along with the implications for teaching and evaluation (outcomes vs. outcomes and interactions). Technology does not drive instruction; instruction and pedagogy drive the way technology is integrated.

By altering how tools are implemented in classrooms to align with contemporary theory and technological innovations, teachers must also be prepared to carefully consider the implications of this shift. In common settings (about and from), practice and evaluation focus on the delivery of information and knowledge gains. Existing evaluations (e.g., quizzes, multiple choice tests, etc.) inform the teacher of student performance. In more complex settings (with), performance is evaluated as part of the process of learning, albeit linked to outcomes. In virtual, immersive settings (in), teachers must consider virtual artifacts in conjunction with common learning metrics. However, one of the most notable and difficult changes across conditions is the role of the instructor. In the first few levels of integration, the role of the teacher might very well be that of a guide or “sage on the stage.” Within immersive environments, roles associated with informed and active participation replace more familiar ones.

Immersive environments are also known to be highly dynamic and changing. Although this is one of the benefits to these environments, it necessitates changes to existing instructional design strategies. Teachers must accept less direct control over the instructional conditions and shift their focus and attention to the rules and constraints governing the immersive environments. Unfortunately, this change combined with the ever-present accountability imposed upon teachers may cause many to blanch before adopting new paradigms. Whatever the challenges, the fact remains that students regularly participate in immersive environments. These digital natives are emerging into worlds that rely less on traditional skills and more on new literacies, such as those exemplified within learning contexts (Lawless & Schrader, 2008; Schrader, Lawless, & McCreery, in press). Although an increased appreciation for learning in technology does not diminish the need for other perspectives (i.e., learning about, from, or with), it does establish a need for educators to fully understand the realities of contemporary educational contexts, shifting paradigms, and emerging instructional roles.
DISCUSSION AND CONCLUSION

Although there have been many innovations in education over the last century, the majority of these technological advancements have failed to dramatically alter the face of education (Cuban, 2000; Reiser, 2001). One possible reason for this lies with a misalignment of contemporary learning theory with practice (Gee, 2006; Papert, 2002). It follows that researchers and teachers need to understand the implications associated with various levels of integration in order to effectively incorporate technology into classrooms. Learning about and from technology implies very little change to existing pedagogies and evaluation methods. Teachers can maintain existing practices somewhat independently from the integration of technology. Although tools can supplement instruction (e.g., drill and practice software), they do not necessitate significant modifications or consideration. When there is a free moment, the student can learn about or from a tool.

By contrast, learning with technology suggests several significant shifts in perspectives in order to maximize the effectiveness of classroom tools as well as corresponding metrics designed to evaluate performance (Salomon et al., 1991; Jonassen, 2000; Papert, 2002). In this case, the technology allows students to extend their own capabilities and focus on other, more relevant aspects of the lesson. Using a calculator, students are able to consider the solution algorithms and connections across problems rather than focus on the arithmetic. Pedagogies adopting this view leverage technology to achieve higher learning goals.

However, viewing technology as a context for learning necessitates further philosophical and pedagogical shifts. In particular, the roles of educators change in profound ways along with the metrics used to document learning. While existing metrics may be used to evaluate performance (e.g., quizzes, essays, etc.), the dynamic and virtual artifacts within the immersive space provide invaluable clues when associated with learning and performance. Further, the instructor’s role changes in profound ways. Teachers might become participants and guides as they help orchestrate and direct the overall flow of learning within these contexts.

Admittedly, researchers and educators are still working toward understanding the implications of learning within technology. Similarly, they also continue to work toward defining appropriate models of integration in general. However, there are obvious trends in cognitive theory toward the
value of the learning context and participant dynamics (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Wilson, 2002). Similarly, networked technologies and the environments they support (e.g., MUVEs and virtual spaces) have grown in availability and popularity (Hayes, 2007; Steinkuehler, Black, & Clinton, 2005; Young et al., 2006). Collectively, these trends seem to suggest that it is time to accept a new preposition and the perceptions that follow.

References


Leu, Jr., D.J. (2000). Literacy and technology: Deictic consequences for literacy education in an information age. In M.L. Kamil, P. Mosenthal,


