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CHAPTER 8

Learning, Change, and Power:

Competing Frames of Technology and Literacy

MARK WARSCHAUER
UNIVERSITY OF CALIFORNIA, IRVINE

PAIGE WARE
SOUTHERN METHODIST UNIVERSITY

As George Lakoff (2004) explained, language always comes with framing. Every word is defined relative to a conceptual framework, and those frameworks shape the word's social significance. The words *technology* and *literacy* are highly contentious ones that can be framed in numerous ways. Historically, literacy has been viewed as the ability to decode print-based texts, and this definition still pervades in many education circles today. Such a view was limited even before the development of new digital technologies, in that typographic literacy extends far beyond decoding and encompasses meaning making, functional use of texts, and critical analysis (see A. Luke & Freebody, 1999). In a rapidly growing digital world, however, such a narrow perspective is even more limiting. We view literacies as plural, consisting of multiple competencies and practices, each shaped by different contexts, purposes, and uses (A. Luke & Freebody, 1999; New London Group, 1996). This perspective recognizes the emergence of new digital literacies that focus not only on foundational skills and practices of reading and writing, but also on the skills, knowledge, and attitudes that enable complex ways of getting and making meaning from multiple textual and symbolic sources (see, e.g., Ba, Tally, & Tsikalas, 2002; International ICT Literacy Panel, 2002; Shetzer & Warschauer, 2000; Warschauer, 2003b).

In this chapter, we consider how the relationship between technology and literacy is commonly framed, and what that means for teaching and learning with digital media. We will examine three of the most common discourses surrounding technology and literacy that we have labeled "learning," "change," and "power." In the learning frame, the emphasis is typically on raising test scores on standardized measures of reading and writing. The change framework turns the lens to an examination of how literacy itself is transforming in radical ways because of revolutions in information communications technology (ICT). Finally, the power framework focuses on the relationship of access and use of technology for social and economic equality. Within our discussion of each framework, we end with a section that highlights examples that illustrate how each of these discourses shape thinking about educational policies and programs. We conclude by discussing our perspective on the implications of these frameworks for teaching and learning and by making recommendations for future research in literacy and technology.

Clearly, the complexity of the issues we address does not easily fit such categorical distinctions, because in the real world people tend to draw from more than one framework. This is certainly true in our own research. Nonetheless, we believe the research on literacy and technology has grown so vast that it is useful to make distinctions among the salient characteristics of current research in order to clarify core ideas and concepts. By synthesizing the vast number of wide-ranging goals, theoretical frameworks, and methods of inquiry within these three frameworks, we ultimately hope to promote interdisciplinary discussion among educators and researchers in identifying possible areas of overlap and conflict among the learning, change, and power frameworks, both within their own work and across disciplines.

Learning Framework: Raising Test Scores

Those who adopt a learning framework are concerned not with how technology is changing literacy, but rather with how student use of technology can enhance learning in general, with outcomes in the area of literacy measured primarily through higher scores on standardized reading and writing tests (see Table 8.1). From this perspective, computers and the Internet are simply new forms of educational media (following radio, film, and television), educational technology (following blackboards and overhead projectors), or learning systems (following programmed instructional kits and audiotape language laboratories used for foreign-language instruction).

With a primary focus on achieving practical and measurable outcomes, the learning framework is driven primarily by quantitative studies. This body of research is grounded in such a broad range of educational theories that it is difficult to point to seminal works in this area. Several of the best known studies on educational technology, such as those of Cuban (e.g., 2001) and

Table 8.1 Learning Framework

Conceptual Framework:	**Learning**		
Central Metaphors:	**Media in Education** Radio Film Television Computer	**Educational Technology** Blackboard Overhead Projector Software Programs Digital Whiteboard Computer Internet	**Learning System** Programmed Instructional Kits Language Lab Computer Lab
Representative Journals:	*Journal of Technology, Learning and Assessment*		
Key Works:	Becker (2000); Cuban (2001); Fuchs and Woessmann (2004)		
Fields of Inquiry:	Educational technology, Educational administration, Educational policy		
Target of Critique:	Technology as a match for schools and learners		
Goal:	Raise test scores and improve student learning		
Research Interest:	Technology's impact on learning and literacy outcomes		

Becker (e.g., 2000), focused on whether or not schools are able to make use of new technologies, and, if so, under what conditions. There is also, though, a growing body of research on what kinds of learning and literacy outcomes students achieve with new technology use at home or school as measured by standardized test scores. A major center of this work is at the Lynch School of Education at Boston College, which hosts the Technology Assessment Study Collaborative and the *Journal of Technology, Learning, and Assessment*, both led by Michael Russell, who has coauthored many of the important studies in this area (Russell & Abrams, 2004; Russell, Bebell, & Higgins, 2004; Russell & Plati, 2002). Most of this research is quantitative in nature, relying on experiments, quasi-experiments, or correlational analysis.

One of the broader studies in this vein, covering students in many nations, was carried out by Fuchs and Woessmann (2004), who analyzed the dataset from the Programme for International Student Assessment (PISA), an international student achievement test conducted in 2000 of 15-year-olds in 32 developed and emerging nations. The PISA assessment had a special focus on reading and literacy, with a dataset covering 174,227 students in 31 countries. Q2 The study found a statistically significant and sizable negative correlation with reading scores for students who had a computer at home, once student and family background and schools' resources and institutional features were controlled for. In contrast, Internet access at home caused a positive correlation—and the more frequently students used the Internet to read e-mails or Web pages, the higher their test scores were. No statistically significant effect was noted for school access to computers, whereas school use of computers and the Internet had an inverted U-shape relationship with achievement; some use of computers and the Internet at school had a positive correlation with reading achievement, whereas a good deal of use had a negative correlation.

These results are ambiguous because they suggest the possibility of a threshold point beyond which too much computer use might result in an educationally ineffective overdose. A recent study by O'Dwyer, Russell, Bebell, and Tucker-Seeley (2005) resituated PISA's primary focus on time and asked instead how computers were used in schools and at home. They correlated reading and writing test scores of 986 fourth-grade students in Massachusetts with particular uses of computers at home and school. The study found that it was not so critical as to whether students used computers, but how they used them; usage for editing of papers was positively correlated with both reading and writing test scores, for example, whereas usage for making multimedia presentations at school or for recreational purposes at home was negatively correlated with both reading and writing test scores. The negative relationship with multimedia presentations is not surprising, given the mechanical way that Microsoft PowerPoint is frequently introduced into classroom instruction (see discussion in Warschauer, Knobel, & Stone, 2004).

Beyond these general studies, a number of more specific studies have investigated the relationship of literacy practices and/or outcomes of particular uses of new technology. In a meta-analysis of 26 comparative studies performed from 1992–2002, Goldberg, Russell, and Cook (2004) concluded that the writing process is more collaborative, iterative, and social in computer classrooms as compared with pencil-and-paper environments, that students are more engaged and motivated in their writing, and that they produce written work that is of greater length and higher quality.

One reason that the benefits of using computers for writing may not appear on standardized tests is that the tests themselves are usually delivered in the pencil-and-paper format. A study by Russell and Plati (2002), comparing scores on writing tests performed by pencil or by computer, revealed that pencil-and-paper tests substantially underestimate the writing ability of fourth- and eighth-grade students, especially for those students who are good at keyboarding. A follow-up study (Russell, Higgins, & Hoffman, 2004) found that the differential is even more pronounced when computer-using students are able to use the grammar and spelling check, which, interestingly, raised not only English-convention scores but also topic-development scores. Unfortunately, even though these studies show that computer-based writing tests may well be advantageous for many students, teachers reportedly decrease the amount of time they spend on computers in order to prepare students for the less efficient, but test-necessary, process of writing essays by hand (Russell & Abrams, 2004).

Finally, some recent studies look at the impact on writing development of participation in one-to-one laptop programs (in which students have access to an individual laptop throughout the school day and at home). The largest such program in the United States, a statewide initiative among middle-school students in Maine, indicated no substantive improvement in reading or writing

test scores after its first year of implementation (Warschauer, 2006). Studies of smaller (and thus perhaps more sharply focused) laptop programs indicate that participants in them receive significantly higher tests and grades and writing for English language arts (Gulek & Demirtas, 2005), and that the benefits appear to be magnified when their instructors have prior experience teaching in laptop environments (Jeroski, 2004).

There have been numerous software-based curricular efforts that can be considered instantiations of a learning perspective. These make use of software for purposes such as drill-and-practice (Taylor, 1980), individualized reading instruction (see, e.g., Slayton & Llosa, 2002), extensive reading management (e.g., Renaissance Learning, 2004), and automated writing evaluation (see Warschauer & Ware, 2006)—all of which purport to teach reading and writing better but none of which seek to enhance broader digital literacies such as multimedia and hypertext development or Internet-related skills of finding, evaluating, and critiquing information. The overall results from such software use has been mixed, with outcomes shaped in part by challenges in implementation (Slayton & Llosa, 2002) and by concerns about the limited social interaction that such integrated learning systems often entail (Paterson, Henry, O'Quin, Ceprano, & Blue, 2003).

Those promoting a learning framework face several challenges in demonstrating the relationship between technology and literacy. As indicated in several of the previously mentioned studies, it is not the mere presence of technology that makes a difference but rather how it is used (see discussion in Leu & Kinzer, 2000; Warschauer, 2003b). Schools, messy social contexts including diverse actors with their own agendas, are very difficult locations to orchestrate and evaluate particular usages of technology, although, as we will later discuss, several researchers have begun to find ways to do so.

In addition, technology—even when used in a particular way—usually is better understood not as having an impact but rather as helping reshape a broad social ecology, and thus affecting learning in ways that are unforeseen (Lankshear & Knobel, 2003; Street, 1995; Warschauer, 1998). The unpredictable nature of learning was discussed by Dewey (1938), who commented, "Perhaps the greatest of all pedagogical fallacies is the notion that a person learns only the particular thing he is studying at the time" (p. 48). This unpredictability likely even more true when powerful digital media are placed in students' hands (see examples in Sandholtz, Ringstaff, & Dwyer, 1997; Warschauer, 1999).

Finally, this framework is hindered by the fact that standardized measures are not available for broader forms of technology-enhanced literacy. While school technology programs often hope to improve existing test scores as measured by traditional assessments, that is only one of their motivations. Some school administrators are, at least theoretically, interested in preparing students with the kinds of 21st century literacies (involving multimedia, knowledge

production, information retrieval and critique, etc.) that go beyond traditional reading and writing (see Warschauer, 2006). The assessments currently available to school districts, however, too narrowly focus on traditional reading and writing measures and thereby limit understanding of digital media's potential. Further, through a washback effect, such tests can even hinder that potential, as witnessed through the previously mentioned example of teachers restricting their use of computers for writing in order to prepare for pencil-and-paper tests.

The danger of an overly narrow view of learning and literacy is seen in the following example.

Example: What Counts as Learning and Literacy at an Elementary School?

A university professor organized an after-school computer journalism club at a low-income, and low-performing, elementary school (Seiter, 2004, 2005). The 25 children who joined the club worked together to identify stories of interest, research them, and publish them in a newspaper that was circulated online and also printed and distributed for free to 15,000 community residents. Newspaper stories varied between those of local community interest (about topics such as firefighters, a boys' basketball team, and a nearby pet shop) and those related to popular culture (media stars, wrestling). The children in the project quickly developed a variety of computer skills, including digital photography, keyboarding, and word processing, and honed their reporting, writing, and editing talents.

Unfortunately, though, the school principal had problems with the project, explaining, "This school is about literacy" (E. Seiter, personal communication, December date, 2004). The journalism project, which allowed students to bring in issues of popular culture, to write articles that might challenge authority, or to carry out community interviews in their own language, apparently treaded on dangerous territory. In the principal's eyes, "literacy" was restricted to activities that stayed close to the school curriculum and helped raise test scores in his low-performing school.

Q3

Change Framework: A New Gutenberg Revolution

A critical response to the learning framework can be found in a *change* framework (see Table 8.2). From this perspective, new technologies are seen as bringing revolutionary transformations in reading, writing, communication, and production of knowledge, similar to those last wrought by the development and diffusion of the printing press in 15th-century Europe.

Two central metaphors characterize the discourse of change. On the one hand, information and communication technologies (ICT) are compared to previous human means of communication. In this sense, it represents a "fourth revolution in the means of production of knowledge," following the development of language, writing, and print (Harnad, 1991, p. 39). On the other

Table 8.2 Change Framework

Conceptual Framework:	Change	
Central Metaphors:	**Means of Communication** Language Writing Print ICT	**Carrier of Written Word** Papyrus Codex Book Screen
Representative Journals:	*Computers and Composition; Kairos: A Journal of Rhetoric, Technology, and Pedagogy;* and *E-Learning*	
Key Works:	Bolter (1991); Gee (2003; 2004); Kress (2003); Landow (1992); Murray (1998); New London Group (1996); Tuman (1992)	
Fields of Inquiry:	New literacy studies, Cultural and media studies, Game studies, Computers and writing	
Target of Critique:	Schools as conservative institutions	
Goal:	Make schooling relevant by valuing new literacies	
Research Interest:	Relationship between home and school literacy practices	

hand, some scholars make the comparison to prior media of written communication. In this light, the developmental path runs from papyrus to codex to book to screen (see, e.g., discussion in Bolter, 1991).

The revolutionary characteristics of ICT are seen in six of its features (Warschauer, 1997, 1999): (a) it allows interactive written communication, thus bridging the historical divide between text and speech, as evidenced in instant messaging, chat, and e-mail; (b) it allows a global form of many-to-many communication, as witnessed by listservs and bulletin boards; (c) it allows the creation of hypertexts that challenge traditional forms of narrative; (d) it democratizes multimedia creation, taking advantage of a myriad of digital tools for recording, producing, and/or editing audio, music, photographs, video, and animation; (e) it allows those texts and multimedia to be easily self-published for a global audience through means such as home pages, blogs, podcasts, and videoblogs; and (f) it links all this published information in a worldwide interconnected database, bringing an almost limitless amount of navigable information available to any individual.

The change framework finds its natural home in the fields of cultural and media studies (Tyner, 1998), new literacy studies (e.g., New London Group, 1996), game studies (e.g., Gee, 2003; Steinkuhler, this volume), and computers and writing (e.g., Bolter, 1991; Landow, 1992). It finds expression in a number of scholarly journals, such as *Computers and Composition; Kairos: A Journal of Rhetoric, Technology, and Pedagogy;* and *E-Learning*. Key research centers include the University of Southern California's Annenberg Center for Communication, with its focus on digital and multimedia literacies, and the University of Wisconsin School of Education, with its focus on video games and literacies.

The object of critique in this framework is the school as a conservative institution. Advocates of the change perspective take schools to task for failing to recognize the radical ways that literacy is changing, and thus subjecting students to an outmoded and ineffective form of education (see, e.g., Gee, 2004). They seek not merely to reform schools, but to radically transform education by replacing current modes of instruction with those more representative of the way people use technologies outside of school (see, e.g., Hull & Schultz, 2002; Lemke, 1998).

Evidence of change is also seen in the historically unprecedented rates at which new digital media are diffusing. In the United States, for example, 75% of the population now has access to the Internet (Nielsen/Net Ratings, 2004), and more than half of home Internet users have broadband access (Belson, 2005). Broadband rates have typically been much higher in other countries, such as South Korea (Kelly, Gray, & Minges, 2003). In recent years, however, Japan has become increasingly competitive in its broadband rates and offers ultra-high-speed broadband access to a higher percentage of households than in the United States (Bleha, 2005). China is also expected to pass the United States soon in total number of broadband users (Reardon, 2005), as it currently has more broadband users in urban areas than does the United States (Bleha, 2005). Rapid diffusion and development leads to a proliferation of new forms of media, which make even other forms of new media seem old; witness, for example, the way instant messaging has supplanted e-mail among youth (Shiu & Lenhart, 2004). New media are not only becoming widespread, but are gaining in social importance at remarkable speed. Blogging, for example, barely existed a few years ago, but is now credited with playing a role in helping shape political scandals (see discussion in Wright, 2003).

Research on technology and literacy from a change perspective is based on several theoretical underpinnings (see discussion in Gee, 2003, 2004). First, *literacy* is usually defined as encompassing the broad and diverse ways that people make use of texts to construct meaning, whether or not those ways are held in esteem by schools or other institutions. Second, literacy practices are seen as being in a period of radical change and flux, with a powerful disconnect between school-based and home-based literacies. Third, technology, literacy, culture, and society are viewed as being completely intertwined. From this perspective, technologies do not impact literacy, society, or culture, but rather are seen as embodiments of social and cultural relations that, in turn, structure social and cultural futures. Fourth, technology and literacy are intimately tied up with expressions of individual and social identity, as users of technologies enter into new communities of practice and enact new social roles.

Researchers adopting this framework most frequently focus on out-of-school literacy practices, usually focusing on the types of literacy practices that are not typically valued in schools. The preferred methodological approach is

ethnography of communication, as this allows the researcher to enter into and explore the cultural environment that surrounds use of new technologies through interviews, observations, diaries, journals, discourse analysis, digital or video documentation, and analysis of texts and multimedia products (see, e.g., Lam, 2000). In other cases, discourse analysis alone is used for intensive examination of computer-generated texts or multimedia (Hull & Nelson, 2005).

The terrain of changing literacy practices is so vast that research in this area can only be touched on in this brief chapter. We'll highlight three areas that have gathered attention: multimedia, digital communication, and video-game-associated literacies.

Multimedia. Kress (1998, 1999, 2003; Kress & van Leeuwen, 1996, 2001) has analyzed textbooks, newspapers, signs, clothing labels, and computer multimedia to examine the grammar of visual and multimodal design. He points out that while language and sound are governed by sequence and time, images are governed by space, display, and simultaneity. The development and combination of modes thus results in what he terms "transformation" (a reshaping of resources within a mode), "transduction" (the shift of semiotic material across modes) and "synaethesia" (the qualitatively new forms of meaning which occur through transformation and transduction).

Through their fine-grained analysis of a multimedia digital story composed in an after-school community technology project , Hull and Nelson (2005) demonstrated how the combining of image and text transcends rather than combines what is possible in each particular mode. In such layering, images can work to repurpose the words they accompany, modes become progressively imbued with the associative meanings of each other, and iconic and indexical images are rendered into symbols. Other features of digital storytelling noted in this and a follow-up study by Nelson (2006) of undergraduate second-language writers include a resemiotization (repurposing semiotic relationships) through repetition (with the repeated image serving to punctuate a story or take on more complex meanings as a story evolves), an awareness of language topology (i.e., the relationship between what written language says and what it looks like), and an amplification of authorship (with digital storytellers finding a deeper meaning of what they want to say through the process of adding and combining modes).

Digital communication. The topic of digital communication is itself a broad field, incorporating media as diverse as e-mail, online discussion forums, blogs, instant messaging, and text messaging. As Baron (1999) pointed out, these can be arrayed from more product-oriented forms that resemble paper-based writing (e.g., Web sites, some e-mail) to more process-oriented forms that share features of speech (e.g., chat, instant messaging, text messaging),

with blogs occupying an intermediary position. Research in electronic communication focuses on issues such as the nature of the genres in each form, the ways that people construct their identities online, and the language choices made by speakers/writers of multiple language or dialects.

For example, Lam (2000, 2003, 2005a, 2005b) has carried out extensive ethnographic studies of Asian immigrants' use of the World Wide Web, e-mail, instant messaging, and chat rooms at home and school in the United States Her work demonstrated the kind of individual and collective textual identities that immigrants develop and express through the playful switching and mixing of codes, symbols, and roles across and within modes, concluding that these practices stand in sharp contrast to the more restricted set of literacy practices that are valued in school.

Similarly focusing on new literacy and communication practice outside educational settings, Ito and Okabe (2005a, 2005b) have carried out extensive ethnographic investigation of Japanese youths' use of mobile phones, and especially on the expressive functions and styles of text messaging in the particular social and cultural milieu of Japanese teenagers' lives. Their research has demonstrated, for example, the flexible social expectations and rhythms established in text message (allowing both intensive conversation and occasional keeping in touch, depending on the particular place and purpose of the communication), the ways that text messaging creates an ambient virtual copresence (by allowing constant intimate exchanges while people are apart), and the nature of augmented flesh meet (in which text messaging helps micro-coordinate physical meetings).

Video-gaming. Gee's (2003) seminal book, based on extensive game playing and observations of video-gamers, puts forth 36 learning and literacy principles that are embedded in video-games, but are often absent from schools. These include the semiotic principle (understanding interrelations within and across multiple sign systems), the bottom-up basic skills principle (learning basic skills not in isolation or out of context but through a process of discovery while engaging a broader domain), and the affinity group principal (learning through groups that are bonded through shared endeavors, goals, and practices rather than through race, gender, or ethnicity). In a follow-up book, Gee (2004) critiqued more explicitly the contradiction between the types of complex learning that diverse learners achieved through video-games and other new media and the way that schools are structured to fail diverse learners. Gee's work in this area was extended by Steinkuehler's (2005, this volume) ethnographic study of participants in Massively Multiplayer Online Games (also known as MMORGS: Massive Multiplayer Online Role-Playing Games). Steinkuehler examined the array of reading and writing practices that take place both within games (via chats, narratives, and letters) and around games (via discussion boards, blogs, and fan fiction sites), concluding that

video-games are actually promoting rather than hindering the types of authentic, creative, and wide-ranging literacies that schools purport to value.

Several outstanding theoretical questions confront literacy theorists from a change framework. The first is: What counts as literacy? In the world of video-gaming, for example, there are now game-based G raphic Novels (Pearce, 2002), in which users take screen shots from their favorite games and annotate them with text to tell a story; Machinima (Lowood, 2005), in which users render and capture video from games and add audio to produce movies; and Mods (Sotamaa, 2003), in which users redesign video-games to include new items, weapons, characters, enemies, models, modes, textures, levels, locations, and storylines. The first clearly matches traditional definitions of literacy, albeit in an alternative format; the second and third cause us to rethink whether literacy can be extended to nontextual realms (Kress, 2003) or even to software design. Q5

A second question is: What counts as authorship? Notions of author, audience, and plagiarism were already called into question by the development of hypertexts and the World Wide Web (Landow, 1992; Murray, 1998); now new forms of narrative and storytelling in game playing and design further complicate the matter (Pearce, 2002).

A third question is: What counts as genre? If we consider genre to be a form of conventionalized social action, how do we consider and evaluate genre in a time when conventions are being rapidly undone, and multiple media are being cast together? The instability of genre in 21st-century life has led a group of theorists to promote design as a principle of new media literacy (Kress, 2003; New London Group, 1996), which emphasizes not mastery of conventional forms but rather understanding and application of broad generative concepts.

Finally, there is the question of how to value out-of-school literacies that may not have much social or economic currency. An obvious starting point for answering this question would be for educators to learn more about these out-of-school literacies and find ways to bridge students' engagement with academic literacy through them (see recent examples in Morrell & Duncan-Andrade, 2004; Ware & Warschauer, in press). Another tack is to create alternative learning spaces where students have caring communities that legitimize their engagement with out-of-school literacies (Hull, 2003; Hull & Schultz, 2002). Such solutions themselves, however, invite further questions pertaining to legitimacy, access, autonomy, community, and academic achievement. The complexities of these various dimensions are seen in the following examples.

Example: What Kind of Change Occurs in Community Technology Projects?

One of the most touted international initiatives to promote informal learning with technology took place in India, where, in 2000, an information technology corporation established a project known as the "Hole-in-the-Wall" to provide computer access to the city's street children (see extended analysis in

Warschauer, 2003b). An outdoor five-station computer kiosk was set up in one of the poorest slums of New Delhi. Though the computers themselves were inside a booth, the monitors protruded through holes in the walls, as did specially designed joysticks and buttons that substituted for the computer mouse. Keyboards were not provided. The computers were connected to the Internet through dial-up access. A volunteer inside the booth helped keep the computers and Internet connections running. No teachers or instructors were provided, in line with the concept called *minimally invasive pedagogy*.

The children who flocked to the site taught themselves out how to click and drag objects; select different menus; cut, copy, and paste; launch and use programs such as Microsoft Word and Paint; get on the Internet; and change the background "wallpaper." The program was hailed by researchers and government officials alike as a groundbreaking project that offered a model for how to bring India's and the world's urban poor into the computer age. Visits to the computer kiosk, however, indicated a somewhat different reality. The Internet access was of little use since it seldom functioned. No special educational programs had been made available, and no special content was provided in Hindi, the only language the children knew. Children did learn to manipulate the joystick and buttons, but almost all their time was spent drawing with paint programs or playing uncomplicated games. There was no organized involvement of any community organizations in helping to run the project and the very architecture of the kiosk—based on a wall rather than a room—made supervision, instruction, and collaboration difficult. Parents in the neighborhood expressed concern that their children's schoolwork was suffering because they spent afternoons playing at the kiosks rather than doing their homework.

A second example that echoes these complexities comes from a technology and writing project conducted at a low-income, predominantly African American community site in Chicago. The "Garden Homes" project, as McNamee and Sivright (2002) reported, was developed using a framework called the Fifth Dimension (Cole, 1996; Griffin & Cole, 1987) in which children in community centers play in an elaborate series of educational technology games orchestrated by a fictitious "Wizard." The network has expanded internationally since its inception to include a worldwide network of participants who exchange letters through digital communication. Staff at the Garden Homes project report many benefits for the participating children, including the creation of a community of adults and peers (both physical and online) who help them learn academically relevant skills such as computer operations and analytical problem solving, and who also provide them with opportunities to develop social skills and deal with difficult personal situations.

Despite these benefits, McNamee and Sivright (2002) highlighted many of the limitations of the project, including the limited amount of positive images of African Americans and different dialects in the software programs; the

disturbingly self-deprecating images of themselves that the children conveyed to their online peers; and the limited involvement of parents, many of whom were strapped financially and emotionally. Finally, because of their negative experiences in schools, the children generally refused to participate in any activities that resembled schoolwork and often preferred to play outside. Q6

The Hole in the Wall and Garden Homes experiments demonstrated the limitations of the change framework, in and of itself, for guiding educational interventions. Just because literacies are new does not mean that they will benefit—or even engage—those who are exposed to them. Both examples highlight the need for organized involvement among educators, families, community members, and volunteers in order to coordinate efforts at enhancing youth involvement. Because effecting change in the lives of young people often involves academic achievement, educators must look for ways in which youth involvement in new literacies can also directly impact their success in school. To this end, future research must include multiple levels of social and economic analysis to examine critically the extent to which new literacies empower young people to be successful in a range of contexts extending beyond their immediate worlds.

Power Framework: Interacted vs. Interacting

The power framework is perhaps the most complex of the three (see Table 8.3). This perspective shares with the change framework the notion that literacies are in a state of rapid flux, and thus values inquiry into new literacy practices. In contrast to the change perspective, however, it tends to focus on those technology-related literacy practices that it sees as being more closely related to achieving on social, economic, and educational power (such as finding, critiquing, and deploying information in the quest for knowledge, or developing

Table 8.3 Power Framework

Conceptual Framework:	**Power**		
Central Metaphors:	**Industrial Revolution** Steam Power Electricity ICT	**Access Node** Phone Line Internet	**Literacy Mode** Print literacy Electronic literacies
Representative Journals	*Information Technology, Education, & Society*		
Key Works	Castells (1996/2000); Cummins and Sayers (1995); Warschauer (1999; 2003b)		
Fields of Inquiry:	Sociology, Economics, Development studies, Critical pedagogy		
Target of Critique:	Unequal power structures		
Goal:	Empower youth through knowledge, access, and skill with socially relevant tools		
Research Interest:	Relationship of access and use to educational and social equity		

sophisticated multimedia) rather than those existing on the margins (such as text messaging).

The power framework shares with the learning framework the notion that educational achievement at school is highly important. It views test scores as a highly politicized and contested terrain, however, and focuses on how social, economic, cultural, and linguistic contexts shape students' access to education, literacy, and academic achievement, and to appropriate uses of technology to achieve desired ends.

The sociological analysis of Manuel Castells provides a critical underpinning of the power framework. In his trilogy on the information age (1996/2000, 1997, 1998/2000), Castells outlined the crucial role that new technologies are playing in society, culture, and economics, and how unequal access to these technologies can have devastating consequences for individuals and communities. He posits a future in which the more privileged become the *interacting,* with the skills, knowledge, and resources to select or create their multimedia circuits of communication, while the less privileged become the *interacted,* limited to passive access to prepackaged choices—while the even more technologically isolated fall into "black holes of informational capitalism" (1998/2000, p. 162). Castells' work provided one of the main metaphors of the power framework, that of informational technology as enabling and representing a third stage of capitalism, following steam power of the 18th century and electrification of the 19th century. Some who pursue the notion of technological inequality and access compare campaigns for universal Internet access to earlier campaigns for universal phone access—in other words, a lifeline for full participation in modern society.

A more relevant metaphor from an educational perspective is that of ICT access and literacy being the new print literacy of the 21st century. In other words, those who cannot access and effectively use new technologies are hampered in ways similar to those of people who could not read in an earlier era. This framework has motivated a wide series of attempts to define, assess, and promote digital literacy (see, e.g., Ba et al., 2002; International ICT Literacy Panel, 2002; Shetzer & Warschauer, 2000; Warschauer, 2003b), with literacy in this sense referring not so much to practices (as in the change framework mentioned earlier) but rather to the skills, knowledge, and attitude that enable meaning making. Another group of researchers examining digital literacy in school settings advocated a New Literacies Perspective (Leu, Kinzer, Coiro, & Cammack, 2004), which outlines a view of in-school literacy to resituate foundational literacies of reading and writing within a much larger set of digital skills and strategies that students need to be successful in the changing knowledge economy. While this research does not draw directly on cultural or social theory to examine issues of power, work on new literacies in schools provides insight into how 21st-century skills are transforming classroom instruction (Coiro, 2003; Labbo & Reinking, 1999; Leu & Kinzer, 2000) and how

teachers must rethink pedagogy in light of new literacies and new technologies (Karchmer, 2001; Smolin & Lawless, 2003).

Another major scholar in the power framework is Cummins, whose work on language, literacy, and power (e.g., 1989) predated his major work on new media. In two coauthored books (Brown, Cummins, & Sayers, 2007; Cummins & Sayers, 1995), Cummins and colleagues set out the relationship of new technology use to broader issues of unequal power relations and literacy development in schools. They suggest that only a *transformative* pedagogical approach can unleash the potential of technology for literacy development—both for "traditional" and new literacies. Through such a transformative or critical approach, students make use of technology to analyze their own lives and social problems, develop and publish material that addresses social issues or positively promotes their identities, and collaborate with distant partners to further exploration of social or identity issues.

Several methodological approaches will be useful for conducting research from a power perspective, and many researchers have argued for perspectives that are interdisciplinary and creative (see e.g., Hagood, 2003; C. Luke, 2003; Mackey, 2003; Nixon, 2003; Leander, this volume; Livingstone, Van Couvering, & Thumin, this volume). The approach we have chosen to highlight in this chapter is that of the comparative case study because it includes research methods ranging from highly ethnographic work to mixed-methods approaches that take into account multiple layers of data sources that can illuminate underlying power issues. In *Electronic Literacies* (1999), for example, Warschauer presented four case studies of culturally and linguistically diverse learners using new technologies in language and writing courses that demonstrated how broader issues of social, economic, and political power shaped access to and use of new technologies, and that highlighted examples of empowering practices with culturally and linguistically diverse learners. The book also highlighted how students on the margin—whether immigrants in the United States or international students from developing countries—view the development of technology-based literacies as critical to their economic and social futures.

In two later studies, using a more explicit comparative approach, Warschauer contrasted the use of new technologies in low- and high-socioeconomic-status (SES) K–12 schools (2000; Warschauer et al., 2004). The studies showed how seemingly progressive pedagogy—such as use of computers for collaborative writing and project work—featured very different purposes and content, with low-SES students engaging in more perfunctory tasks and those in high-SES school doing more in-depth critical analysis. In addition, other features of the school context in low-SES schools—such as higher teacher turnover, weaker technical support networks, a greater fear of high-stakes assessments, and less student access to home computers—all complicated effective use of technology for literacy and learning. Some scholars have characterized these differences

in how technology is used as a second-level digital divide (Hargittai, 2002), in which the concerns about technological access that initially characterized the digital divide have since shifted to focus on the uses of technology (see Warschauer, 2003b for an extended analysis). These comparative works focusing on U.S. education were complemented by international case studies, which demonstrated how power relations similarly shaped implementation of technology-based literacy and language programs in China (Fang & Warschauer, 2004), Egypt (e.g., Warschauer, 2003a), and elsewhere (for overview, see Warschauer, 2003b).

Attewell and Winston (2003) also used a comparative case study approach, though with the individual, rather than the school or program, as the unit of analysis. Their comparative examination of low and high SES youth's use of new technologies in home contexts study painfully reveals the truth of Castells' aforementioned prediction. They describe how African American and Latino youth in poor and working-class communities of New York devote their efforts to downloading pictures of their favorite rappers and wrestlers, pasting images into reports, and going cyber-window shopping, while avoiding even news of their love interests if that requires them to read. Meanwhile, across town, their affluent, Caucasian American peers are writing school reports on home computers, checking out and participating on message boards related to their hobbies, following election news, and creating or modifying Web sites in support of their interests.

Another study by Attewell, this time quantitative, examined the benefit that educational payoff that low and high SES students got from having and using a home computer (Attewell & Battle, 1999). The study found that ethnic minorities gain far less of a performance boost from home computers, perhaps due to having fewer social resources or cultural capital to support learning from their home computers.

A challenge for advocates of a power framework is to find the right balance between determinism and agency. Inequality in both United States and global contexts is pervasive, and powerful technologies, which ordinarily have an amplification effect (Warschauer, 1999), can magnify those inequalities. This results in a "Sesame Street Effect" (Attewell & Battle, 1999, p. 1) whereby an innovation that promises to help at-risk children catch up educationally instead benefits affluent children even more, as they leverage their language and literacy skills, cultural capital, and social resources to better learn from and/or with the innovation. This effect has been witnessed in recent research on one-to-one laptop and handheld programs in 12 schools across the United States (Warschauer, 2006). The programs were universally successful in the high SES schools, but the outcomes were more mixed in low SES schools, where teachers struggled with a broad range of other challenges that hindered effective use of laptops. It is thus easy to find such a Sesame Street Effect in almost any implementation of new technologies in education (Cook et al., 1975;

Holloway & Green, 2003). To leave an analysis at that, however, is to succumb to determinism and pessimism (and, indeed, this is true of any approach which emphasizes social reproduction; see discussion in Giroux, 1983).

At the same time, as we look for positive examples of bottom-up agency, in which students and teachers of diverse backgrounds make use of technologies in truly innovative and transformative ways, it is also necessary to avoid romanticism. Some of the impressive examples that are reported may not be sustainable, due to the extraordinary efforts or resources they require or their mismatch with broader institutional expectations.

We will next discuss several projects that illustrate well both the potential and challenges of the power perspective.

Example: Power in the Classroom Through Critical Project-Based Work

Our first example is taken from "Project Fresa," a year-long theme-based project developed by two teachers who attended a professional development program emphasizing critical pedagogy and educational technology (see extended discussion in Warschauer, 2003b). The project took place at Mar Vista Elementary School, located in the midst of strawberry plantations in Oxnard, California, a couple of hours' drive north of Los Angeles. About 80% of the students in the school are Latino (including Mexicans, Mexican Americans, and Latin Americans), and the majority of them have family members working as laborers in the strawberry fields.

The project took as its focus the local strawberry (*fresa,* in Spanish) industry. The children began by formulating their own research questions about the conditions of strawberry workers. They then used these research questions to generate interview and survey questions, enrolling their family members, relatives, and neighbors as respondents. They conducted the interviews, usually in Spanish, and translated them in English. Afterwards, the students learned to record in spreadsheets and to produce graphs in various formats of the data they have gathered (analyzing, for example, which types of graphs best display what types of information). The graphs were incorporated into PowerPoint presentations together with photos and quotations from the people they interviewed, as well as with their own original poetry or prose about conditions in the fields.

With the guidance of the teachers, they then searched for further information about the conditions of strawberry workers on the Internet, and also invited guest speakers into their classroom from environmental and workers' rights groups. Based on the information obtained from the Internet and guest speakers, students wrote letters via e-mail to both the strawberry growers and elected officials, expressing concerns they had about strawberry workers' rights—and then collectively critiqued the responses (or, in some cases, nonresponses) they received for what that told them about the broader political and economic context of the strawberry industry. Later, they began an e-mail exchange with children in Puerto Rico who live in a coffee-growing area to

compare notes about the two industries and the condition of workers. At the end of the year, the students held a public presentation, inviting parents and community members to view the multimedia products they had created.

Though no independent evaluation was conducted of Project Fresa, its design reveals the potential benefits of the underlying power framework. Such projects seek to help students actively master technology, rather than use it in a passive manner. They engage students in their own research, data collection, analysis, and interpretation, and in creating quality products such as letters to elected officials and data-based presentations. Such projects also help students learn to speak out and take action on issues of importance to their community. Through gathering and evaluating information from a variety of sources, including workers, nongovernmental organizations, businesses, politicians, and children in other parts of the world, students can gain a better understanding of the broader socioeconomic forces that shape their lives.

Our second example of a power perspective in the classroom is taken from a split-level third- and fourth-grade class at a laptop school in southern California where the teacher presented the class with the challenge of helping prepare their younger second-grade peers for the yearly high-stakes statewide math exam (see extended analysis in Ware & Warschauer, in press). Equipped with laptops, wireless high-speed Internet access, multiple software programs, and an innovative teacher, the elementary school students, many of whom were non-native speakers of English, designed age-appropriate games targeted to review the types of math tested at the second-grade level.

The pedagogy underlying the production of these educational video games looked very different from a traditional classroom. The students conducted independent research on the Internet and located the appropriate state level standards for second-grade math. They collaborated in groups of four to discuss which types of activities would engage their target second-grade audience and negotiated a collaborative, multiday project plan to guide their decisions and regulate their time. Such autonomy in project-based learning is rarer in conventional classrooms, in which teachers often require that students follow a predetermined sequence of steps. Students used both linguistic means (a direction booklet) as well as multimodal means (digital explanatory videos) to create age-appropriate instructional materials, a step that is rarely taken in elementary school peer-teaching scenarios, in which older students are often given prefabricated scripts to follow as they work with younger peers. Finally, throughout the process, these young children dealt with cognitively complex tasks of breaking down knowledge and repackaging it, of transforming information from one mode to another, and of redesigning the pedagogy of math drills that typically inform test preparation in schools (Kress, 2003; New London Group, 1996). Such multimodal pedagogies position students not as recipients of knowledge, but rather, as Luke (2003) suggested, as students actively involved in drawing on blends of new and old learning styles and practices.

Internationally, many classrooms are beginning to make pedagogical changes that reflect the spirit of a power perspective. D. J. Leu, Karchmer, and D. D. Leu (1999) reported on a number of these transformations in which students and teachers explore new ways of using technology to expand literacy learning (to conduct international e-mail exchanges and develop multimedia portfolios of literacy projects) and to share their work with a range of audiences (local businesses, district and state schools, and international sister schools). As with Project Fresa, no independent evaluation has been conducted on these projects, but we find the projects noteworthy as they mark early attempts to transform classrooms in ways that move well beyond the mandated curricula that characterize much of school-based literacy instruction. Q8

Despite the benefits of such project-based learning, such innovations to the school-based curriculum are not easy to organize. In Project Fresa, for example, though the teachers involved took care to match the project with the state learning standards (in areas such as graphing and letter writing), creating such matches in project-based work is more challenging than simply teaching from the mandated textbooks. Such projects also take a considerable amount of time to set up and manage, and U.S. teachers are provided relatively little time for such collaborative planning, compared to teachers in other developed countries such as Japan (Stigler & Hiebert, 1999). Finally, classroom teachers at low SES schools are under great pressure to raise test scores, and most thus shy away from creative project-based instruction in order to concentrate on more narrowly focused interventions related to state examination material (Warschauer et al., 2004). Project Fresa itself was repeated only one more year until both teachers left the school, one to retire and one to become a vice principal at another elementary school. The latter reported (M. Singer, personal communication, June x, 2005) that she has been unsuccessful in getting teachers at her school to try similar projects due to their fears about lessening their focus on test scores. It is thus unlikely that such projects will be implemented widely in U.S. schools without a broader repurposing and restructuring of education, moving away from the prescribed and scripted literacy curricula and punitive assessment policies currently in vogue. Q9

To summarize, the frameworks of learning, change, and power dominate the way that academics and educators think about literacy and technology. These three frames can be thought of as corners of a triangle, as of course any individual's perspective is far more likely to fall on a continuum within the triangle rather than at one of its vertices. Indeed, some of the most interesting work on technology-mediated learning in the broad sense of the term has been done by scholars discussed earlier under the change perspective (see Gee, 2003, 2004; Kress, 2003; New London Group, 1996).

Though we consider each of these three frameworks to be legitimate perspectives for researching technology and literacy, in the end we favor a power framework as being best able to integrate the strengths, while minimizing

the limitations, of the other two frames, at least in regards to understanding technology and literacy in school contexts. The strength of the learning perspective is that it seeks demonstrable evidence of student improvement in foundational areas of reading and writing. The weakness, though, is that it tends to reduce learning to performance on high-stakes examinations, with a negative washback effect on classroom instruction, particularly as such instruction might help promote broader 21st-century literacies. The strength of the change perspective is that it tackles head-on how literacy is being transformed, but the framework does not consistently attempt to account for what such transformations mean for diverse learners in schools. A power framework can consider learning and change not as abstract ends but rather in the context of working to expand students' broader educational, social, and economic opportunities.

Conclusion

Literacy is changing at a faster rate than perhaps ever before in human history, leading many researchers in communications, applied linguistics, and other fields to attempt to document, and in some cases celebrate, those changes. Educators, however, have witnessed one new technology after another—from radio, film, and television, to programmed instructional kits and language laboratories—parade in and out of the classroom, leaving little behind but empty coffers and unfulfilled promise (Cuban, 1986). In an era of high-stakes testing and strict accountability to standards, many educators look to today's technology from a utilitarian stance of how they may promote learning as measured by standardized examination. At the same time, neither learning nor change occurs in a social vacuum, and a third framework for technology and literacy focuses on issues of underlying power, and how new technologies might be deployed to enhance the broad educational, social, and economic opportunities of culturally and linguistically diverse learners.

The implications of this analysis for teaching and learning are multiple. As is clear from much of the research on out-of-school literacies, youth use ICT interactively and purposefully, in ways that are increasingly hypertextual, connected, and communicative. Educators and researchers on in-school literacies need to take these practices seriously and explore creative ways to tap into this rich, existing set of uses in order to help bridge students toward gaining the kinds of skills and strategies that they need to be successful in schools and in the expanding knowledge economy. It is not, however, simply a one-way street of inducting students into what are considered legitimate forms of school-based literacy. Rather, educators must look for ways to acknowledge and even appropriate for themselves the creative and complex literacy practices that youth bring into schools. Bridges between schools and youth form more easily when educators take seriously the literacy texts and practices that enrich youth culture, as Morrell and Duncan-Andrade (2004) have compellingly

demonstrated in their classroom that legitimized hip-hop music alongside canonical work as valued literary texts.

Transformative pedagogy, of the kind suggested by Cummins and his colleagues (Brown et al., 2007; Cummins & Sayers, 1995) are visible in schools where teachers are provided the professional space and resources to engage students in highly interactive, multimodal project-based learning, as seen in the example of the elementary-school teacher working with third and fourth graders in the laptop magnet program (see example in Ware & Warschauer, in press). Administrators, particularly those who embrace technology and literacies of the 21st century, must be willing to look beyond the state-mandated curriculum and prescribed standardized tests, toward an innovative curriculum still under exploration and assessments that are still in development.

Future research on literacy and technology in education requires innovation and creativity in methodology and approach. Researchers already conducting work on new literacies in schools have begun to document the skills and strategies that students need to be successful in the digital age (see Coiro, 2003; Leu et al., 2004), and their early work has highlighted the need for a serious commitment to professional development (Karchmer, 2001) and for a critical approach to the effects of high-stakes testing regimes. Large-scale, quantitative analyses of literacies in schools and society will certainly be needed, but the meaning of such quantitative findings can be better understood within a power framework that recognizes the multiple, highly contextualized, and changing demands of literacy in the new knowledge economy. Ethnographic and qualitative work, too, can help educators stay abreast of the rapidly changing demands of ICT in schools, workplaces, homes, and youths' lives. Such qualitative research will, we hope, continue to contribute theoretical insights into the changing nature of literacy, genre, and identity, but it will also benefit from taking a broader sociocultural perspective that takes into account issues of social and economic equity as outlined in the power framework.

In summary, examining the distinct theoretical underpinnings and educational emphases of three underlying frameworks on literacy and technology allows us to better understand the larger context in which research on this topic takes place. Consideration of these three frameworks can assist researchers not only in situating their own scholarship, but also in considering how alternative viewpoints on technology and literacy may inform other people's practices and, perhaps eventually, their own.

References

Attewell, P., & Battle, J. (1999). Home computers and school performance. *The Information Society, 15*(1), 1–10.

Attewell, P., & Winston, H. (2003). Children of the digital divide. In P. Attewell & N. M. Seel (Eds.), *Disadvantaged teens and computer technologies* (pp. 117–136). Münster, Germany: Waxmann.

Ba, H., Tally, W., & Tsikalas, K. (2002). Investigating children's emerging digital literacies. *Journal of Technology, Learning, and Assessment, 1*(4).

Baron, D. (1999). From pencils to pixels: The stages of literacy technologies. In G. E. Hawisher, & C. Selfe (Eds.), *Passions, pedagogies, and 21st century technologies* (pp. 15–33). Logan: Utah State University Press.

Becker, H. J. (2000). Findings from the teaching, learning, and computing survey: Is Larry Cuban right? *Educational Policy Analysis Archives, 8*(51).

Belson, K. (2005, June 21). Dial-up Internet going way of mobile phones. *New York Times*.

Bleha, T. (2005). *Down to the wire*. Retrieved September 5, 2006, from http://www.foreignaffairs.org/20050501 faessay84311–p0/thomas-bleha/down-to-the-wire.html

Bolter, J. D. (1991). *Writing space: The computer, hypertext, and the history of writing*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Brown, K. R., Cummins, J., & Sayers, D. (2007). *Literacy, technology, and diversity: Teaching for success in changing times*. Boston: Allyn & Bacon.

Castells, M. (1996/2000). *The rise of the network society* (2nd ed.). Malden, MA: Blackwell.

Castells, M. (1997). *The power of identity*. Malden, MA: Blackwell.

Castells, M. (1998/2000). *End of millennium* (2nd ed.). Malden, MA: Blackwell.

Coiro, J. (2003). Reading comprehension on the Internet: Expanding our understanding of reading comprehension to encompass new literacies. *The Reading Teacher, 56*, 458–464.

Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Belknap Press of Harvard University Press.

Cook, T. D., Appleton, H., Conner, R., Shaffer, A., Tamkin, G., & Weber, S. J. (1975). *"Sesame Street" revisited*. New York: Russel Sage Foundation.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Cuban, L. (2001). *Oversold and underused: Computers in classrooms, 1980–2000*. Cambridge, MA: Harvard University Press.

Cummins, J. (1989). *Empowering minority students*. Sacramento: California Association for Bilingual Education.

Cummins, J., & Sayers, D. (1995). *Brave new schools: Challenging cultural illiteracy through global learning networks*. New York: St. Martin's Press.

Dewey, J. (1938). *Experience and education*. New York: Macmillan.

Fang, X., & Warschauer, M. (2004). Technology and curricular reform in China: A case study. *TESOL Quarterly, 38*(2), 301–323.

Fuchs, T., & Woessmann, L. (2004). *Computers and student learning: Bivariate and multivariate evidence on the availability and use of computers at home and at school* (CESIFO Working Paper No. 1321). Munich, Germany: Center for Economic Studies at the University of Munich.

Q10

Gee, J. (2003). *What video games have to teach up about learning and literacy*. New York: Palgrave Macmillan.

Gee, J. (2004). *Situated language and learning: A critique of traditional schooling*. New York: Routledge.

Giroux, H. (1983). *Theory & resistance in education*. New York: Bergin & Garvey.

Goldberg, A., Russell, M., & Cook, A. (2004). The effect of computers on student writing: A meta-analysis of studies from 1992 to 2002. *Journal of Technology, Learning, and Assessment, 2*(1), 3–51.

Griffin, P., & Cole, M. (1987). New technologies, basic skills, and the underside of education: What's to be done? In J. Langer (Ed.), *Language, literacy, and culture: Issues of society and schooling* (pp. 199–231). Norwood, NJ: Ablex.

Gulek, J. C., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *Journal of Technology, Learning, and Assessment, 3*(2).

Hagood, M. (2003). New media and online literacies: No age left behind. *Reading Research Quarterly, 38*(3), 387–392.

Hargittai, E. (2002). Second-level digital divide: Differences in people's online skills. *First Monday, 7*(4).

Harnad, S. (1991). Post-Gutenberg galaxy: The fourth revolution in the means of production and knowledge. *Public-Access Computer Systems Review, 2*(1), 39–53.

Holloway, D., & Green, L. (2003). *Sesame Street effect: Work, study, play and the family internet*. Paper presented at the Australian and New Zealand Communications Association Conference, Brisbane, Australia.

Hull, G. (2003). AT LAST: Youth culture and digital media: New literacies for new times. *Research in the Teaching of English, 38*(2), 229–233.

Hull, G., & Nelson, M. E. (2005). Locating the semiotic power of multmodality. *Written Communication, 22*(2), 224–261.

Hull, G., & Schultz, K. (Eds.). (2002). *School's out!: Bridging out-of-school literacies with classroom practice*. New York: Teachers College Press.

International ICT Literacy Panel. (2002). *Digital transformation: A framework for ICT literacy*. Retrieved February 28, 2005, from http://www.ets.org/research/ictliteracy/ictreport.pdf

Ito, M., & Okabe, D. (2005a). Intimate connections: Contextualizing Japanese youth and mobile messaging. In R. Harper, L. Palen, & A. Taylor (Eds.), *The inside text: Social, cultural, and design perspectives on SMS* (pp.127–143). Dordrecht, Netherlands: Kluwer Academic Publishers.

Ito, M., & Okabe, D. (2005b). Technosocial situations: Emergent structuring of mobile email use. In M. Ito, D. Okabe, & M. Matsuda (Eds.), *Personal, portable, pedestrian: Mobile phones in Japanese life* (pp. 257–276). Cambrige, MA: MIT Press.

Jeroski, S. (2004). *Implementation of the wireless writing program: Phase 3*. Retrieved June 21, 2005, from http://www.prn.bc.ca/WWP_Report04.pdf

Karchmer, R. (2001). The journey ahead: Thirteen teachers report how the Internet influences literacy and literacy instruction in their K-12 classrooms. *Reading Research Quarterly, 36*, 442–466.

Kelly, T., Gray, V., & Minges, M. (2003). *Broadband Korea: Internet case study*. Geneva, Switzerland: International Telecommunications Union.

Kress, G. (1998). Visual and verbal modes of representation in electronically mediated communication: The potentials of new forms of text. In I. Snyder (Ed.), *Page to screen: Taking literacy into the electronic era* (pp. 53–79). Routledge: London.

Kress, G. (1999). "English" at the crossroads: Rethinking curricula of communication in the context of the turn to the visual. In G. E. Hawisher, & C. Selfe (Eds.), *Passions, pedagogies, and 21st century technologies* (pp. 66–88). Logan: Utah State University Press.

Kress, G. (2003). *Literacy in the new media age*. London: Routledge.

Kress, G., & van Leeuwen, T. (1996). *Reading images: The grammar of visual design*. London: Routledge.

Kress, G., & van Leeuwen, T. (2001). *Multimodal discourse: The modes and media of contemporary communication*. London: Arnold.

Labbo, L. D., & Reinking, D. (1999). Negotiating the multiple realities of technology in literacy research and instruction. *Reading Research Quarterly, 34*, 478–492.

Lakoff, G. (2004). *Don't think of an elephant: Know your values and frame the debate*. White River Junction, VT: Chelsea Green.

Lam, W. S. E. (2000). Second language literacy and the design of the self: A case study of a teenager writing on the Internet. *TESOL Quarterly* (34), 457–482.

Lam, W. S. E. (2003). *Second language literacy and identify formation on the Internet*. Unpublished doctoral dissertation, University of California, Berkeley.

Lam, W. S. E. (2005a). *Re-envisioning language literacy and the immigrant subject in new mediascapes*. Manuscript submitted for publication.

Lam, W. S. E. (2005b). Second language socialization in a bilingual chat room. *Language Learning and Technology, 8*(3), 44–65.

Landow, G. P. (1992). *Hypertext: The convergence of contemporary critical theory and technology*. Baltimore: John Hopkins University Press.

Lankshear, C., & Knobel, M. (2003). *New literacies: Changing knowledge in the classroom*. Buckingham, U.K.: Open University Press.

Leander, K. (2007). Toward a connective ethnography of online/offline literacy networks. In J. Coiro, M. Knobel, C. Lankshear, & D. Leu (Eds.), *Handbook of research on new literacies* (pp. xx–xx). Mahwah, NJ: Erlbaum.

Q11

Lemke, J. L. (1998). Metamedia literacy: Transforming meanings and media. In D. Reinking, M. McKenna, L. Labbo, & R. D. Kieffer (Eds.), *Handbook of literacy and technology: Transformations in a post-typographic world* (pp. 283–301). Hillsdale, NJ: Erlbaum.

Q12

Leu, D. J. , Karchmer, R., & Leu, D. D. (1999). Exploring literacy on the Internet. *The Reading Teacher, 52*(6), 636–642.

Leu, D., & Kinzer, C. (2000). The convergence of literacy instruction with networked technologies for information and communication. *Reading Research Quarterly, 35*, 108–127.

Leu, D. J., Jr., Kinzer, C. K., Coiro, J., & Cammack, D. (2004). Toward a theory of new literacies emerging from the Internet and other information and communication technologies. In R. B. Ruddell & N. Unrau (Eds.), *Theoretical models and processes of reading* (5th ed., pp. 1568–1611). Newark, DE: International Reading Association.

Q13

Livingstone, S., Van Couvering, E., & Thumim, N. (2007). Converging traditions of research on media and information literacies: Disciplinary, critical, and methodological issues. In J. Coiro, M. Knobel, C. Lankshear, & D. Leu (Eds.), *Handbook of research on new literacies* (pp. xx–xx). Mahwah, NJ: Erlbaum.

Q14

Lowood, H. (2005). Real-time performance: Machina and game studies. *The International Digital Media & Arts Association Journal, 2*(1), 10–17.

Luke, A., & Freebody, P. (1999). A map of possible practices: Further notes on the four resources model. *Practically Primary, 4*(2), 5–8.

Luke, C. (2003). Pedagogy, connectivity, multimodality, and interdisciplinarity. *Reading Research Quarterly, 38*(3), 297–314.

Mackey, M. (2003). Researching new forms of literacy. *Reading Research Quarterly, 38*(3), 403–407.

McNamee, G. D., & Sivright, S. (2002). Community supports for writing development among urban African American children. In G. Hull, & K. Schultz (Eds.), *School's out: Bridging out-of-school literacies with classroom practice* (pp. 169–197). New York: Teachers College Press.

Morrell, E., & Duncan-Andrade, J. (2004). What youth do learn in school: Using hip-hop as a bridge to canonical poetry. In J. Mahiri (Ed.), *What they don't learn in school: Literacy in the lives of urban youth* (pp. 248–268). New York: Peter Lang.

Murray, J. H. (1998). *Hamlet on the holodeck: The future of narrative in Cyberspace*. Cambridge, MA: MIT Press.

Nelson, M. E. (2006). Mode, meaning, and synesthesia in multimedia L2 writing. *Language Learning and Technology, 10*(2), 56–76.

New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review, 66*(1), 60–92.

Nielsen/Net Ratings. (2004). *Three out of four Americans have access to the Internet, according to Nielsen Net Ratings*. Retrieved June 21, 2005, from http://direct.www.nielsen-netratings.com/pr/pr_040318.pdf

Nixon, H. (2003). New research literacies for contemporary research into literacy and new media? *Reading Research Quarterly, 38*(3), 407–414.

O'Dwyer, L. M., Russell, M., Bebell, D., & Tucker-Seeley, K. R. (2005). Examining the relationship between home and school computer use and students' English/language arts test scores. *Journal of Technology, Learning, and Assessment, 3*(3). Retrieved August 11, 2006, from http://www.jtla.org

Paterson, W. A., Henry, J. J., O'Quin, K., Ceprano, M. A., & Blue, E. (2003). Investigating the effectiveness of an integrated learning system on early emergent readers. *Reading Research Quarterly, 38*(2), 172–207.

Pearce, C. (2002). Emergent authorship: The next ineractive revolution. *Computers & Graphics, 26*, 21–29.

Reardon, M. (2005). *China to trump U.S. in broadband subscribers*. Retrieved June 21, 2005, from http://news.zdnet.com/2100-6005_22-5695591.html

Renaissance Learning. (2004). *Accelerated reader*. Wisconsin Rapids, WI: Renaissance Learning.

Russell, M., & Abrams, L. (2004). Instructional effects of computers for writing: The effect of state testing programs. *Teachers College Record, 106*(6), 1332–1357.

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research, 30*(4), 313–330.

Russell, M., Higgins, J., & Hoffman, T. (2004). *Examining the effect of text editor and robust word processor on student writing performance (inTASC Publications)*. Boston: Lynch School of Education.

Russell, M., & Plati, T. (2002). Does it matter with what I write?: Comparing performance on paper, computer and portable writing devices. *Current Issues in Education, 5*(4), 2–27.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press.

Seiter, E. (2004). Children reporting online: The cultural politics of the computer lab. *Television & New Media, 5*(2), 87–107.

Seiter, E. (2005). *The Internet playground: Children's access, entertainment, and miseducation*. New York: Peter Lang.

Shetzer, H., & Warschauer, M. (2000). An electronic literacy approach to network-based language teaching. In M. Warschauer, & R. Kern (Eds.), *Network-based language teaching: Concepts and practice* (pp. 171–185). New York: Cambridge University Press.

Shiu, E., & Lenhart, A. (2004). *How Americans use instant messaging*. Washington, DC: Pew Internet & American Life Project.

Slayton, J., & Llosa, L. (2002). *Evaluation of the Waterford Early Reading Program 2001–2002: Implementation and student achievement* (Planning, Assessment and Research Division Publication No. 144). Los Angeles: Los Angeles Unified School District Program Evaluation and Research Branch.

Smolin, L. I., & Lawless, K. A. (2003). Becoming literate in the technological age: New responsibilities and tools for teachers. *The Reading Teacher, 56*, 570–577.

Sotamaa, O. (2003, December). *Computer game modding, intermediality and participatory culture*. Paper presented at the New Media? New Theories? New Methods? Conference, Sandbjerg, Denmark.

Steinkuehler, C. (2005). The literacy practices of massively multiplayer online games versus online standards. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada.

Steinkeuhler, C. (in press). Cognition and Literacy in Massively Multiplayer Online Games. In D. Leu, C. Lankshear, M. Knobel, & J. Coiro (Eds.), *Handbook of research on new literacies* (pp. xx–xx). Mahwah, NJ: Erlbaum.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.

Street, B. (1995). *Social literacies*. Boston: Addison-Wesley.

Taylor, R. (1980). *The computer in the school: Tutor, tool, tutee*. New York: Teachers College Press.

Tuman, M. (1992). *Word perfect: Literacy in the computer age*. Pittsburgh, PA: University of Pittsburgh Press.

Tyner, K. (1998). *Literacy in a digital world*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ware, P., & Warschauer, M. (in press). Hybrid literacy texts and practices in technology-intensive environments. *International Journal of Educational Research*.

Warschauer, M. (1997). Computer-mediated collaborative learning: Theory and practice. *Modern Language Journal, 81*(4), 470–481.

Warschauer, M. (1998). Researching technology in TESOL: Determinist, instrumental, and critical approaches. *TESOL Quarterly, 32*(4), 757–761.

Warschauer, M. (1999). *Electronic literacies: Language, culture, and power in online education*. Mahwah, NJ: Lawrence Erlbaum Associates.
Warschauer, M. (2000). Technology and school reform: A view from both sides of the track. *Education Policy Analysis Archives, 8*(4).
Warschauer, M. (2003a). The allures and illusions of modernity: Technology and educational reform in Egypt. *Educational Policy Analysis Archives, 11*(38).
Warschauer, M. (2003b). *Technology and social inclusion: Rethinking the digital divide*. Cambridge, MA: MIT Press.
Warschauer, M. (2006). *Laptops and literacy: Learning in the wireless classroom*. New York: Teachers College Press.
Warschauer, M., Knobel, M., & Stone, L. (2004). Technology and equity in schooling: Deconstructing the digital divide. *Educational Policy, 18*(4), 562–588.
Warschauer, M., & Ware, P. (2006). Automated writing evaluation: Defining the classroom research agenda. *Language Teaching Research, 10*(2), 1–24.
Wright, C. (2003). Parking Lott: The role of Web logs in the fall of Sen. Trent Lott. *Culture, Communication, and Technology Program, 3*, 1–30.

COMMENTS

Q2	CA: This seems to contradict "32" in last sentence.
Q3	CA: Please supply communication date.
Q5	CA: Should this term be capitalized?
Q6	CA: You may want to consider replacing with a more formal term.
Q8	CA: Please verify author initial.
Q9	CA: Please supply communication date.
Q10	CA: Please verify publisher location.
Q11	Please supply page numbers.
Q12	CA: Please verify author initial.
Q13	Please supply page numbers.
Q14	Please supply page numbers.