

Reading and Writing With Computers: Literacy Research in a Post-Typographic World*

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Richard Lanham (1989), in an article about how electronic texts are changing reading and writing, points out how technological change often requires businesses and professions to address the question "What business

or profession are we really in?" For example, as technological advances led to alternative forms of transportation early in this century, railroads had to decide if they were in the railroad business or the transportation business. The decline in railroads as they moved to the margins of the transportation industry testifies to the outcome of those that stayed in the railroad business. More recently, those who produce newspapers have faced decisions about whether they are in the newspaper business or the information business. Some major newspapers are hedging their bets, such as the *Atlanta Journal-Constitution*, which has added an on-line news service available to readers who subscribe electronically. And the Steinway Company, a leading manufacturer of pianos, is threatened by competition from companies such as Yamaha that manufacture electronic keyboards. Steinway must decide if it is in the piano business or the music business. I am sure that for many who make and play Steinway pianos, such a decision is an agonizing and emotional one. To them, a piano is more than a device that produces music; the physical and sensory characteristics of a well-crafted piano evoke a strong aesthetic response that electronic keyboards do not. The risk of losing that aesthetic is more salient to them than any of the keyboard's potential advantages.

The central theme of this address to the membership of the National Reading Conference is that we are experiencing an irreversible movement from printed to electronic forms of reading and writing, which places us at a similar crossroads in our professional lives, both individually and collectively. Evolving forms of electronic reading and writing point to fundamental changes in the way we communicate and disseminate information, the way we approach the task of reading and writing, and the way we think about helping people become literate. And, as history suggests, such fundamental changes in literacy may have social, political, and cultural repercussions. As Myron Tuman (1992b) has stated,

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It is as if the terrain we stand on has shifted—with many of us about to look up and discover . . . the playful speculations of computer enthusiasts transformed into pressing questions of public policy. We are all soon likely . . . to be responding to the questions . . . about reading and writing with computers, not as futurists or theorists, but as teachers, parents, and citizens faced with immediate and difficult educational decisions. (p. 15)

I believe that our conceptions of literacy, and by extension our research agenda, must respond to these changes, or, as Marshall McLuhan has cautioned, we risk driving into the future looking in the rearview mirror.

This perspective affects the direction of this research address. My interpretation of the NRC research address is that it should be an informed review and commentary on the state-of-the-research in a particular area of study related to literacy. However, given the profound implications of a shift toward electronic reading and writing, I believe that a consideration of the existing and needed research must now be contextualized within more global concerns. That is, our entire conception of literacy needs to be reevaluated.

Thus, my theme implies a bold goal: I hope to convince you that virtually every area of interest among literacy researchers must now be reconsidered because we are poised to enter the post-typographic era that McLuhan (1962) and others predicted 30 years ago. However, it is not television and the other video media, at least in analog form, that will usher in the post-typographic culture as McLuhan argued; it is the digital forces of the computer in all of its shape-shifting forms and uses.

In the past we have waged a successful rearguard action against television and other modern communication media by defining them as foils to our conceptions of the literacy business (although, as Susan Neuman, 1991, and others have pointed out, years of research indicate that television viewing has marginal, if any, direct effect on levels of literacy). We have even occasionally embraced new or competing technologies on our own terms; for example, the research conducted by Pat Koskinen and her colleagues (Koskinen, Wilson, Gambrell, & Neuman, 1993) on the use of closed-captioned television to increase reading ability, ultimately to be applied to printed materials. But simply defining computer technology as alien to what we do, or accepting it only if it will surrender to our print-based biases, will not, if current trends continue, slow the rise of the computerized word against the printed word.

Along with many of my colleagues in this audience who have an abiding interest in the technological dimensions of literacy, I believe we should not be threatened by the electronic word. To the contrary, I believe we have much to gain by assimilating electronic reading and writing into our conceptions of literacy. At the very least, even if we determine that the digital world is in some way inferior to print, we will better understand what business we are really in and be ready to carry it out with a deeper understanding.

Thus, I hope not to portray myself as an evangelist preaching an unexamined acceptance of computer-based reading and writing as superior to print. I value a healthy skepticism in my own thinking and share with many of you an ambivalence about what we might gain or lose if electronic media come to overshadow print. What I do know, and will strongly argue, is that we in our field cannot continue business as usual. As electronic reading and writing move into the mainstream of everyday discourse, we must decide whether we are in the print business or, if not, what business we are really in.

To support my position and to comment on the research that has been done or needs to be done, I will address the following key questions:

1. To what extent are reading and writing changing? That is, what evidence is there that we are moving into a post-typographic era?
2. Could books be moving to the margins of the literacy; and, if so, how much should we care?

3. Is reading and writing with a computer really that different? And, if so, how?
4. How might incorporating electronic reading and writing into our conceptions of literacy reconfigure our research agenda?
5. How much does the research involving computers speak to these issues? What do we most need to know if we are headed toward a post-typographic world?

Are We Moving Toward a Post-Typographic Era?

To address this question, it is necessary to consider the term *post-typographic*. Obviously, it is meant to demarcate a shift to a time when typography or print no longer dominates. However, its significance is rooted in the understanding that, throughout history, literacy has been a dynamic concept, intimately related to the tools and materials (i.e., the technology) used to read and to write (Kaufert & Carley, 1993). It also is meant to acknowledge that technology fundamentally shapes the entire spectrum of literate activity and its consequences. For example, as Jay Bolter (1991) has pointed out (see also Landow, 1992), the conceptual units of writing, such as paragraphs, chapters, and books, are linked to typography, as are our notions about diverse topics such as copyrights, plagiarism, authorship, and the literary canon.

The term *post-typographic* has been used by various writers to highlight different effects of electronic communication. For McLuhan (1962) it meant cultural effects; for some literary theorists it has suggested a time when postmodern views of meaning will be operationalized (see Bolter, 1991; Landow, 1992; Moulthrop, 1991; Moulthrop & Kaplan, 1994; Murphy, 1988); and for Walter Ong (1982) it meant a cognitive shift towards a "second orality." In each instance the term has been used to mark an intellectual and cultural watershed with a significance that extends beyond the question of whether we compose with a stylus, a typewriter, or a computer.

When the technology of reading and writing remains relatively stable as it has until recently in our lifetimes, the role of technology in shaping literacy is of little more than historical interest. As Jay Samuels used to say when I was a graduate student, "If scientists were fish, water is the last thing they would investigate." Using the term *post-typographic* highlights that electronic texts are increasingly becoming a destabilizing influence, requiring us to examine assumptions so basic that they have been transparent. Considering that we may be entering a post-typographic world means facing the discomforting reality that our assumptions about literacy are not immutable laws of nature, but only the natural consequence of one way to read and write.

The pace at which we are moving away from print has of late accelerated to a point that is difficult to ignore. New examples appear almost daily. *Newsweek* just joined the other news magazines by announcing an interactive version available through a commercial on-line service. An article in *Scientific American* (Stix, 1994) reported that the exchange of information among leading scientists is increasingly bypassing conventional journal publication. As noted in that article, the 1994 edition of the *Directory of Electronic Journal, Newsletters and Academic Discussion Lists*, published by the Association of Research Libraries, lists 440 electronic academic journals, a fourfold increase from 1991 (see also the *Los Alamos E-Print Archives*, available on the World Wide Web as <http://xxx.lanl.gov/>). Currently, about 100 have some type of peer review. The article also documents that the number of journals and books purchased by libraries has decreased steadily since 1985.

The move toward electronic reading and writing is not limited to scholars and scientists. We sign for deliveries with a stylus on an electromagnetic tablet. Nurses use a similar technology to chart patients, medications and vital signs, which are sent wirelessly to computers in a physician's office. The clerk in an auto parts store conducts an

electronic search for a needed part, which is then displayed graphically on a CRT screen. Hotels include special phone links for guests who wish to use modems. Britannica and other companies are increasingly marketing electronic versions of encyclopedias in place of their printed counterparts. Students at major universities such as Stanford, UCLA, and MIT, where many dormitories have direct Internet connections, are using computers to register for courses, to research topics in libraries around the world, to submit their work to instructors, and to find out who in their dormitory wants to chip in on a pizza. Traffic on the Internet has been doubling every 8-10 months. Publishing companies are tentatively experimenting with electronic texts. Rental cars are being equipped with electronic street maps. Anyone who thinks these are isolated examples that will eventually disappear is living in a time warp that is increasingly difficult to sustain.

If we in our field have been slow to acknowledge these developments, the general public, corporate America, and the government have not. Both *Newsweek* and *Time* recently published cover stories about the Internet, and *Newsweek* has an ongoing feature entitled "Cyberscope" that deals with aspects of the Internet and computer-based communication. Vice President Al Gore's superhighway metaphor has become part of the national vocabulary. We read of high-stakes corporate jockeying that is occurring in response to ambiguity about the future of conventional forms of communication and entertainment.

Neither have the fundamental issues raised by these developments been ignored. Jube Shiver, Jr., in a *Los Angeles Times* article about how easy it is to reproduce digital information, wrote that the new technology

has created a multibillion-dollar legal morass—confusion that underscores the difficulties of defining issues as fundamental as ownership and power in a digital age where information can be copied or altered with a few keystrokes. . . . Indeed, the spread of digital technology is quickly eroding the political and geographic boundaries that have allowed industry and governments to maintain control over information through legal measures. . . . Information is becoming liquid. It can no longer be contained.

Hopefully, we in our field will begin to provide thoughtful and measured responses to such developments. It would be unfortunate indeed if we found ourselves on the trailing edge of a shift toward a post-typographic world with nothing of substance to add to the discussion. We risk more than looking foolishly provincial, for by continuing to invest only in the print business we will miss the opportunity to shape the new world of digital literacy.

Are Books Moving to the Margins of Literacy, and Should We Care?

When I discuss the increasing influence of electronic texts with colleagues and students, I am greeted with a variety of responses that typically range from enthusiastic interest to polite skepticism. When I suggest further that electronic texts may ultimately replace printed ones, I can expect some strong opposing arguments. But the pitch and the tenacity of these arguments escalate considerably when I suggest the possibility that the book may ultimately be treated like the phonograph, a technology valued primarily for the sake of nostalgia. Books are cultural icons representing our affinity for printed materials. They serve as a rallying point for our biases against anything that threatens print-based literacy. If we are going to deal reasonably with electronic literacy, we must examine our print-based biases, and a good place to start, it seems to me, is with our attitudes toward and beliefs about books.

Rarely before the present have we had any reason to question the centrality of books in our conception of literacy. Only occasionally are we confronted with their abiding and pervasive effect on us. An example I used in a *Journal of Reading Behavior*

book review (Reinking, 1991) is the scene in the film *Dead Poets Society* where Robin Williams, as teacher John Keating, directs his students to rip out the scholarly preface in their poetry books. The dramatic tension of the scene is derived from our mixed feelings—applauding, on one hand, the readers' ability to exercise personal power over the dominating influence of the book, while at the same time recoiling from this flagrant violation of a venerable object.

However, books, and indeed writing itself, were not always viewed with such veneration and respect, and such an awareness lends perspective to our indignation about the thought of losing the ideal of the book. For example, Socrates considered writing inhuman, a manufactured product outside of the mind, and ultimately a destroyer of memory. This position persisted into the Middle Ages, when St. Thomas Aquinas wrote that "it is fitting that Christ did not commit his teaching to writing, on account of his own dignity and . . . whereby his doctrine would be imprinted on the hearts of his hearers." And, when relatively inexpensive printed books were beginning to replace handwritten illuminated manuscripts, a 16th-century administrator lamented,

Could a portable, private instrument like the new book take the place of a book made by hand and memorized as one made it? Could a book which could be read quickly and even silently take the place of a book read slowly aloud? Could students trained by such printed books measure up to the skilled orators and disputants produced by manuscript means?

Will future citizens of a post-typographic world smirk at our own resistance to a changing literacy landscape, as a feeble attempt to preserve a literacy that is not necessarily better but only more familiar? Given the increasing flexibility and power of electronic texts, the arguments for elevating books over electronic texts are already beginning to sound shallow and desperate. The fact that some prefer to take a book rather than a computer to read in bed or at the beach hardly seems to be a firm foundation upon which to argue for the preservation of books at all costs. It may, in fact, seem foolish, when considering the computer's capability to provide a whole library at one's disposal in a single, portable, highly interactive, and increasingly readable device. The strong aesthetic response that we associate with books, especially certain genres of fiction, is real, but learned. It does not negate the possibility that an equally powerful aesthetic response could reside within creative forms of electronic reading and writing, a possibility entertained by a *New York Times Book Review* article (Coover, 1993) on the emerging genre of hypertextual fiction. Opposing such electronic forms of creativity on preference alone is no more justifiable than rejecting all forms of textual creativity except those that are consistent with Western literature.

We are not accustomed to serious questions being raised about the value and centrality of the conventional book. However, Jay Bolter (1991), for example, has described a mindless and passive absorption in a narrative as "anti-reading." Another example is a satirical novel by Robert Grudin (1992), entitled simply *Book*, which points out the unhealthy influences of books especially over academics. In one of its more memorable sections the book's footnotes revolt, questioning and finally taking over the narrative from the author. The author's playfulness with the concept of the book raises one's consciousness to the confinement and narrowness of building conceptions of literacy predominantly on books. Myron Tuman (1992a) has detailed the historical, ethical, pedagogical, and aesthetic limitations of books and other printed materials, and many of us are likely to feel uncomfortable with his position on teaching writing:

. . . [Teachers of writing] must confront the possibility that the sustained, detailed crafting of written language is too difficult a task, too removed from normal, informal, sporadic uses of oral language, to be the normative impulse driving a truly democratic language arts curriculum . . . [because in making this task central] we doom many students to be labeled as failures. (p. 124)

We are not used to or comfortable with such detached critiques of printed materials, especially books, but these critiques make us think, and that is important at this juncture in the history of literacy. As Richard Lanham (1993) stated:

Efforts to defend the codex book as the bastion of Western culture [make it seem as if] defending the wrapper would protect what is in the box. . . . These efforts to galvanize the codex book in the face of encroaching electronic expression miss the two basic points that should underlie such a campaign. . . . Before we fix on the book as the center of humanistic culture, shouldn't we have a better idea of **what books do to us and for us?** [bold in the original] . . . Having decided what we want to protect, how do we make sure it survives the movement from book to screen? (p. 99)

Is Reading and Writing Different With a Computer?

Implicit in the viewpoint that we are entering a post-typographic era is that the differences between printed and electronic texts are substantial enough to alter current conceptions of literacy. I believe the differences are that important, although they are not obvious to the print-based mind. I will briefly highlight five differences here that I have written about more extensively elsewhere (Reinking, 1992, 1994a; Reinking & Chamlin 1994b), because they are an important starting point for setting a post-typographic research agenda and for thinking about how we can prepare future generations of readers and writers.

Interactivity and malleability. The first difference is that electronic texts are truly interactive, and they are interactive because they are so malleable. The interaction that is referred to between readers and printed texts and that fills the literature about reading processes has a metaphorical, not a literal, meaning. Until now, describing reading as an interactive or transactional process has emphasized the active role of a reader in making meaning, not a text's capability to be modified by or respond to individual readers. Printed texts are fixed, inert entities that stand aloof from the influence and needs of a particular reader. Electronic texts, on the other hand, can alternately respond to individual readers while inviting them to manipulate the text to meet their personal needs. George Landow (1992) has pointed out that the flashing cursor on the screen is the visual representation of a reader's intimate presence within a text and lack of restrictions in modifying it. Likewise, electronic texts can be programmed to monitor what a reader is doing or not doing while reading a particular text, and to adjust the textual presentation accordingly.

Interactivity and malleability undermine basic assumptions of typographic literacy. First and foremost, they blur the distinction between readers and writers, a distinction that Roland Barthes (1970) has made in describing the "readerly," as opposed to the "writerly," text. He states:

Our literature is characterized by the pitiless divorce which the literary institution maintains between the producer of the text and its user, between its owner and its customer, between its author and its reader. This reader is thereby plunged into a kind of idleness—he is intransitive . . . serious. . . . instead of gaining access to the magic of the signifier, to the pleasure of writing, he is left with no more than the poor freedom either to accept or reject the text: reading is nothing more than a referendum. (p. 4)

In contrast, Barthes described "writerly texts" that invite readers to participate in the construction of meaning. Although he was not discussing electronic texts, he could have been. A recent example is *Marble Springs*, a piece of hypertext fiction created by Deena Larson (1993). A reader explores the lives of the people in an imaginary frontier town, as seen mainly through the eyes of the women who lived there. There is no plot in a traditional sense, but the reader creates a picture of people and events by exploring the

town. More relevant to the notion of writerly texts is that readers are invited to expand upon the stories of the people in the town, or to create new characters.

Interactivity and malleability also undermine the authority we ascribe to printed texts. As Bruce Edwards (1991) has observed,

The authority of the text is its finality as an unerasable hardcopy product. In contrast, . . . the digitized word facilitates discovery, retrieval, recombination, and revisions of ideas and form. . . . Its authority or meaning is located in the interaction between the author and the electronic community of readers in and for which the text was created. (p. 74)

As Bolter (1991) has stated in referring to electronic texts, "the ephemeral is no longer marginal. . . . A text that changes repeatedly to meet changing circumstances may now be as compelling as one that insists on remaining the same through decades or centuries" (p. 56).

One does not have to look too hard to substantiate the position that interactivity (often associated with a multimedia approach) is becoming the touchstone of contemporary culture. Everything from the remote control to the hands-on museum could be cited. We can say that is too bad, that interactive media are inferior to books, but if we wish to take that stand, we had better marshal some convincing reasons soon, because just saying it won't preserve the status quo.

The ascendancy of nonverbal elements. The ascendancy of nonverbal elements is also a characteristic of electronic texts. Nonverbal elements include pictures, icons, movies, animations, and sound. Not only are such elements available in electronic texts, but they can easily and cheaply be integrated with written prose.

Multimedia is a term that has only recently been associated with reading and writing. This development, as Jay Lemke (1994) pointed out, means that we must reorient our thinking about the relationship between alphabetic, iconographic, and nonverbal modes of communication. In electronic texts, images and sound compete equally with alphabetic symbols, forcing us to consider their respective contribution and value toward expressing meaning. We can no longer blithely accept the notion that graphical information is subservient to the primacy of the alphabetic code. Electronic texts force us to acknowledge our biases for words over other modes of communication and to think about whether such biases are justifiable. Does saying we are in the literacy business mean automatically that we are also in the alphabetic code business?

Electronic texts resurrect the iconic impulse that has been suppressed by print, and we see that impulse manifest its influence on everything from road signs to graphical interfaces on computers (Bolter, 1991). In fact, it has surfaced in this year's conference program, which uses pictures of watches to signal a new time slot for sessions.

One consequence is that electronic texts require a renewed self-consciousness about the meaning contained in the visual forms of a text. We look at, not through, electronic texts to find their meaning. Or as Lanham (1993) has put it poetically, "The ideal decorum for prose style has always been through unselfconscious transparency; like the typography that enshrined it, it should be a crystal goblet to set off the wine of thought it contained" (p. 74). He went on to suggest that electronic texts undermine the solemnity of printed texts. For example, he imagined how students might manipulate a printed version of Milton's *Paradise Lost*:

Wouldn't [they] begin to play games with it? A weapon in [their] hands after 2,500 years of pompous pedantry about the Great Books. Hey, man, how about some music with this stuff? Let's voice this rascal and see what happens. Add some graphics and graffiti! Print it out in [different fonts, with] San Francisco for Lucifer and Gothic for God. (p. 7)

It's one thing when Ted Turner wants to colorize some classic old movies; it may be another when students can easily alter or extend everything from a Whitman poem to the principal's latest memo.

As readers and writers of electronic texts, we will be pushed toward a more complex definition of what a text is and what successful readers and writers must know about to create one. For example, Chuck Kinzer and his colleagues at Vanderbilt (the Cognition and Technology Group at Vanderbilt University, 1994) have made increasing use of the term *representational literacy*, meaning the ability to communicate ideas flexibly, using multimedia forms.

A glimpse of the future is found in the Apple Classrooms of Tomorrow project carried out by Rob Tierney and his colleagues (Tierney et al., 1992). When high school students were given access to various state-of-the-art hardware and software for use in school and at home over several years, their views of text began to change. As one student stated about his writing after two years in the project,

Now I incorporate graphics with my text a lot more. I relate it or I try to link it together so that it looks like one unit. . . . I try to make it look more aesthetic and I try to have it more pertinent to what the text is. . . . The things we created weren't really something that could be done on a page. . . . It was something you had to become involved with. . . . It makes it more non-linear sometimes. (p. 4)

Researchers too may find a multimedia approach useful in reporting their investigations. For example, a research report in electronic form could include a video of an interview with a subject rather than a transcript.

New textual structures. The characteristic of electronic texts that has received the most attention is the degree to which they invite nonlinear reading and writing, often manifested in what have been referred to as hypertexts. Various definitions of hypertext have been proposed, but they always include nonlinear access to separate but interconnected nodes of text. Although hypertext has existed as a concept since the 1940s, and as a term since the 1960s, its surging popularity is due not only to technological advances but also, I think, to the view that it is a harbinger of the post-typographic world.

Much more could be said about hypertexts, but I will highlight two points that are pertinent to my theme. First, hypertexts remind us that acquiring the discipline to organize one's thoughts into a linear, hierarchical argument is a large part of what we call being literate only because the technology of print does not invite other ways to structure an argument, not because that is the natural way we think. Hypertexts provide a means to express ourselves in ways that reflect more directly the complexity of our thinking and the interrelatedness of ideas. As Bolter (1991) has argued, "When technology provided us with printed books and photographs, our minds were repositories of fixed texts and still images. When the contemporary technology is electronic, our minds become pulsing networks of ideas" (p. 207).

Second, hypertexts further the educational, social, and political ends of literacy that we have always valued. For example, as Henrietta Shirk (1991) commented about hypertexts in composition instruction, "Writers will no longer create in solitary environments; they will become contributing members of hypertext development teams" (p. 198). In other words, hypertexts turn the notion of a community of writers and readers into an objective reality. Or, in the social and political arena, as George Landow (1992) has argued,

[The] hypertextual dissolution of centrality [of a single meaning], which makes the medium such a potentially democratic one, also makes it a model of a society of conversations in which no one conversation, no one discipline or ideology, dominates or founds the others. (p. 70)

Given the now feasible alternative of nonlinear reading and writing, insisting that students be taught to read and write only printed texts is like insisting that they use only straight lines when they draw.

Expanding the boundaries of freedom and control. As illustrated by hypertexts and recent developments such as the Internet, another characteristic of electronic texts is that they expand exponentially readers' freedom to access textual information and writers' freedom to disseminate their ideas without the barriers of conventional publishing. At the same time, computers provide unprecedented opportunities to control readers' access to text and to monitor their strategic actions while reading a particular text. These countervailing forces raise some familiar issues that are taking on new shapes and forms.

The control made possible by electronic texts is derived from the fact that only a limited amount of textual information can be presented on a computer screen at one time. Text displayed on a computer is as if we are viewing the textual world through a window (see Wilkinson, 1983), and what is hidden is just as important as what is visible. The two-dimensional placement of text on a printed page requires an additional dimension when displayed on a computer screen, and that additional dimension is time (see Daniel & Reinking, 1987). That is, creating an electronic text requires deciding not just *where*, but *when* the text will be displayed.

This capability clearly illustrates the entirely new domains of research questions created by electronic texts. For example, Tobias (1987, 1988) has investigated the effects of varying types of mandatory review of poorly understood texts. Theoretical issues are raised in reconciling the findings that learners with little background knowledge make poor choices and findings by Spiro, Coulson, Feltovich, and Anderson (1988) that readers who must impose their own organization on content presented nonlinearly tend to have higher levels of understanding. The capability of the computer to sense reading difficulty, and to present or limit options accordingly, also suggests that unique computer-based reading experiences might make early reading instruction less dependent on a teacher, as Peter Reitsma's (1988) research on computer-based speech feedback illustrated. Thus, electronic texts make possible an ultimately empowering form of control, which the pragmatist Cherryholmes (1993) referred to when he said,

It is often useful to accede power to texts because texts, in turn, enhance the reader's power in other situations from how to drive a car to how to cook an omelette to how to pour concrete. (p. 13)

The issue of control in electronic texts also reminds us that free access to textual information in even a democratic print-based society is often an illusion (see Kaufer & Carley, 1994). As someone has said, "The only people who have freedom of the press are those who own one." Control of readers' access to text in a post-typographic world is less subtle and is therefore more difficult to disguise with excuses—such as having limited funds to buy only "good" books.

The pragmatics and conventions of literate activity. Electronic reading and writing also change the pragmatics and conventions of written communication. As Brandt (1990) has stated, "Learning to read and write is not learning how texts stick together but how people stick together through literate means" (p. 42). The social and interpersonal conventions of literacy in a typographic world may be transformed in a post-typographic one. The handwritten letter on a particular stationary, for example, continues to communicate something beyond its prose. Those of us who regularly use E-mail (clearly the prominent example of this characteristic) are struggling to discover the pragmatics of this new form of communication. What meanings are being sent and received between the lines? What is appropriate "netiquette" in a discussion group? When is it ethical to forward a message without permission from its author? The social dynamics of accidentally sending a private message to an entire discussion group is not only a hazard of E-mail communication; it is also a literacy event worthy of study for the way it affects written communication in a post-typographic world.

Some findings are emerging from the work of researchers such as Marion Fey (1994), who has used a feminist perspective to look at communication among participants in an on-line college course; Jamie Myers (1993), Susan McIntyre (1992), and Margie Gallego (1992), who have all studied social interaction patterns of education majors using E-mail in conjunction with college coursework; and Lorri Neilsen (manuscript in preparation) and her colleagues, who have studied how E-mail undermined bureaucratic authority in a school system and high school.

Columnist Dave Berry has described E-mail as the CB radio of the 90s, only with a lot more writing. There is a serious side to Berry's tongue-in-cheek comparison, as Howard Rhinegold (1993) has highlighted in his book *The Virtual Community: Homesteading on the Electronic Frontier*. He acknowledged that his original attraction to E-mail discussion groups was his enjoyment of writing as a performing art, itself an interesting new mode of writing. However, he has come to see the real value of E-mail discussion groups as "virtual communities" or "electronic agora"—functioning much like the marketplace in ancient Athens, "where citizens met to talk, gossip, argue, size each other up, [and] find the weak spots in political ideas by debating about them" (p. 14). As Rhinegold has pointed out, E-mail is a blend of opposing values both altruistic and self-serving, compassionate and unfeeling, time saving and time consuming. As such, it encompasses a wider range of communicative modes and purposes than any single type of printed document.

A typographic world is finding that it is increasingly difficult to absorb the pragmatics and conventions of electronic texts. For example, in academia the new American Psychological Association manual struggles to create citations of electronic sources that conform to print-based citations, and promotion committees are ambivalent about how electronic publications should count as professional products.

The Need to Realign Our Research Agenda

These five characteristics suggest to me that staying in the mainstream of a world in which electronic texts play an increasingly central role in communication, education, and culture will necessitate realigning the entire spectrum of literacy scholarship and research. For example, we can no longer view technology as a peripheral topic of study, legitimized primarily in terms of the possibilities afforded by computers to enhance literacy as we know it. Instead, we must allow a technological perspective to dominate, at least temporarily, our thinking about literacy in every nook and cranny of the field, even if it is only to determine that nothing is happening that substantially alters our current conceptions. More likely, if we allow ourselves to appraise dispassionately the changes that are occurring and their possible consequences, we will see that a post-typographic perspective permeates virtually every existing topic of study in literacy. Existing questions and findings become either moot or transformed.

Examples that I hope illustrate the breadth of these changes include the following:

1. How do we conceptualize textual difficulty when readers have instant access to the pronunciation of a word, a video illustrating its meaning, or an alternative text written for someone with less background knowledge?
2. Is the research on graphic aids in printed texts relevant to electronic texts, where a broader range of visual elements are used, and where those visual elements frequently overshadow the prose?
3. What do concepts such as reader response and intertextuality mean when the distinction between reader and writer is unclear and when thousands of formerly disjointed texts can be merged seamlessly to be viewed on a single computer screen.

4. What role does the computer play in contributing to or redefining current conceptions of emergent literacy?
5. What are the semiotics of electronic texts?
6. Is what we know about how readers locate information in printed materials relevant to the Boolean strategies used to search large electronic databases?
7. What is the relevance of what we know about strategy instruction based on printed texts when electronic texts determine not only what strategies make sense but the options for modeling and supporting them?
8. Who will care if we know all there is to know about note taking and annotating printed texts, if eventually no one is lecturing or using a conventional textbook?

Those of us who have previously pursued research interests in the area of technology must also realign our research agenda. Our research questions have typically been shaped by considering how electronic reading and writing might enhance conventional print literacy. Word-processing research is a good example. Much of the existing research increasingly seems shortsighted because it is driven by a concern for how word processing affects the writing of printed texts. Word processing is already firmly established as a fact of literate life, and no reasonable person would argue against its use. Why should we be interested in comparing word processing to typewriting or handwriting, any more than we are in comparing it to writing on cuneiform tablets? In addition, word-processing programs are quickly moving to a position outside the realm of typography by enabling users to cut and paste quick-time movies into documents. Likewise, there are new applications, such as *Storyspace* (Bolter, Joyce, Smith & Bernstein, 1993), which might be described as a word processor for hypertexts.

Another realignment is needed in our approach to investigating how computers might enhance literacy in schools. Classroom research, too, should move beyond ad hoc comparisons that pit computer-based against print-based activities, usually to determine their relative effectiveness for achieving conventional curricular objectives. Such research, like the instructional media research of the past, has produced little of value. Classroom research must be guided by a realization that computers are going to become increasingly part of the mainstream of schooling. In addition, as we more fully understand the nature of literacy in a post-typographic world, it will be our responsibility to foster it through research in schools.

One of the most promising areas of classroom research involves examining how the computer can realize its potential to transform conventional instruction. That potential has not been realized because of the tremendous inertia that must be overcome to reform education and because of the technical, logistical, and financial difficulties associated with using computers for other than mundane activities in schools (see Means, 1994; Means, et al., 1993). Nonetheless, I see some signs that we are poised to move into a post-typographic age of instruction in schools too. For example, there is increasing political capital to be gained from the position that schools need to be equipped with appropriate technologies. Access to the Internet, accompanied by the increasing appeal and use of multimedia learning materials, in my view, will be a major step toward nailing the coffin that contains the conventional textbook and its stranglehold on instruction. And it takes little imagination to realize how much our research would change if instruction were not centered in a textbook.

For example, George Landow (1992) at Brown University has used a large hypertextual database in place of a textbook in his undergraduate Victorian literature course. Students read and add to a large hypertext that mingles texts created by faculty, graduate students, and their undergraduate peers. In summarizing his experience he stated,

Hypertext systems, just like printed books, dramatically change the roles of student, teacher, assignment, evaluation, reading list, as well as the relations among individual instructors, courses, departments, and disciplines. No wonder so many faculty find so many reasons not to look at hypertexts. (p. 163)

Similarly, Marilyn Cooper and Cynthia Selfe (1990) pointed out that computer conferencing in academic courses gives students authority to resist an academic agenda that does not meet their needs or values.

In my own recent work investigating the effects of multimedia book reviews as an alternative to the conventional book report (Reinking & Watkins, in press), I have learned that fully integrating technology into classroom life tends to disrupt conventional modes of interaction in ways that are often appealing and pleasant to both teachers and students. Teachers begin to consider alternatives for instruction that never occurred to them before, and they begin to examine more critically their own practice, as have my colleagues and I in our collaboration with Chuck Kinzer and Vicki Risko (Kinzer et al., 1994) to implement the interactive video materials they have developed for preservice teachers.

To pursue and appreciate the importance of the classroom research involving technology, it will be necessary for some of us to shed misconceptions and biases. For example, I think there is a misconception that computers are incompatible with certain instructional goals or philosophies. As my colleagues Linda DeGroff (1990) and Ron Kieffer (personal communication) have pointed out, computers can make important contributions to a whole-language agenda, despite their early association with teaching isolated skills through drill and practice. Both Elizabeth Sulzby (1994) and my colleague Linda Labbo (1994) are investigating how computers in schools and homes relate to the concept of emergent literacy. For those who may doubt the computer's power to enhance students' experiences with aesthetically rich, authentic writing, I suggest viewing several applications such as *Amanda's Stories* (wordless picture book stories enhanced by the computer; see Goodenough, 1991), *Martin Luther King's Letter From a Birmingham Jail* (a hypermedia program that illustrates King's rhetorical skills; see DeYoung, 1993), and a new compact disc entitled *Poetry in Motion* (a multimedia presentation of several modern poets performing and commenting on their work; no author, no date).

The power of computers to inspire reading and writing throughout the curriculum is also illustrated by an experience I had this summer in a weeklong workshop for teachers at Kent State University. I introduced a high school shop teacher, who attended the workshop mainly to accompany his wife, an elementary language arts teacher, to a computerized version of Robert Persig's *Zen and the Art of Motorcycle Maintenance* (1992). For his required project he developed a series of activities for his students to use the search and find functions in the computer version of the book, to locate Persig's use of tools such as a wrench. The purpose of the activities was to have his students think about the different orientations of people who are mechanically inclined and those who are not, and to formulate reactions to some of the philosophical concepts underlying these distinctions—not usual fare for a high school shop class, I suspect.

In pursuing useful classroom research it will also be necessary to move beyond conventional experimental designs and purely descriptive qualitative methods. We need research methods that help us understand not only the complex interactions that define classroom life but also the way in which technological interventions can enhance the most important goals of literacy within that complexity. In my own work (see Reinking & Pickle, 1993; Baumann, Alvermann, Dillon, Shockley, & Reinking, in press; Reinking & Watkins, in press) I have found Dennis Newman's (1991) concept of a formative experiment useful in meeting that need. In a formative experiment a researcher sets a valued

pedagogical goal, then studies the factors that enhance or inhibit an instructional intervention's effectiveness in achieving that goal. The intervention is continually modified in response to incoming data, in order that it may more effectively accomplish the goal. Another example is the work of Chip Bruce and Andee Rubin (1993), who have used an approach they call *situated evaluation*. I think it is worth noting, as these examples illustrate, that researchers interested in technology have been in the vanguard of those searching for better models of classrooms research.

Some Things That We Know and That We Need to Know

Given the scope and depth of the changes that are likely to occur as we move into a post-typographic world, our current research base is extremely thin. Further, much of the research has been conceptualized from the standpoint of print and is of marginal usefulness. Yet we have learned some things that are useful, and some current research seems to be moving in the right direction. I wish to highlight a few promising areas of research now, in addition to those I have already alluded to.

Existing research clearly indicates that, under some conditions, the unique characteristics of electronic texts can effect increases in learning during independent reading (e.g., Reinking, 1988; Reinking & Rickman, 1990). For example, consider how a reader encountering an unfamiliar word can instantaneously obtain a definition of the word, perhaps as a dictionary entry surrounded by conceptually as opposed to alphabetically related words; a pronunciation of the word; a video or animation pertaining to the word's meaning; a concordance of similar uses of the word in different contexts, and so forth. Consider as well the capability of the computer to sense that a reader is having difficulty and on that basis prescribe remedial action or even alter the text to accommodate the reader. It could sense difficulties from sources as mundane as performance on inserted questions, or as exotic as eye movements or galvanic skin response. In conducting such research we must consider the distinction between short-term and long-term effects—what Gabriel Salomon and his colleagues (Salomon, Perkins, & Globerson, 1991) have called the effects *with* and *of* technology.

We need to understand more about the strategies that readers and writers use when reading and writing electronic texts. We need more research like that being conducted by Mark Horney (1994) and by Don Leu and Michael Hillinger (1994), who have presented their work at this year's conference. We also need to investigate navigational aids to deal with the lost-in-hyperspace problem inherent in exploring large, interconnected textual networks, which is made possible by browser applications such as Mosaic or Netscape on the Internet. One intriguing solution has been explored by Jay Bolter (personal communication), who has developed virtual reality texts. Readers virtually enter a textual world that they see through special goggles. In this textual world, topics appear on objects that resemble large buildings, connected by skyways representing links. To read the textual nodes related to a particular topic, one moves a special glove to enter a building where the texts can be displayed on the walls of rooms. This application may seem bizarre until we think of it as an electronic version of what we do when we enter a large library, which can be conceptualized as a huge text organized around topics linked by the Dewey decimal system.

There is consistent evidence that introducing innovative computer applications aimed at moving instruction in different directions does not alone change instruction and learning. The most thoroughly documented and extensively researched example is the work of Chip Bruce (Bruce & Rubin, 1993; see also Miller & Olson, 1994) and his colleagues investigating QUILL, a comprehensive process-writing application implemented over several years and schools. They found that teachers molded the

QUILL activities to fit their existing ideas about writing, which were sometimes contrary to the underlying purposes of the program. We need more research that investigates how technology affects the intricate social fabric of classrooms. As Sylvia Weir (1989) has stated,

The kind of teaching and learning I am concerned with treats the computer as an adjunct to socially mediated learning, as part of a context, a constellation of children with children at the computer, of teachers with children with computers. (p. 61)

We also know that computers can help students learn more mundane aspects of reading and writing, such as the alphabetic principles underlying conventional writing, and that this aspect of instruction can be accomplished in engaging ways that frees teachers to concentrate on less transient aspects of literacy (see McKenna, 1994; Roth & Beck, 1981).

We can also learn from past mistakes. We need look no further than the research on the IBM *Writing to Read* program for a good example of research run amok (see Krendl & Williams, 1990). The enthusiasm for using computers must be tempered with sound research and thoughtful theories. As researchers we must heed Thoreau's caution against inventions that are an "improved means to an unimproved end."

Some Proposals and Concluding Remarks

Most of all, we in the field need to promote solid scholarship that analyzes the extent to which electronic reading and writing are transforming literacy. NRC has taken some steps in that direction. The ad hoc technology committee appointed by Rob Tierney several years ago has become a standing committee. Selecting technology as the topic of this year's research address is another step in the right direction, as is the increasing use of the NRCEMAIL listserv for topical interchanges among NRC members. However, much more needs to be done. I was disappointed that none of the statements from candidates running for office this year highlighted technology as a pressing concern of the field. It is time for more of our field's leaders, known for their insightful analyses, to confront directly the issues of electronic reading and writing. The time and energy consumed by the debates surrounding whole language might better be served by attending to a developments that may make them moot. We need more graduate students who consider technology in their dissertations and more mentors who encourage them to do so. We need to extend our interest in cross-disciplinary research to those who study computer technology and its effects on people's lives. Journal editors and reviewers need to acknowledge the importance of technology by encouraging more submissions in that area, and we need career incentives to encourage the development of theory-based computer applications for research and instruction. We might consider setting technology as the dominant theme of an annual conference at which all of the presenters would interpret their interests in terms of a post-typographic world.

I do not underestimate the difficulties in making technology more central to the field. As Robert Samuelson (1993) stated in a *Newsweek* column earlier in 1995, "new technologies gush uncertainties." The emerging technologies of electronic communication change rapidly, and as Samuelson points out, they require major investments in infrastructure and training to be used effectively. Acknowledging that we are moving towards a post-typographic world also threatens the security of our print-based academic accomplishments. It will also be difficult to encourage discussion of technology and literacy in an atmosphere where people are labeled either as technophiles or as Luddites. My interest in technology does not mean that I enjoy reading technical magazines about computers, or that I have no reservations about the computer's influence on literacy.

Despite these difficulties, I believe we can confront the challenges we will face in moving toward a post-typographic world. It would not be the first time that we have redefined the nature of our business. Fifteen years ago, we saw ourselves predominantly as being in the reading comprehension business, and around 5 years ago we began to see ourselves as being in the literacy, not just the reading, business. I agree with Bruce Edwards (1991), who argues that

[the] term *textuality* . . . may be more valuable to us than literacy in assessing how . . . the digitized word may affect the utility and meaning of reading and writing in coming generations. For textuality is so familiar, so utterly grounded in our experience of the real, it often disguises the fact that literacy is itself a technology. (p. 71)

Being in the literacy business means seeing our business as intimately related to textuality, and that in turn means that our business has always been related to technology. That is the perspective we need for literacy research in a post-typographic world, and the one that I hope I have stimulated you to think more about.

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