TOWARD A VISION OF THE FUTURE ROLE OF TECHNOLOGY IN LITERACY EDUCATION

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"'I am the Oz, the Great and Terrible.
Why do you seek me?' . . .
Dorothy asked, 'Where are you?'
'I am everywhere,' answered the voice,
'but to the eyes of common mortals I am
invisible.'. . . As it [the screen] fell with a
crash they[Dorothy, Tin Woodsman,
Scarecrow, and Cowardly Lion] looked
that way, and the next moment all of them
were filled with wonder. For they saw,
standing in just the spot the screen had
hidden, a little old man, with a bald head
and a wrinkled face, who seemed to be as
much surprised as they were. 'Who are you?'
'I am Oz ..." (Baum, 1973, p. 262-263 [emphasis added]).

"Pay no attention to that man behind the curtain."
(from the movie version of *The Wizard of Oz*)

It was an earthshaking moment for Dorothy when she first realized that all of the marvels, bells, whistles, magic and trials she had experienced in the Land of Oz during her quest for a way home were being manipulated by a small, balding man, in a rumpled suit, who was frantically operating complex technological devices behind a screened curtain. In the very moment that Dorothy recognized the previously hidden technology for what it was, a powerful means for extending and enhancing one's power within the environment, she experienced a profound paradigm shift that allowed her to reconceptualize her quest as one that was attainable. No longer a witless victim of technological powers ruled by others, she became empowered.

The purpose of this paper is to draw back the curtain on the future just a little bit in order to catch a glimpse of how technological innovations are likely to play a role in America's quest to provide her children with an effective literacy education that prepares them to succeed in their future endeavors. The paper explores an emerging vision of the future role of technology in literacy education in the near-term and offers brief closing comments about long-term possibilities. It is unlikely that the contribution of this paper will result in a *Dorothy Moment*—an overall paradigm shift in the educational field that recognizes that literacy-related use of computers in classrooms offers a means for extending and enhancing one's power. It is more likely that this paper may take a small step forward by inviting others who are interested in this important topic to participate in a conversation that may help all interested stakeholders craft a clearer vision for the best uses of computer-related technology in the literacy curriculum—a shared vision that will empower us to

chart an appropriate course, establish worthy goals, and garner necessary resources to enact the vision.

The paper is organized into the following sections:

- Introducing 3 Key Factors
- Laying a Groundwork: Brief Glimpses from Past and Present Decades
- Forecasting the Future of Literacy Education: The Wizard is Back!
- Asking Questions: Cautions Worth Raising
- Concluding Comments: Ready or Not, Here It Comes!
- References

(Note: For those who wish to read this text in a more hypertextual, nonlinear format, or for those who wish to begin with reading about the vision for the near future, I provide the following outline of the relevant section which appears towards the end of this paper: Forecasting the Future of Literacy Education: The Wizard is Back! (1) Anticipating Societal Literacy Expectations; (2) Forthcoming Definitions of Literacy as Digital; (3) Counting on Computer-Equipped Homes; (4) Formulating Relevant Learning Theories; (5) Venturing into the Vision.)

INTRODUCING 3 KEY FACTORS

For purposes of this discussion, I have attempted to simplify many of the complexities involved in considering the role of technology in literacy instruction by focusing on three key factors. Although many multifaced elements influence literacy instruction (see Labbo & Reinking, in press, for a more complete exploration of multiple philosophical orientations that guide technology-related literacy instruction), the type of literacy instruction that has occurred, currently occurs, and will most likely occur in future classrooms in America tends to feature the following three factors:

1. Definition of Literacy
2. Predominate Learning Theory
3. Classroom Communicative Technologies

Definition of Literacy: In the best of all possible worlds, the definition of literacy adopted by educational institutions will mirror mainstream society's definitions of and expectations for what it means to be literate. In other words, educational goals and purposes for literacy instruction should reflect a synergistic relationship with society's expectations for how literacy is utilized and valued in various societal endeavors. That is not to say that every educator or citizen will be able to articulate a clear definition of literacy upon demand, primarily because such a definition is frequently experienced on a tacit level, embedded within unstated but collectively followed cultural practices. Additionally, I do not mean to suggest that there is always an exact alignment between academic literacy that occurs at different levels of children's literacy development and societal literacy. However, in an era when computer-related, communicative literacy abilities are proliferating throughout all aspects of life in American society and throughout the global marketplace, it is crucial to explore a vision for the role computer-related literacies should play in defining children's literacy development in school in the near future.

Predominate Learning Theory: Predominant learning theories are important to consider because they provide insights about underlying instructional frameworks that allow us to understand the nature of literacy instruction. Experts who write literacy basal series and curriculum guides are frequently guided by the most current and widely-adopted learning theories. Additionally, teachers conceptualize their instructional roles as literacy teachers in light of their deeply held philosophical underpinnings and their understanding of learning theories. The philosophical framework that undergirds instructional decision-making will in large part determine how communicative technologies are used or not used within the walls of a classroom.

Classroom Communicative Technologies: Communicative technologies - sets of tools, devices, materials, and the processes people engage in when using the tools to perform a range of literacy functions—are important to consider because they speak to the range of literacy-related instructional practices that are possible within a classroom. That is, the presence and use (or nonuse) of available technologies either ultimately supports (or limits) children's opportunities to become literate in ways valued by society. For example, society-at-large, teachers, and literacy curricular objectives may all put forth the expectation that every literate member of our society should be able to send and access e-mail; however, if the communicative technologies to do so (i.e., internet hook up, CPU, keyboard, monitor, software, a link to someone to participate in an email who is also connected to requisite technologies) are not present in the classroom, a literacy discontinuity will develop. Such a *school-society literacy discontinuity* is likely to have serious consequences for students from nonmainstream families with low socioeconomic levels and limited resources because students from mainstream families are likely to have access to complex forms of computer-related literacies at home. If one of the goals of literacy education is to better prepare *all* students to function as literate beings in society, it is crucial to weigh how well the use of communicative technologies present in the classroom coincides with the use of those tools in the larger society.

LAYING A GROUNDWORK: BRIEF GLIMPSES FROM PAST AND PRESENT DECADES

It is beyond the scope of this paper to give an exhaustive historical overview of all past reading instructional practices across time eras or to thoroughly describe all of the possible current instructional practices. Nonetheless, a helpful way to lay a groundwork for effectively establishing a vision for future trends in communicative technology-related literacy instruction is to consider briefly how the three factors—definitions of literacy, learning theories, and communicative technologies - have been exhibited in elementary school classrooms in America during a previous decade, the 1930s, and how they have been manifested more recently in the 1990s.

A GLIMPSE OF THE PAST—COMMENTS ABOUT LITERACY EDUCATION IN THE 1930S

In the 1930s skill and drill lessons geared toward students' mastery of reading skills directly related to behaviorist learning theory, a theory that advocated a stimulus—response approach to learning. Additionally, mainstream society firmly believed that an educated factory-based workforce should be able to read and write at a functional level in order to understand simple work-related instructions and to be able to read newspaper accounts that would allow them to make informed decisions when voting in elections. Thus, notions of literacy were primarily print-based and consisted of reading and writing the printed word.

Communicative technologies such as, blackboards, slates, mass-produced basal reading materials, practice lessons, pens, ink wells, and inexpensive books, supported the goal that students, many of them from families newly immigrated to America, would be able to have adequate skills practice in order to obtain national notions of print-based literacy development (Stokes, 1997), and children's development as laid out on an instructional scope and sequence. For example, published reading basal series and literacy-related literature-based curriculum materials are routinely organized along developmental reading stages (See Chall, 1983), an articulated instructional scope and sequence that loosely lays out organizational frameworks such as the following:

1. emergent literacy (PreK-K) - children construct concepts about print,
2. beginning literacy (1st- 2nd grade) - children learn about decoding and word recognition,
3. fluent literacy (2nd/3rd-grade) - children become fluent readers of connected text,
4. maturing literacy (4th-5th grade) - children are able to read various genres and are also able to read-to-learn content area texts,
5. strategic literacy (6th and up) - children are able to strategically approach various texts for various purposes.

Many teachers view their current instructional role as that of a facilitator and guide who offers children supported practice that allows them to socially construct knowledge about conventional literacy. The teacher mediates children's cognitive processing and opportunities to learn literacy-related skills and strategies through whole group direct instruction, small group interactions, and individual conferences. Home-School connections tend to focus on fostering an ongoing flow of communication that can be used to inform parents about the school literacy program, offer suggestions for appropriate home literacy activities, invite parents to participate in classroom activities and events, and arrange for teacher/parent conferences to discuss the child's literacy progress.

Currently available instructional communicative technologies include resources and devices such as, classroom sets of children's literature, published basal reader series, recorded books on audio tape, Big Books, video tapes and VCRs, dry erase boards, at least one classroom computer center (complete with a 15 - 3 year old CPU, a monitor, a keyboard, a mouse, and sometimes a printer, but few if any ink cartridges or printer paper), CD-ROM talking books, phonic game software, simulation game software, simple word processing software, keyboard practice software, and limited access to the internet. For the most part, when computer-related technologies are used in the classroom, they are considered to be an add-on component to an already full curricular and instructional day. At selected times of the day (when students have free choice or when successful students complete paper and pencil seat work early), computers in the classroom are used for basic skill and drill tutorial practice, publishing a final draft of a paper on a word processor, or playing a simulation game as a reward.

In considering the presence and use of communicative technologies in schools in the 1990s, it should also be noted that the classroom is typically the last institutional location in a society that fully incorporates new technological advances into the way work is accomplished. A gap exists between technology access and use across schools and technology access in the larger society because of school budgetary constraints and a lack of effective professional development for teachers (Papert, 1993; Reinking & Bridwell-Bowles, 1991). For example, in spite of recent excellent initiatives, such as the U.S. Department of Education National Educational Technology Plan, *Getting America's*

Students Ready for the 21st Century, disparities in classroom connections to the internet exist across socioeconomic levels and geographic regions. A case in point is provided in persuasive statistics. Schools with only 11% of students eligible for free or reduced price school lunches had 62% of their classrooms connected to the internet while schools with 71% or more students in the same category had only 39% of classrooms connected (NCSS, 1999). Additionally, newer technologies are often expensive and prone to short-term obsoletness, a situation that occurs more often than not when newer versions of computer-related technology appear on the market within a few short years or even months after a school computer purchase. School boards sometimes adopt a wait-and-see attitude that results in schools being left in a computer-related technological gap with use of technology in society.

Educators of the 1990s are faced with the enormous task of preparing students to be literate in a future that is unclear and for a level of computer-related literacy that many educators themselves have not yet grasped (Leu & Kinzer, in press). There is little doubt that a generational technological gap exists in many classrooms between what teachers know about using computers and what their students know. Therefore it comes as little surprise that teachers across the nation do not routinely integrate available computer-related technologies into their everyday literacy curriculum (U.S. Congress, 1995). Other reasons come into play: lack of adequate staff development, absent on-site technical support, scant directions or suggestions in Teachers' Editions of published basal materials, outdated computers, little time to evaluate and select suitable software or identify curriculum-relevant Web-sites that may integrate into the curriculum, and glitches, glitches, glitches in operating hardware and software.

The overall goal of literacy instruction in the 1990s, including work with computers, is to meet society's expectation that students will be able to use the language arts of listening, speaking, reading and writing to participate in various discourse communities for various public and private purposes. However, those goals are not always met with great success. Many stakeholders, including teachers, administrators, parents, community members, and tax payers, understandably have become concerned with literacy as it is evaluated in high-stakes, standardized testing/assessment instruments. Instructional time in classrooms may be focused on helping children use literacy in ways that are required on standardized tests. Unfortunately, the type of literacy knowledge, skills, and strategies tested on such instruments are not always reflective of society's larger literacy goals in general and computer-related literacy goals in particular.

FORECASTING THE FUTURE OF LITERACY EDUCATION: THE WIZARD IS BACK!

This section is organized into the following topics:

- Anticipating Societal Literacy Expectations
- Forthcoming Definitions of Literacy as Digital
- Expecting Computer-Equipped Homes
- Formulating Relevant Learning Theories
- Venturing into the Vision

Anticipating Societal Literacy Expectations: The penetration of digital reading and writing into all aspects of daily literacy activity has increased and will ultimately have a profound effect on

what is considered mainstream reading and writing (Reinking, 1998) in the very near future. For example, when many Americans want to write a quick note to a colleague, they compose and immediately send it via e-mail on a computer screen. The note will be sent in the same amount of time to a computer in an office across the hallway as it will take to send it to a computer in an office across an ocean. When someone decides to find out the latest international news, he accesses an on-line news service and downloads video clips, audio commentary, or printed news columns on his computer screen. When someone decides to write a report, she is more likely to draft, revise, and edit it on a computer screen with a word processor than with a pen and paper. In these instances, the computer is more than a typewriter or publishing instrument, it is a tool for composing that allows the author to encounter and manipulate ideas on the computer screen.

In the realm of work, information will continue to be used as a major resource for solving problems within America and across the globe (Leu & Kinzer, in press). However, access to information will not be enough as workers need specialized skills for making sense of various data sources found on the Web. Flexible networks, instead of centrally planned organizations, will soon allow people who work in various work-related avenues and locations to collaborate on multiple projects that cross commercial, geographic, business, and national boundaries (Mikulecky & Kirkley, 1998).

Forthcoming Definitions of Literacy as Digital: In light of burgeoning technological accessibility and the observation that print is only one of many communicative symbol forms used in digital realms, it is not surprising that the call of many educational philosophers, educators, and researchers for expanded notions of literacy will be realized in the near future. Reinking (1994) posits that current notions of reading and writing will be expanded to include electronic literacy, the ability to understand electronic text in various forms. It is misguided to view electronic, or digital texts, as nothing more than a printed page displayed on a computer screen.

Gilster (1997), suggesting that literacy should be reconceptualized as a digitally-based, not print-based ability, states: "Digital literacy is the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (p. 1). Elaborating on this definition, he speaks about a merging or convergence of multiple forms of media by explaining how a digital signal carries graphics, animations, audio, video, and text that are sorted out and delivered for interactive manipulation on a computer screen. In other words, informational forms can take on any shape when transmitted as a sort of binary soup that moves, stores, and displays voices, images, linked documents and words within and across computer screen documents. Furthermore, the various informational sources link seamlessly and can therefore be manipulated by consumers of information or producers of information in ways that meet their communicative goals.

Digital literacy refers to a way of processing information that differs significantly from what happens when we read a novel or a letter and the differences are inherent in the medium. Digital content is dynamic and pathways taken are hypertextual, malleable, and idiosyncratic. To be digitally literate will mean to learn skills necessary to navigate, locate, communicate on-line, and participate in digital, virtual, and physical communities. Therefore, literacy will also be seen as *informatic*, involving a range of meaning-making strategic abilities required to navigate through and assemble knowledge from various informational resources in cyberspace (Lemke, 1998; Bruce, 1998). Literate consumers and producers of information must be able to take a critical stance toward sources of information, intended audiences, and the reliability of the information.

Expecting Computer-Equipped Homes: The time is soon approaching when the infrastructure will be in place that allows affordable computers to be present in almost every home (some projections speculate this will be reached by 2006). The technological interface of these devices will be as easy to operate as a telephone. Thus, being digitally literate at a functional level, the ability to access and interact with the ideas through multiple digital symbol systems presented on a computer screen, will be accessible to the larger community. However, unless educational institutions are successful in promoting higher orders of digital literacy processes, one's ability to manipulate data for public and personal communicative purposes may continue to be determined primarily by educational and socioeconomic levels.

Formulating Relevant Learning Theories: Wright (1987) suggests that adequate theories may need to wait until more is known about the optimal formats for displaying electronic and printed texts; however, instead of seeking one overarching theory, it is possible that digital literacy is so complex that it will require multiple theoretical underpinnings. Many several potentially relevant learning theories are likely candidates. For example, *sociocognitive* orientations (Vygotsky, 1978) that are prevalent in the 1990s are likely to remain influential in instructional decision making in the near future. As Leu and Kinzer (in press) observe, social learning strategies will be crucial to children's literacy development because social collaborations, such as group learning among internet project participants, help prepare them for future workplace organizational/decision-making frameworks.

Another emerging theoretical perspective, *semiotics*, has potential for shedding light on digital literacy learning processes and instruction because it combines cognitive psychological and sociocultural learning theory (Lemke, 1998). The cognitive psychology component is grounded in the idea that comprehension and expression of ideas is mediated by students' abilities to interpret signs and sign systems. From a digital perspective, children construct meaning by interpreting an array of multimedia signs (ie., words, icons, music, video) they encounter on a computer screen. However, their interpretations are not mediated by the signs in isolation. Rather from a semiotic perspective, the social and cultural contexts surrounding the signs play a role in meaning making. Thus, the purposes for meaning making, the culturally agreed upon interpretations of the symbols, and the interactions with significant others in the environment all combine to effect meaning (Rowe, 1994). In digital communicative platforms, multimodal symbols available in multimedia software packages give young children opportunities to encounter, select various symbol systems, interpret meanings of the symbols, and consider cultural connotations and contexts involved in expressing the meaning they wish to communicate to a particular audience (Labbo, 1996).

Venturing into the Vision: In the foreseeable future, the man behind the curtain is still busy at work but unlike his counterpart, Frank Baum's wizard, the work he does is not overtly manipulative or sinister but is beneficial. This circumstance will occur because The Wizard and his technologies are so integrated into daily school life, curricular activities, and literacy acts that he has become invisible (Bruce & Hogan, 1998). The future technological Wizards of Oz (ie, the programmers, hardware designers, software designers, curriculum writers, support teams, and architects of the web) have done their jobs so well, that many of the barriers to effective current computer-related literacy instruction have been removed. For example, computers and peripherals are affordable, dependable, and luxuriously present in classrooms. Technological support, when needed, is on-site, on-line, quick, responsive, and sophisticated.

In view of this openly optimistic scenario, I present selected implications for classroom practice that may contribute to an obtainable and potentially desirable vision by considering what

teachers will (1) know about computer-related literacy; (2) what computer-related literacy tools they will have access to; and (3) what they will do with computer-related instructional tools.

1. **What teachers will know:** There will no longer be a generational technological gap between students and teachers because teachers will have grown-up in a society that has so embraced digital literacy that computer usage is second-nature to them. Additionally, teacher preparation programs will have learned how to integrate computer-related technology into literacy education course content and delivery (See Kinzer & Risko, 1998, for a discussion of digital case study anchored instruction). However, teachers will have to continue to adopt an attitude of perpetual adaptation as newer technologies enter the classroom.

   Teachers will understand that effective use of computers in classrooms is not a matter of either-or (e.g., either print-based alphabet based instruction or digital multi-symbolic modes of instruction). Rather, they will be very conversant with new definitions of literacy as digital, a definition that encompasses alphabetic as well as multimedia symbolic modes. Teachers will embrace emerging theoretical perspectives on literacy learning as socially constructed and potentially cognitively distributed because they understand that there is a fundamental relationship between cognition, digital features, and digital literacy development.

2. **What teachers will have**: Teachers and students will have access to multiple types of state-of-the art computer equipment and communicative technological devices. They will create and have access to digital tool kits. Digital took kits will consist of previously incompatible applications (e.g., art programs, video clips, email, word processors, electronic books, data bases, internet links) that will digitally converge in a multimedia screenland (Labbo, in press b; 1996) instead of on a computer screen business desk top. Multiple software resources and technologies may be orchestrated to meet students' various literacy needs. For example, a digital tool kit might consist of supported text for reading difficult passages, a space to collaborate with a peer, and a place to record and email thoughts about a passage to others within a learning community.

   In the near future, teachers have an interactive, on-line relationship with each student's family. As a result, many cultural barriers may be transformed into cultural bridges as information becomes a two-way flow. For example, instead of the school primarily informing parents about children's school-based activities, parents will inform teachers about children's home-related literacy strengths in ways that will inform the curriculum and impact students' achievement (Moll, Amanti, Neff, & Gonzalez, 1992).

3. **What teachers will do**: Teachers will (1) assume flexible instructional roles, (2) support children's traditional print-based literacy development, (3) support children's digital literacy-development, (4) foster children's awareness of critical literacy and reasonsing.

   1. Teachers will assume *flexible instructional roles*. Teachers will be masters of digital literacy pedagogy who are comfortable stepping into out and out of the following flexible roles: Model, Mentor, and Manager (Labbo, in press a). What is unique about teacher roles is that they are perceived by teachers as being flexible because they may be shared with a variety of experts who may be present in the classroom or present on-line.

- Model: Teachers and expert others will demonstrate the purposes, outcomes, and strategies for use of literacy technologies.
- Mentor: After introducing and modeling a strategy, teachers will support students' initial and ongoing computer literacy-related projects. Mentors, may consist of the teacher, a paraprofessional, parent volunteers, student teachers, cross-age computer buddies from intermediate grades, more capable peers in class, experts or peers on-line. Teachers will also select specific software applications for its ability to serve as an effective mentor that is programmed to give specific types of feedback to individual students.
- Manager: Teachers will manage the literacy curriculum to a large degree by allowing it to emerge from children's interests, thematic units, explorations and projects on the web, and authentic inquiry.

2. Teachers will *support children's traditional print-based literacy development,* Software and internet resources will provide teachers with access to various reading and writing tutorial programs that may be selected to meet children's individual literacy developmental needs. For example, children who have English as a second language (ESOL) will be able to access reading practice materials in both languages.

   Children who have difficulties comprehending text will have supportive digital environments on screen that allow them to not only read a text, but have access to video clips of conceptual constructs (e.g., an orbiting planet), definitions of specialized vocabulary (trajectory), links to other textual references (an interactive encyclopedia of the solar system), additional background knowledge (a narration about why it is important to learn about planetary orbits) (Anderson-Inman & Horney, 1998), pronunciations of unknown words, or a mini-lesson that may be tailored to help a child learn how to sound-out an unknown word (a voice prompt "If you know that J-a-n-e-t is Janet, then pl-a-n-e-t would be ... Planet.") (McKenna, 1998).

   Teachers will arrange for children to have in-depth conversations about various types of text with peers in class and with an extended on-line community. Children will have access to word processing programs that allow them to compose and shape their thoughts into communicative forms, instead of using the word processor to type a final draft of writing composed with paper and pencil.

3. Teachers will *support children's digital literacy-development.* Reinking (1987) suggests that computer-mediated text and printed text are separate media and that each format requires unique [approaches] to literacy instruction. In his view, every medium is ultimately characterized by how its symbol systems and technological features interact with cognitive processes. A particular type of medium requires a learner to engage in a unique set of cognitive skills to derive meaning. On a similar vein, Salomon (1994) suggests that every cognitive interaction with digital media leaves an impression of cognitive residue on the cognitive processes and brain of the user. This interacting with features of technology over time may significantly alter the user's cognitive and strategic abilities.

Hypertext, for example, permits texts to respond to the needs of a particular reader but also places a burden on the reader to chart a course through information and make sense of the unique pathway traveled (Reinking, 1987). Hypertext is designed as a nonlinear set of informational modules that are connected by semantic links. Teachers may use various approaches to helping children become able to strategically navigate though hypertext for specific purposes. For example, in initial encounters, teachers may configure a hypertext program to control the number and possible paths of student-text interactions that can occur by limiting the reader's access to specific portions of text. Arranging for various levels of access to different portions of text over time may guide students' development of metacognitive awareness and abilities to make sense of hypertextual documents.

Lemke (1994, 1998) raises the notion that multimedia literacies must be taught in ways that ensure an appreciation for how *converging media multiply meaning*. That is, the act of accessing, comprehending, composing, producing, and publishing ideas in work that integrates disparate media forms such as diagrams, drawings, video clips, voice audio, animation, music, archival photo images, sound effects, etc. must be accomplished in ways that are not possible through the presentation of the same ideas in an isolated medium. Teachers will support students' assembly and production of knowledge through multimedia presentations that highlight the multiplicity of meaning factor (Lemke, 1998).

4. Teachers will *foster children's awareness of critical literacy and reasoning* required for communicating in digital domains. Adults will help children understand that the Internet is made up of a complex universe of interest groups and individuals that range from vanity presses, to lunatics, to altruistic institutions. Students must be taught how to critically comprehend and challenge information they encounter through careful analysis of Web pages and Web links (Leu, 1999, personal communication). For example, teachers can arrange for a collaborative learning workshop that is designed to compare information on the same topic drawn from various Web pages. After noting that there are broad discrepancies, not only of opinion but of facts represented across pages, students will benefit from a discussion of how to figure out which sources are reliable and why.

ASKING QUESTIONS: CAUTIONS WORTH RAISING

How will children's literacy development be viewed in the near future? In short term, the paradigm shift from an understanding of literacy as totally print-based to literacy as both print and digitally-based, curriculum writers may attempt to superimpose a new scheme on an older, traditional developmental scope and sequence. For example, the progression might be characterized in the following stages: digital literacy conceptual development level (PreK-K), digital literacy acquisition (1st-2nd grade), digital fluency literacy (3rd-4th grade), digital strategic literacy (5th grade), digital aesthetic literacy (6th-7th grade), to digital critical literacy (8th grade and up). The problem with such organizational frameworks is a lack of a research base or an experiential base to support it. It is likely that multi-age and cross-age collaborative projects will place increasing pressure on curriculum developers to reconceptualize how children acquire and develop digital literacy in ways that challenge traditional notions of development.

Can we expect computers to offer a quick-fix for classrooms where children struggle to attain literacy? Computers in classrooms in the near future will not result in a quick-fix for remediating all of the literacy instructional problems experienced in classrooms or in society at large.

Digital literacy is as complex, if not more so, as print-based literacy. Digital literacy instructional issues are complex and will no doubt create unique sets of difficulties that will need to be sorted out.

Technology is changing so fast, isn't it safer to wait a while before investing in computers for classroom and in substantial staff development efforts related to digital literacy instruction? Leu & Kinzer (in press) make the observation that societal forces preclude adopting a wait-and-see attitude that is intended to allow a sufficient level of computer development and research to amass before making efforts to equip and use computer-related technologies in classrooms. They elaborate in the following statement. "... A preeminent group of scientists and educational researchers in the U.S. recently argued that ICT ... Were so central to the future of the U.S. That additional data on their efficacy were unnecessary before moving to systematically integrate these technologies into schools." The authors note that societal forces may become more powerful than data developed by a scientific community. They also report on a comment made in a report of the President's Committee of Advisors on Science and Technology (PCAST, 1997) "The Panel does not, however, recommend that the deployment of technology within America's schools be deferred pending the completion of a major program of experimental research." (p. 131).

What counts as research? There is little doubt that we can't afford to make sound recommendations for digital literacy instructional practices based on anecdotal evidence alone or on ungrounded inclinations that may be more driven by opinions than it is by objective observation. However, we also can't afford to wait the typical 10-15 year cycle it takes for research results to filter into the classroom. It is crucial that we adopt new notions of what counts as research and who is qualified to conduct research. University and classroom teacher collaborative research partnerships, presented and discussed in a wider Web community of educators, is one possibility worthy of consideration. Teacher Action Research projects that coincide with Staff Development and accountability for dissemination of results may also be a productive means of discovering crucial insights related to digital literacy instruction.

What types of research questions may help us realize a vision of a digitally literacy instructional program?* Research that is both quantitative and qualitative is needed. Research that is conducted over the short term, and longitudinally is needed. The following types of research questions may help begin to articulate an agenda for inquiries of various types:

(1) Research questions about digital literacy instruction:

- How should we teach children to navigate the Web?
- How do teachers integrate computer-related technologies effectively into their classroom literacy curriculum?
- What are effective ways to prepare preservice teachers to enact effective digital literacy instruction?
- How should classrooms be designed, arranged, and managed to make best use of digital literacy equipment?
- What are effective ways to conduct staff development on computer literacy-related instruction for professional teachers during staff development?
- What should we expect across a developmental digital literacy continuum from kindergarten through 12th-grade?

(2) Research questions about digital literacy meaning making processes:

- How are various digital genres written and read?
- What is the interaction between cognition and features of digital literacy programs?
- How do young children make sense of multimedia symbol systems with and across digital documents?
- What features of digital texts are most supportive of various children's literacy needs and why?
- What are children's opportunities to construct literacy knowledge with digital tool kits?
- How can we assess children's comprehension of digital documents such as hypertext?
- How should we design and conduct effective digital literacy assessment?
- What is the cognitive relationship between reading alphabet-based symbols and reading multimedia symbols?
- What new literacies emerge with the use of internet technologies for reading and language arts?

CONCLUDING COMMENTS: READY OR NOT, HERE IT COMES!

In writing this paper I have resisted the advice of some in the field to discuss computer-related education in the near future in America as an activity that will occur outside of the walls of a classroom. By doing so, I do not mean to ignore the likelihood that schooling may be so reconceptualized and transformed in the long range that it will no longer occur in classrooms. On the contrary, I suspect many viable alternative forms for on-line approaches to literacy education will occur as the decades unfold and as society changes to embrace technological innovations. However, I strongly suspect that the institution called school will survive well into the 21st century and that teachers will continue to play a central role in children's digital literacy development.

Speculation about the longer term view of literacy education suggests to me that the time will one day come when every child in an instructional setting will have a digitally produced Personal Learning Assistant (PLAyer) who will be designed to respond to the literacy instructional needs of the child. Entire instructional rooms will be intelligent, in the sense that they will be equipped with technology that is intuitive and responsive to children's gestures, touches, and voices through a multiplicity of intuitive interface structures. Computer technologies will recognize and transform spoken words into any symbol system the communicator wishes to use to express particular ideas for particular purposes (Labbo, in press b). While these thoughts of the future are engaging and entertaining, the technological strides needed for such a longer term vision to become reality are substantial and are not likely to occur within the first decades of the 2000s.

In closing, whether we are ready for the paradigm shift about literacy education that is sure to occur, the societal forces for integrating digital literacies into the local workplace, popular culture, and global marketplace are upon us. It is up to us to figure out how to best prepare for the inevitable changes that are sweeping the informational internet across our nation, but are making only soft inroads into classrooms. As long as we have institutions in America called public schools, teachers

will be given the mandate to prepare every student who enters their classrooms to be able to act as literate beings in the life of American society. Between the near term and the long term, computers stand to foster students' development of both traditional and digital literacy; however, we have many questions to answer and many cautions to consider as we formulate a vision for best computer-related literacy practices. As a final thought, I suggest that the banner posted over the state of computer literacy-related use in classrooms of today and of the near future is not one that reads, *Under Construction* , but one that reads, *Under A State Of Jumbled Construction*. Like Dorothy and her companions in the Land of Oz, making our vision a reality will take great deal of intelligence, heart, and courage.

REFERENCES

Anderson, Inman, L., & Horney, M. A. (1993). Profiles of hypertext readers: Case studies from the ElectroText project. Paper presented at the annual conference of the American Educational Research Association, Atlanta, GA.

Ash, G. E. (1998). "Literacy is a human endeavor. Period.": Literacy definitions and delineations from the JLR Editorial Board. In T. Shanahan & F. V. Rodriguez-Brown (eds.), National Reading Conference Yearbook 47, (pp. 451-460). Chicago, IL: National Reading Conference, Inc.

Baum. L. F. (1973). The annotated Wizard of Oz: The Wonderful Wizard of Oz. New York: Clarkson, N. Potter, Inc./Publisher.

Beach, S. A. (1995). Defining literacy: Implications for reading instruction. Reading Psychology, 16, 89-98.

Bruce, B. C. & Hogan, M. P. (1998). The disappearance of technology" Toward an ecological model of literacy. In D. Reinking, L. D. Labbo, M. McKenna, R. Keiffer (Eds.), Handbook of literacy and technology: Transformations in a post-typographic world. (pp. 269-281). Mahwah, NJ: Lawerence Erlbaum Associates, Publishers.

Chall, J. S. (1983). Stages of reading development. New York: McGraw Hill.

Freppon, P. A., & Dahl, K. L. (1998). Theory and research into practice: Balanced reading instruction: Insights and considerations. Reading Research Quarterly, 33, 240-251.

Kinzer, C. K., & Risko, V. J. (1998). Multimedia and enhanced learning: Transforming preservice education. In D. Reinking, L. D. Labbo, M. McKenna, R. Keiffer (Eds.), Handbook of literacy and technology: Transformations in a post-typographic world. (pp. 185-202). Mahwah, NJ: Lawerence Erlbaum Associates, Publishers.

Labbo, L. D. (in press a). 12 things young children can do with a talking book in a classroom computer center. The Reading Teacher.

Labbo, L. D. (in press b). What will classrooms and schools look like in the next millennium? Reading Research Quarterly.

Labbo, L. D., & Reinking, D. (in press). Negotiating the Multiple Realities of Technology in Literacy Research and Instruction. Reading Research Quarterly.

Lemke, J. L. (1994). Multiplying meaning: Literacy in a multimedia world [Paper presented at the National Reading Conference, Charleston SC]. (ERIC Document Reproduction Service, No. ED 356 767)

Lemke, J. L. (1998). Metamedia literacy: Transforming meanings and media. In D. Reinking, L. D. Labbo, M. McKenna, R. Keiffer (Eds.), Handbook of literacy and technology:

Transformations in a post-typographic world. (pp. 283-301). Mahwah, NJ: Lawerence Erlbaum Associates, Publishers.

Leu, D. J., & Kinzer, C. K. (in press). The convergence of literacy instruction and networked technologies for information and communication. Reading Research Quarterly.

Mikulecky, L., & Kirkley, J. R. (1998). Changing workplaces, changing classes: The new role of technology in workplace literacy. In D. Reinking, L. D. Labbo, M. McKenna, R. Keiffer (Eds.), Handbook of literacy and technology: Transformations in a post-typographic world. (pp. 303-320). Mahwah, NJ: Lawerence Erlbaum Associates, Publishers.

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. Theory into Practice, (31)2, 132-141).

NCSS (1999). National Center for Educational Statistics Issue Brief: Internet Access in Public Schools and Classrooms: 1994-1998. (Http://nces.ed.gov/pubs99/1999017.html#table1).

Papert, S. (1993). The children's machine: Rethinking school in the age of the computer. New York: Basic Books.

Reinking, D. (1987). Computers, reading, and a new technology of print. In D. Reinking (Ed.), Reading and computers: Issues for theory and practice (pp. 3-23). New York: Teachers College Press:

Reinking, D. (1994). Electronic literacy (Perspectives in Reading Research No. 4). Athens, GA: National Reading Research Center. (ERIC Document Reproduction Service No. ED 371 324).

Reinking, D., & Bridwell-Bowles, L. (1991). Computers in reading and writing. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds.), Handbook of reading research (Vol. 2, pp. 310-340). New York: Longman.

Reinking, D., Labbo, L. D., McKenna, M. & Kieffer, R.(Eds.), (1998). Handbook of literacy and technology: Transformations in a post-typographic world. New York: Erlbaum.

Rowe, D. W. (1994). Preschoolers as authors: Literacy learning in the social world of the classroom. Cresskill, NJ: Hampton Press, Inc.

Salomon, G. (1994). Interaction of media, cognition, and learning: An exploration of how symbolic forms cultivate mental skills and affect knowledge acquisition. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Stokes, D. E. (1997). Pasteur's quadrant: Basic science and technological innovation. Washington, DC: Brookings Institution Press.

U.S. Congress, Office of Congressional Assessment. (1995). Teachers and technology: Making the connection. Washington, DC: U.S. Government Printing Office.

Wright, P. (1987). Reading and writing for electronic journals. In B. K. Britton & S. M. Glynn (eds.), Executive control processes in reading (pp. 23-55). Hillsdale, NJ: Erlbaum.

Venezsky, R. (1990). Toward defining literacy. Newark, DE: International Reading Association.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

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