Editor's Introduction

This special issue has focused on research about the uses of technology for teaching and learning in K–12 classrooms or with K–12 learners. This is a wonderful special issue, but as the editor, it has been surprising how few studies were submitted, reviewed, and accepted that meet the focus of the issue. Additionally, during a recent panel discussion on educational research at NECC 2005, audience members' comments provided some interesting thoughts about this type of research not being "valued" or easy to conduct. These simultaneous reflections have brought up some questions that our community may wish to think about:

- In many ways it is not easy to conduct research in our schools or with young learners due to the messiness of classrooms, the complexity of students' access to technology throughout their "away from school" lives, and the ethical issues of disadvantaging some learners.
- Our literature base is far from clear on best practices, and frequently research studies replicate other studies that found "no significant difference." Not surprisingly, the results continue to be the same and we appear not to move forward in our understanding.
- We seem to continually re-learn that substantial efforts and systemic supports are required for the vast numbers of teachers to use technology in innovative and instructionally sound ways.

The article by McNabb, "Raising the Bar on Technology Research in English Language Arts," was an attempt to begin a dialogue among the research community to identify what we do know about using technology in various content areas. Although it does not present new empirical data, it does offer the reader one researcher's perspective on technology in literacy and language arts. You may wonder where I hope this will lead. It is my intention to encourage others to submit focused articles such as this for the next several issues of *JRTE*. As always, I welcome your input, suggestions, and contributions to the dialogue *JRTE* is attempting to encourage and support.

—Lynne Schrum
lynne.schrum@ed.utah.edu

Raising the Bar on Technology Research in English Language Arts

M. L. McNabb
Learning Gauge, Inc.

When it comes to a theory about what works with regard to technology integration into English language arts, the research basis has a long way to go. Innovative teachers of English language arts were forerunners for technology integration when desktop computers became available in schools during the 1980s. They eagerly began using word processing for writing instruction

and multimedia drill-and-practice software for reading instruction. When the Internet became available in schools, English language arts teachers across the country began teaching themselves how to use it to provide students with opportunities for digital information research, reading enrichment, and hypertext writing (McNabb, Hassel, & Steiner, 2002). Technology integration practices in English language arts are prevalent, but research has not produced substantial evidence about the effects of these practices on students' literacy development.

Kamil, Intrator, and Kim (2000) indicate that very little research has been conducted in the area of technology and literacy. In their review of research on reading and writing that was published between 1986–1996, they found less than five percent of the articles addressing issues associated with technology. They categorized the available research into six areas where research indicates at least preliminary conclusions: writing and composition, hypermedia, multimedia, work with special populations, motivation, and collaboration. Their findings indicate two primary areas of the English language arts curriculum for technology integration: writing and hypermedia/multimedia. The latter relates to the nature of reading materials.

Given the historical influence of technology upon literacy, the lack of robust research and significant findings is somewhat troubling. There has been a synergistic relationship between technology and literacy for at least the past 500 years (Reinking & Bridwell-Bowles, 1996; Swafford & Kallus, 2002). Printing press technology has shaped our current understanding of reading and writing processes in profound ways. Print-based reading materials are unilinear. Printed texts have established narrative and rhetorical structures that readers use as scaffolds for comprehension (McNabb, Thurber, Dibuz, McDermott, & Lee, 2005). Printed texts are carefully constructed by authors for a given audience and purpose. Authors of print make assumptions about their intended readership. These assumptions inform their use of vocabulary, depth of knowledge presented, and motivational language. Authors of print also select a form of narrative or rhetorical structure and assume the reader will start at the beginning and follow the structure through its page sequence.

In contrast, a significant characteristic of digital texts is their hypertextual structure. Landow (1992) explains that chunks of information that are linked together non-sequentially characterize hypertexts. Hypertexts allow readers choices, which make reading multilinear (Bolter, 1998; Landow, 1992). Multimodal hypertexts that link printed words with audio, video, pictorial, or kinetic texts are technically called hypermedia. In this article, the term hypertext includes its multimodal forms of hypermedia. Landow (1992) claims that traditional reading conventions and strategies apply only within a single node (or page) of hypertext or hypermedia. Little is known about the cognitive processes readers experience as they venture beyond their starting node. There is, however, some evidence indicating significant differences from reading print.

Heller (1990) reviewed early studies about reading hypertext. She found evidence of reader disorientation, cognitive overload, lack of commitment, and unmotivated rambling among readers of hypertexts. Most at risk of low comprehension were students who did not have strong self-monitoring abilities. Students with a well-focused reading purpose upon which to base their read-

ing decisions may comprehend more than those without a clear focus. Students who struggle with spatial processing, attention, and/or memory dysfunctions may experience difficulty reading hypertext (McNabb et al., 2005). Reading hypertext involves developing one's own internal narrator and rhetorical structure. In order to do so, readers engage in intense comprehension monitoring to avoid information overload. The volumes of loosely associated information found in hypertexts put demands on the reader's mental energy and active working memory not required of the reader of print narratives.

Hypertexts can challenge even good readers' abilities to synthesize multiple perspectives, evaluate texts for bias or unreliability, and to make sense of disjointed associations on the fly. In this regard, reading hypertext generates information processing cycles that do not occur when reading a printed narrative. On the other hand, the multimodal and interactive features of digital texts may have profound implications for enhancing readers' understanding of printed words (Anderson-Inman & Horney, 1998; McKenna, 1998). Digital text features such as sound and/or graphics that elaborate on the meaning of print can aid comprehension. Anderson-Inmann and Horney (1998) conducted a series of descriptive studies involving at-risk readers with a range of reading deficiencies. Participating students used "supported text" features of digitally altered reading materials. Supported text features included links to vocabulary definitions for general words and phrases unfamiliar to readers due to low levels of abstract thinking and/or prior knowledge. Illustrations, graphic concept maps, summaries, translations, and expanded explanations are other types of supported text features Anderson-Inman and Horney used. In a similar series of descriptive studies, McKenna (1998) found benefits of using multimodal texts to scaffold at-risk readers' comprehension of "talking books" that associate students' listening and viewing with their comprehension of print.

Beyond that, we do not know much about the effect of the missing narrator, who explains and guides readers in print, but does not exist in the web of associated hypertexts (McNabb et al., in press). The interactivity of digital texts requires readers to make decisions about which link to follow next and why. The reading processes involved in comprehending the contexts surrounding hyperlinks and the processes behind the inferential leaps readers make when they click a hyperlink are unexplored by research.

There is research from which to propose hypotheses for future inquiry about the effects of technology on literacy development. For example, Paul (1996) describes "repeated exposure to less frequent and more difficult words in a meaningful context" (p. 9) as an indicator of effective literacy learning opportunities. A hypothesis I draw from this research is that reading digital texts may positively support vocabulary building in context and expand students' lexicon. Another hypothesis is that use of the Internet for guided reading may engage students more than reading print. Higher levels of engagement are associated with gains in reading achievement. Paul's research indicates that an emphasis on guided reading in schools strongly correlates with higher reading scores and academic achievement measured by the National Assessment of Educational Progress (NAEP).

Existing research results have not been overwhelming. In a meta-analysis of controlled technology studies spanning three decades, Kulik (2003) reports that integrated learning systems and writing-based reading programs are the major types of technology used in English language arts instruction. The cumulative research results show no significant difference among performance for those who used integrated learning systems (ILS) for reading and students who did not use ILS. These results are consistent with other research reviews about ILS' effectiveness (Becker, 1992). The lack of significant difference may be explained by the fact that ILS use tends to mimic the same drill-and-practice modes of instruction used in traditional reading instruction.

Kulik's meta-analysis also describes results from years of writing research. The cumulative research indicates that students who use word processing for writing compositions typically develop better writing skills than students who are not taught to write using word processing. In addition, students who were provided with enriched computer access, broadly defined as extensive opportunities and resources for authentic writing and research, performed better in writing than students who did not have access to the same amount of opportunity and resource (Kulik, 2003).

To date, most of the research about technology and literacy has focused on traditional literacy practices that are grounded in print. Given the prevalence of digital texts in our networked culture, researchers would be wise to start asking deeper questions about the effect of digital texts on reading and writing processes and skill development.

If Bolter (1998) is correct in his claim that "hypertext undermines the rhetorical foundation for the teaching of writing—that is, the need for a unified point of view and a coherent thesis" (p. 10) then: How do we conduct research to determine effective instructional strategies and the appropriate foundational skills for writing with digital authoring tools? Kinzer and Leander (2002) report on research about how readers make meaning as they move across hypertext links. They suggest that reading hypertext is much like writing or co-authoring. In other words, they claim the nature of reading hypertext is different than reading print, as it requires a high level of student engagement in critical analysis. Using tools and techniques that help engage students in literacy activities is an important aspect of effective literacy learning environments (Au & Raphael, 2000; Kamil et al, 2000; Wood, 2000). Although research points to the importance of student engagement in reading and writing, the questions that come to mind are: Do opportunities to read hypertext enhance student engagement beyond that found with reading print? How do various levels of student engagement influence development of reading fluency and comprehension? How do hypertext reading and writing processes differ from those used with print? What are the optimum instructional strategies to facilitate students' hypertext reading and writing skills development?

It has been my experience working on evaluation studies of technology integration initiatives that when students read hypertext, the reader's active process of constructing meaning is made visible. One can observe the reader's path and make inferences about the developmental level of his or her internal narrative,

ability to focus, and comprehension. Conducting a think-aloud along with the observation and capturing a hypertext link log can yield rich data about how well the reader meets the challenges of hypertexts.

Digital texts force readers to make choices. Critical awareness of how hyperlink options relate to the reader's purpose, prior knowledge, and motivation may affect comprehension. These phenomena lead to new questions about assessment as well. If hypertext brings forth each student's individual reading path and processes, then what are the characteristics of appropriate methods of measurement?

Other pertinent questions include: Do traditional reading and writing strategies applicable to print-based materials transfer to digital text? As information networks provide students with access to vast amounts of uncensored text, what are the best methods for fostering students' ability to critically evaluate digital information? These and other developmental issues associated with digital texts are pressing concerns for a few literacy researchers (Leu & Kinzer, 2000). Much more emphasis needs to be given to the nature of digital literacy and the corresponding literacy learning opportunities that are appropriate for preparing students to be literate with digital texts.

Existing research only provides a glimpse into what may be occurring for readers of digital texts. The possible positive and negative effects I described above are mere hypotheses waiting to be researched. What we really need is a comprehensive research agenda to address these issues in a systematic way. The little research that does exist does not begin to provide enough evidence to answer questions such as: What is the fundamental nature of reading processes associated with hypertext? How do these compare with processes readers use when reading print? Do the reading processes inherent in navigating through the associative web of hypertext transfer to reading print narratives? What comprehension abilities are prerequisite to derive meaning from hypertext?

McNabb et al. (2002) found a nationwide lack of professional development for English language arts teachers interested in integrating digital texts into literacy learning opportunities for students. Many teachers still rely on "computer teachers" in "labs" to do their preps and teach their students. These dynamics tend to keep technology integration at the basic operations level. The movement toward content areas integration has been slow. This trend will continue until teachers are prepared and confident in teaching with digital texts. Researchers can help by partnering with teachers to investigate what works and to discover the new literacy skills needed to comprehend and produce digital texts.

Fortunately, wireless Internet and portable computers are shifting access rates with predictably significant increases in the student-to-networked-computer ratio in the coming years. This shift has the potential to radically affect learning outcomes from students' use of technology in content areas, *if* teachers are provided with the professional development opportunities they need to adequately integrate technology in the service of academics. Researchers can provide a great service toward this end by addressing the deeper issues of technology use in specific content areas. In this article, I have raised critical questions to address in a research agenda for technology in English language arts—the content area

with which I am most familiar. I challenge others to join this quest for answers to key questions about how technology affects learning in English language arts and other content areas.

Contributor

Dr. McNabb is the director of Learning Gauge, Inc., providing program evaluation and professional development services related to uses of technology in support of students' academic learning. (Address: mlmcnabb@msn.com.)

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