

**Learning Space: Perspectives on Technology and Literacy in a Changing  
Educational Landscape**

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## **Abstract**

Rapid developments in both educational technologies and curriculum philosophies have changed the ways in which students and educators interact with texts. Calling upon the work of such leading literacy scholars as Manzoor Ahmed, Vicki Jacobs, and Terry Salinger, this essay examines America's stagnant functional literacy rates through the interrogation of a simple question first raised by N. Katherine Hayles in her recent text *How We Think*: Why should hypertext, and web reading in general, lead to poorer comprehension? Using historical trends and contemporary research findings on how children use a variety of texts, this essay represents a call to re-affirm the importance of dialogical reading practices in the home and the classroom. Concurrent to effectively teaching those traditional reading practices, our educational system must also prepare children for a future in which machine and hyper reading habits will only take on additional prominence. A positive repositioning of literacy as a foundational academic, professional, and societal skill must therefore be equal to the passion that many administrators are currently expressing (through curriculum design and resource allocation) for courses in science, technology, engineering, and math (STEM).

**Keywords:** literacy, STEM education, hyper reading, close reading, machine reading, dialogical literacy practices

In *The Structure of Scientific Revolutions*, historian and physicist Thomas Kuhn introduces the theory of paradigmatic shifts—those changes in social and scientific traditions that have such immense consequences that their very nature is no longer commensurable to the long-held systems of belief they displace. Kuhn theorizes that, in the process of normal scientific inquiry, moments of crises emerge that demand innovative approaches to new testing methods. When these methods gain traction within a community and consensus emerges on the validity of the data they produce, a paradigm shift redefines the culturally shared values and assumptions of the group.

While Kuhn's influential 1962 text examines scientific developments in support of its claims, the tradition of human communication, as cavernous in its scope and breadth as any other discipline in scientific inquiry, seems mired at present in a period of crisis that capably illustrates his theories at work. As editor Terence Hawkes states simply in the preface to Walter Ong's *Orality and Literacy: The Technologizing of the Word*:

It is easy to see that we are living in a time of rapid and radical social change. It is much less easy to grasp the fact that such change will inevitably affect the nature of those academic disciplines that both reflect our society and help to shape it. (ix)

One such area of rapid change is the emerging primacy of the digital writing space, a technological paradigm shift whose origins may have begun decades ago, but whose consequences have come most glaringly to bear in the last two decades. As the ubiquity of digital publication has exploded throughout the developed world, our approaches to writing and communication have undergone drastic changes. The consequences of these developments can be immense for, as Ong asserts, more “than any other single invention, writing has transformed human consciousness” (78). As a cornerstone of literacy, a nebulous set of abilities that Terry

Salinger views as encapsulating “reading, writing, and many other skills,” (1) writing stands at the heart of creative expression and educational opportunity. Writing connects thinkers across the thresholds of time and space, and the process of decoding the written system—of reading and deciphering information—represents the other side of the communication equation. Taken together, the processes of sending and decoding information comprise the dominant divisions of the topic we have come to understand generally as “literacy.”

Cultures organize themselves around a core of designing principles, and inclusive communication practices stand at the heart of any cohesive society. As changes in technology reshape the ways in which we learn new concepts, conduct business, manage our interactions, and cultivate the interests of the greater good, a series of questions begins to emerge: How has technology impacted our approaches to education? How do we define “literacy,” and how can we improve the general levels of cultural navigation for those who have been left behind by what is now commonly referred to as the “digital divide”? And finally, how have shifting attitudes about the future of our economy begun to manifest themselves in the day-to-day administration of our educational systems?

Rapidly developing technologies can become something of a double-edged sword. Just as “first-movers” enjoy an advantage when implementing a “disruptive technology or business model that...challenge[s] an incumbent with innovative technology,” so to do early adopters enjoy an advantage when experimenting with these products and services from the user’s perspective (Lucas 8). In many instances, gaps in the level of access to a particular technology exist which can predict who the winners and losers might be when a paradigm shift takes place. Inequalities in socioeconomic status, geographical location, and access to training and skills practice are some of the issues that have surfaced in recent years as America’s educational

community attempts to track and make sense of the changes the digital revolution has had on student achievement.

Establishing both contemporary and historical perspectives is useful in creating a framework for thinking about literacy and education in America, and an analysis of aggregate reading comprehension levels is the most logical place for such a discussion to begin.

It was reported in the 2009 National Assessment of Educational Progress (NAEP<sup>1</sup>) that 33% of fourth graders read below the testing instrument's lowest level of "basic." In other words, a third of the testing subjects failed the assessment. The instrument tested children on a series of comprehension questions spanning both literary and informational reading passages. There was a slight measure of improvement for eighth graders testing in 2009, although 25% of students still failed to meet the "basic" standard, and only 4% of students could read at the "advanced" level ("Reading 2009").

When comparing these findings with historical trends, we actually learn that reading achievement levels have improved slightly since 1971, though that improvement has been negligible. The "Average Scale Score" (scored 0-500) figure for thirteen-year-old students in 1971 stood at 255; in 2009, the figure had risen to 260 ("Long-Term Trend"). It is important to note, however, that some critics have ascribed the slight improvement to a revision of the testing instrument, which was implemented in 2004 ("Reading 2009").

What do these statistics actually *mean* for our students, our educational system, and the future of our economy? Well, they illustrate that in 2009, fully one third of testing subjects aged nine and ten read below grade level, while a quarter of subjects aged thirteen and fourteen

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<sup>1</sup> The results of the 2013 NAEP reading report will be released in the fall of 2013.

couldn't meet those same basic reading standards. That's a large segment of our population that is still fundamentally learning to read, rather than using reading to learn (Jacobs 12). These results paint a picture in which roughly "40 percent [of adolescents] cannot draw inferences from written material...and only one-third can solve a mathematics problem requiring several steps" (Jacobs 7).

When students struggle to decode written, oral, and visual information in the classroom, realizing even basic levels of comprehension becomes exceedingly difficult. Students experience progress at different rates, and some become discouraged to the point of abandoning the educational system altogether.

In fact, "among public high school students in the class of 2008-09, the [national] AFGR (adjusted freshmen graduation rate) was 75.5 percent" ("The Condition of Education"). This means that almost 25% of American students failed to graduate from high school on time with a regular diploma. The drop-out rate is almost a perfect reflection of the number of eighth graders who failed to read at grade level in the 2009 NAEP report, and is perhaps a contributing factor in the dismal adult literacy scores that were reported in a 2009 study by the National Center for Education Statistics. As Greg Toppo notes:

A long-awaited federal study finds that an estimated 32 million adults in the USA—about one in seven—are saddled with such low literacy skills that it would be tough for them to read anything more challenging than a children's picture book or to understand a medication's side effects listed on a pill bottle.

Toppo's use of examples above presents an important question: *How* do we define the idea of "literacy" itself? What are the practical literacy outcomes that, if negotiated successfully, allow a person to make his or her way in American society?

While the previously cited test findings are based solely on reading comprehension, many educational theorists have expanded the definition of literacy to include a much broader set of skills and attributes. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has drafted three separate definitions of the term over the last five decades:

- (a) A person is literate who can, with understanding, both read and write a short simple statement on his or her everyday life (UNESCO 1958);
- (b) A person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his or her group and community and also for enabling him or her to continue to use reading, writing and calculation for his or her own and the community's development (UNESCO 1978);
- (c) Literacy is the ability to identify, understand, interpret, create, communicate and compute using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve his or her goals, develop his or her knowledge and potential, and participate fully in community and wider society (UNESCO 2005). (Ahmed 181)

These characterizations illustrate an evolution in thought and complexity in *how* we characterize literacy, but the basic comprehension questions actually posed in the 2009 NAEP testing instrument seem not to push much at all beyond the boundaries presented in UNESCO's first, exceedingly simplistic definition. Taken together, our alarming national drop-out and reading-comprehension rates (especially when juxtaposed with our present period of rapid

technological innovation) present a pair of seemingly simple questions with very complex answers: How did we get here, and what should we do to reverse these negative statistical trends?

A response to the first question might rest at least partially in an understanding of our cultural attachments to media itself. In his 1994 text *The Gutenberg Elegies*, Sven Birkerts expresses his reticence about the digital march to progress. He compares the “morbid symptoms” that the Greeks endured in their transition from oral to written language dominance with our present circumstance, stating:

If the print medium exalts the word, fixing it into permanence, the electronic counterpart reduces it to a signal, a means to an end...The tendencies outlined above are already at work. We don't need to look far to find their effects. We can begin with the newspaper headlines and the millennial lamentations sounded in the op-ed pages: that our educational systems are in decline; that our students are less and less able to read and comprehend their required texts, and that their aptitude scores have leveled off well before those of previous generations. (123)

Birkerts adopts a refreshingly cautionary stance on the idea of an “all-electronic future,” stating that he harbors a “great feeling of loss and a fear about what habitations will exist for self and soul” in the digital age (128). His contrarian views concerning some of the digital epoch's most widely lauded attributes (which, among Lucas's substantial inventory, include two billion digitally networked users and instantaneous data retrieval) is predicated on three adverse developments: language erosion, a flattening of historical perspectives, and the waning of the private self (128-31).



It is the actual physical diminution of the collected tools of our intellectual heritage that Birkerts views as an affront to learning in the digital era:

The depth of field that is our sense of the past is not only a linguistic construct, but is in some essential way represented by the book and the physical accumulation of books in library spaces...Once the materials of the past are unhoused from their pages, they will surely *mean* differently. The printed page is itself a link... (129)

Almost twenty years after the publication of *The Gutenberg Elegies*, a recent study presented in *Research in Social Stratification and Mobility* seems to have confirmed some of Birkerts's theories on the connection between proximity to tangible books and learning. As Tom Bartlett reports in his article "Want Smart Kids? Here's What to Do," having a sizable accumulation of books in the home is a greater predictor of educational success than is a parent's socioeconomic status or level of educational attainment. Bartlett writes:

Researchers found that children who grew up in a home with more than 500 books spent 3 years longer in school than children whose parents had only a few books. Also, a child whose parents have lots of books is nearly 20-percent more likely to finish college. For comparison purposes, the children of educated parents (defined as people with at least 15 years of schooling) were 16-percent more likely than the children of less-educated parents to get their college degrees. Formal education matters, but not as much as books.

While correlation does not illustrate causation, it *is* a sizable study (conducted over twenty years, and covering more than 70,000 respondents from twenty-seven countries) that supports the notion that intellectual curiosity can be a natural byproduct of informational access.

And so, given Lucas's postulate on instantaneous data retrieval, should it not stand to reason that students using the internet have greater access to information, and therefore possess the potential to become stronger scholars than their print-reliant forebears?

Theorist N. Katherine Hayles effectively refutes that argument in her recent text *How We Think*. Citing neurophysiologist Stanislas Dehaene and psychiatrist Norman Doidge, Hayles constructs a convincing argument that web reading can actually contribute to poorer overall comprehension. In her chapter "How We Read," she outlines three practices that seem now in competition with one another in the digital era: close reading, machine reading, and hyper reading. Close reading is the traditional tool of literary scholars, which includes "detailed and precise attention to rhetoric, style, language choice, and so forth through a word-by-word analysis of a text's linguistic techniques" (Hayles 58). The other types, in Hayles's view, represent modes of "fast reading and sporadic sampling" (58). Hyper reading truncates context as terms and phrases are limited and refined through search queries, while machine reading may eliminate context altogether as complex algorithms comb large amounts of data, sifting for patterns that often emerge independent of meaning. Citing Dehaene's "neural recycling" hypothesis, which suggests that some reading practices effectively repurpose existing brain circuits, Hayles argues that close reading allows the commitment of data to long-term memory to happen more efficiently (64-5). This is particularly true when one considers the cognitive strain of "clicking on links, navigating a page, scrolling down or up, and so on" while trying to situate content within long-term memory (Hayles 64). The linear reading habits that Birkerts and Hayles

view as the foundation of curating, learning, and possessing information are exercised less frequently among contemporary students, and there is also the added concern of using information out of context that contributes to what Harvard's Dr. Vicki Jacobs views as a lack of "higher-order' intellectual skills" (7).

Such digital reading practices, when coupled with the flood of erroneous information regularly disseminated in the unfettered digital domain (Notte), have spawned the subsidiary academic discipline of digital literacy studies. It's not enough simply to understand the linear aspects of a story, essay, or article; consumers of information must also understand which evidence is credible and trustworthy. As Trever Millum notes, "Yes, you can get an enormous amount of data very quickly but, no, the technology does not sift it for you, quality assure it, analyse it or synthesise it. Those old-fashioned skills still need to be taught" (28). Millum's salient points speak to the importance of teaching digital literacy skills, but evidence suggests that vulnerable student populations are ill-prepared to succeed in the digital educational environment. For some, not acquiring these skills could represent a serious barrier to attending college altogether:

For disadvantaged students lacking awareness or the digital-connection capabilities, entry into college may become harder to obtain than ever before. "Our first-generation college students, even if they have computers with high-speed Internet, still struggle through the college-application process because they do not have the same frame of reference and knowledge base when it comes to things like college-search websites," said Darrell Sampson, a guidance counselor with the 182,000-student Fairfax County school district in Virginia. "If you do not know what it is you are supposed to be looking for, or how the process is

supposed to work," he said, "you are probably not going to be accessing the wealth of information available through technology meant to assist you."

(Fleming)

Disparities in digital literacy instruction and skills practice represent only one barrier to student access. Another is present in the geographical discrepancies of broadband availability, even in a country as wired as the United States. In a recent article published in *Congressional Digest*, it was reported that, "of the 19 million Americans who live where fixed broadband is unavailable, 14.5 million live in rural areas" ("Access to Telecommunications..."). The Federal Communication Committee's *Eighth Broadband Progress Report* noted that rural broadband speeds were significantly slower than were services in urban areas, indicating that it's not only what you know, but where you live that dictates your level of inclusion within a fully integrated (education, commerce, entertainment, and civic engagement) digital environment.

The K-12 and post-secondary educational communities appear situated in a precarious position—stretched between a print legacy built on the cultivation of close reading skills and an extensively mediated digital environment that embraces hypertextual documents and machine reading practices. While post-secondary institutions have embraced the validity and profitability of online and hybrid educational learning opportunities, a stigma concerning medium still exists on the topic of publication for, even in "the late age of print, scholars in the humanities continue to regard print forms as authoritative" (Bolter 112). Even though there is some inherent incongruity in embracing the digital classroom while eschewing the digital journal, post-secondary institutions are improving the levels of rigor in online education while expanding educational opportunity in the form of free classes. Harvard and the Massachusetts Institute of

Technology, for instance, are foundational participants in the edX movement, a push to offer free online courses (Lewin).

Both the present and the future of American K-12 education are less clear, even though the stakes are much greater. The American public education system is, after all, the foundation upon which our country's intellectual and entrepreneurial capital is constructed. A systemic (and seemingly chronic) lack of funding has become exacerbated by competing educational philosophies which stand to further fragment and stratify our student populations in the short term, and our labor pool in the long term.

Since becoming a founding sponsor in the National Science and Math Initiative (NMSI) in 2007, energy company ExxonMobil has aggressively advertised the importance of bolstering the number of Americans earning post-secondary degrees in the fields of science, technology, engineering, and math (STEM). The NMSI is seeking to implement broad reforms in our country's K-12 educational system. One such advertisement laments the findings of the 2009 Program for International Students Assessment, which placed the United States 17<sup>th</sup> overall in scholastic achievement in science and 25<sup>th</sup> overall in math (*Letssolvethis.com*). Touting a mixture of educator professional development, rigorous and common core state standards, and an increased emphasis on advanced placement education, the NMSI's efforts to reverse our country's place in the PISA standings are both laudable and lofty, as a variety of competing factors have had material negative impacts on the organization's ability to meet its benchmarks. One of these important factors is our country's stagnant progress rates in reading competencies across all levels of K-12 education.

Where the STEM fields are concerned, educational reform has become something of a political flashpoint across the country. In Florida, Governor Rick Scott has tied all levels of educational emphasis, from elementary to post-secondary schooling, to STEM. In announcing his 2011 legislative priorities, Scott wrote:

The K-12 system must also meet STEM demands in both the K-12 setting as well as in its workforce education programs. Our students must meet high academic standards with strong preparation in science and math in order to be prepared to compete with an increasingly competitive global workforce. (Solocheck)

Florida is not alone in its push to situate STEM at the top of the educational hierarchy. Rick Perry, Governor of Texas, has made it a foundation of his state's educational philosophy, and President Barack Obama has launched the "Educate to Innovate" initiative, which lists the following as its goals:

- 1) Increase STEM literacy so that all students can learn deeply and think critically in science, math, engineering, and technology.
- 2) Move American students from the middle of the pack to top in the next decade.
- 3) Expand STEM education and career opportunities for underrepresented groups, including women and girls. ("Educate to Innovate")

The aims of such programs are certainly not without merit; after all, it's commendably prescient for a society to cultivate a workforce that can meet the demands of a diverse global marketplace. But such a drastic restructuring of our educational hierarchy could not come at a worse time for our students, who are, based on national testing measurements, ill prepared to handle such a

rigorous curriculum. Such fundamental shifts in our collective educational philosophy, while giving the appearance of sagacity, actually appear to represent the opposite ideal. Asking kids who lack basic reading fundamentals to participate in a rigorous STEM curriculum is the very definition of placing the cart before the horse.

And which students will struggle the most with these program adaptations? According to the figures found on page 10 of the 2009 NAEP report, minority (who typically realize fewer educational and technological resources in the home) populations continue to experience a sizable skills gap in relation to their White counterparts. According to the report, White students enjoy a “26-point score gap” over Black students, and a “25-point score gap” over Hispanic students (“Reading 2009”). This translates into stronger levels of academic preparation for White students, which is advantageous in a push to secure work in the high-paying STEM professional fields.

Technology marches forward, caring nothing about race, gender, socioeconomic status, or geography. It simply exists, as a conceptual entity, to build on existing paradigms in its inevitable progression along historical and cultural continuums. But that sterile characterization of technology as a concept does nothing to alleviate the truths of our lived experience, which indicate that “hierarchies based on gender, race, and economic advantage remain strong in our culture” (Bolter 210). So these seemingly parallel concepts must ultimately converge in their formation of an answer to one final important question: What is our best path forward?

*Harvard Educational Review* published a special issue on the topic of adolescent literacy in the spring of 2008, and Jacobs set the tone for that issue with a piece titled “Adolescent Literacy: Putting the Crisis in Context.” In her oft-cited analysis, Jacobs traces a decade of

empirical findings on the subject of literacy, as well as the variety of responses designed by the educational community to correct these deficiencies.

Three key concepts rise to prominence in reviewing Jacobs's report. The first is that elementary education is crucial to intellectual development. The second is that a shift away from integrating reading specialists in the classrooms and delegating literacy education to content-area instructors has resulted in negative consequences for our students. And the third is that educators must balance technological access with instruction in traditional reading and writing competencies.

In addressing these concepts in order, it is apparent that children must learn to reason and decode early in life. As Jacobs reports:

Children who have acquired decoding and fluency skills by the end of the third grade will most likely be prepared to learn how "to acquire knowledge, broaden understandings," and cultivate their "appreciations of the written word" (Harris and Hodges 213). Those who have not achieved automaticity and fluency in their reading will be severely limited in their access to more technical, syntactically complex, and dense reading that is characteristic of content-based reading.

Without access to print, they cannot acquire the knowledge that later learning presupposes. (13-4)

It is not by coincidence that Jacobs overtly refers to print in the passage above. Children require "dialogic reading," a form of conversational interaction between parent and child that a recent Vanderbilt University study found was impeded when parents and children read on tablets or e-readers (Guernsey). The use of tactile, physical books that Birkerts champions in *The Gutenberg*



*Elegies* forms the basis for the close reading that Hayles views as crucial to intellectual development in *How We Think*.

Secondly, K-12 administrators must revisit the importance of reading specialists as an integral component of their institutions' pedagogical infrastructure. Jacobs writes:

If the trend persists and we continue to transfer the responsibility for adolescent reading instruction (including for struggling readers) to content-area teachers, we need to understand that these teachers face a daunting task—especially if the ultimate goal is to create excellent classroom reading teachers. (22)

What good is the NMSI's commendable goal to expand the professional development opportunities for science and math teachers if 25% of their eighth graders can't read at a basic level? Early emphasis on literacy skills is important, but so is ancillary emphasis on reading skills. Specially trained educational professional can offer these services in the classroom, if an educational philosophy that stresses reading to learn can find funding for them.

The final concept is the necessity for America's educational collective to strive for educational balance. Research indicates that early education is so crucial to a child's intellectual development that an emphasis on dialogic reading, vocabulary accumulation, and syntactical reasoning is paramount in predicting future academic success. Primary educators should focus the great majority of their pedagogical energy on teaching students traditional reading competencies with physically printed texts. Occasional exposure to digital learning opportunities, including educational games and word processing programs, is important, but the day-to-day instruction of reading and writing should still take the form of repetitive, interactive, hands-on teaching and learning.

As students matriculate into the secondary ranks, both teaching digital literacy skills and providing *all* students with the tools necessary to implement those skills are crucial. This can be a daunting task for cash-strapped districts, but it's not impossible, nor is it unprecedented.

My wife is a school counselor at a large urban high school in Jacksonville, Florida. Sandalwood High School's student population reflects the general make-up of the city; it is racially and ethnically diverse, with wide gaps in the socioeconomic status of its students and their families. Access to digital technologies is marginal on school grounds, and many students have few economic or technological resources in the home. Sandalwood, like many schools in Duval County, struggles to meet state-imposed standards for reading based on the Florida Comprehensive Assessment Test (FCAT). In 2012, only 45% of tenth graders in Duval County could read at grade level ("Duval Reading...").

In an effort to reverse these trends, the district's new school superintendent, Nikolai Vitti, has made digital learning a focal point for all levels of K-12 education. In December of 2012, Vitti and the school board announced that Duval County had secured special bond funding that is backed by the Florida Department of Education. With access to zero-interest funding, Superintendent Vitti hopes to provide, within a period of two years, each of the district's 125,000 students with access to either an iPad or a laptop computer. In clarifying his rationale for greater technological integration, Vitti said that students "have become digital learners, and this technology will enhance their opportunities for success in a technology-driven world" ("Duval County Public...").

It's an important step in granting educational equality to all Duval County students, but the true measure of the move's success won't be known for years, as the earliest adopters of these digital technologies, the children now entering third and fourth grade in our local

elementary schools, make their way through the system. Our best hope is that the kids in that population embody the spirit of the pedagogical approach that Tufts professor Maryanne Wolfe presents in *How We Think*:

We must teach our children to be “bitextual” or “multitextual,” able to read and analyze texts flexibly in different ways, with more deliberate instruction at every stage of development on the inferential, demanding aspects of any text. Teaching children to uncover the invisible world that resides in written words needs to be both explicit and part of a dialogue between learner and teacher, if we are to promote the processes that lead to fully formed expert reading in our citizenry.

(75)

Paradigm shifts have deep and lasting consequences. In many cases, they render old technologies useless while new opportunities and technologies fill those voids. The rapid changes in our reading and writing spaces fully illustrate these concepts, from the necessity for adapting to new reading strategies to the creation of digital literacy curricula and specialists. And yet, for all of the cultural bluster about maintaining our status as a global innovator in the age of information, it is crucial that American educators acknowledge the value of the basic, foundational literacy skills that are best cultivated in the traditional, repetitive skills practice of interacting with print texts.

The future is coming, but when in human history has that ever not been the case? We shouldn't mythologize either the importance of a STEM education or the dominance of the digital environment. In order to meet the demands of the paradigm shifts that stand just beyond the horizon, it's important not to lose perspective on the importance of the technologies, such as

the book and our systems of communication, that have for centuries made those paradigms possible.

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