INTERNATIONAL LITERACY ASSOCIATION READING RESEARCH QUARTERLY

What Research Has Revealed About Readers' Struggles With Comprehension in the Digital Age: Moving Beyond the Phonics Versus Whole Language Debate

Patricia A. Alexander
University of Maryland, College Park, USA

ABSTRACT

The purpose of this article is to look anew at the concepts of reading, reading development, and reading research as they exist beyond the boundaries of the "science of reading" controversy. The context for this reconceptualization is reading in the digital age and the challenges that today's readers confront daily. Those challenges include information saturation, the proliferation of misleading and malicious online content, the struggle to use valid evidence to support claims, and the tendency to treat complex issues in an overly simplistic fashion. How these concerns pertain to the ongoing "science of reading" debate is also considered. The author concludes with an overview of three recommendations for addressing the challenges faced by readers in this digital age. If they are to be realized, these recommendations require the consolidated effort of reading researchers, reading educators, school leaders, parents, policymakers, and students themselves.

The argument that I set forth in this critique is that much of the rhetoric surrounding the science of reading has been predicated on an overly restrictive view of reading and reading development and what the science of reading encompasses. Further, it is my contention that this constrained view has resulted in a disregard for significant reading challenges that students are facing daily. These challenges extend well beyond the primary grades, learning to read, and phonics instruction. They exist at all grade levels, encompass reading acts occurring in and out of school, and affect even competent or mature readers and those who are struggling. What is also crucial to keep in mind is that these challenges, which I will describe, do not signify inherent problems in students. Rather, these challenges represent students' natural responses to the contexts in which they live and learn. Thus, without the knowledge and insights provided by reading researchers, without the effective and well-orchestrated instruction offered by teachers, and without support and reinforcement from parents, community leaders, and policymakers, these contemporary and mounting challenges will go unaddressed, leaving a generation of readers to suffer the consequences.

To justify the position that I take in this critique and as a step toward expanding the discourse surrounding the "science of reading" controversy,

INTERNATIONAL LITERACY ASSOCIATION

Reading Research Quarterly, 55(S1)
pp. S89–S97 | doi:10.1002/rrq.331

I am using the platform of this special issue of *Reading Research Quarterly* to do the following:

- Forward an alternative conceptualization of reading, reading development, and the science of reading than what currently populates the rhetoric on this contentious issue
- Draw on the relevant interdisciplinary research to document significant reading challenges that K–20 students are presently experiencing in this digital age
- Identify collaborative opportunities for reading researchers, teachers, school administrators, parents, community leaders, and policymakers to address these contemporary challenges to reading competence and reading development for all students

Reconceptualizing Reading, Reading Development, and the Science of Reading

The Nature of Reading

Trying to navigate the rhetoric surrounding the latest iteration of the reading wars led me to several realizations about the main concepts at the heart of the debate. For example, the controversy presently circulating in educational outlets (e.g., Goodwin, 2020), the popular press (Strauss, 2019), and social media (e.g., Loewus, 2019) speaks about reading and whether it should be taught by means of phonics or whole-word approaches. The reality is that reading does not begin or end with phonics or whole-word instruction (Seidenberg, 2013). It is far broader and more complex. Reading, broadly conceived, is any interaction between a person—be it a child, adolescent, or adult—and written language (Pearson & Cervetti, 2013). That interaction can involve written language at many levels, from words and sentences, to paragraphs, to entire volumes (Shanahan, 2019). Also, reading can be performed for many reasons, from purely personal to largely academic, and in many contexts, both in and out of school, as well as online or in print (Ito et al., 2013; Singer & Alexander, 2017).

This reconceptualization of reading also requires some adjustment in what qualifies as text. Certainly, texts still encompass many well-known, traditional forms, such as works of fiction, exposition, folk tales, picture books, biography, and poetry. Yet, for today's students, fondly referred to as the iGeneration or iGens (Twenge, 2017), many nontraditional, nonacademic, and ever-evolving forms of text are part of their reading experiences. Those alternative texts commonly found online and in social media include text messages, tweets, blogs, websites, memes, and podcasts.

Reading Development

Although I appreciate that some engaged in the ongoing "science of reading" debate have attempted to expand discussion beyond the simple issue of phonics versus whole-word instruction (Shanahan, 2019; Willingham, 2017), nonetheless, the narrow conception of reading aligned to the "science of reading" controversy has also contributed to a myopic view of reading development. Specifically, from the tenor of the interactions found in the popular press and social media, there is the distinct impression that reading development begins when very young children first realize that linguistic symbols convey meaning and that those symbols are associated with certain sounds, making them pronounceable. Then, development is thought to end when children can process a fair amount of text fluently and with understanding.

The problem with that too familiar conceptualization is that it captures only some portion of the initial phase of a lifelong developmental process (Alexander, 2005). There are certainly critical neurophysiological factors involved in reading that take form in vitro, long before any informal or formal reading instruction can occur (Gabrieli, Christodoulou, O'Loughlin, & Eddy, 2010; Wolf, 2008). That is not to imply that reading development can be charted solely or even primarily on the basis of structural or functional characteristics of the brain or body. Reading is as much, if not more, a social and cultural phenomenon as a neurophysiological one (Gutiérrez, 2008; Ito et al., 2013; Leu et al., 2015).

What must also be understood is that reading development does not end in third, sixth, or even 10th grade (Alexander, 2005). Quite to the contrary, it is still ongoing among the undergraduate and graduate students I teach. As an older adult, I am still learning to read in that I am still building word knowledge, adapting to the new forms of texts, and devising strategies for coping with declining visual acuity. The bottom line is that as long as there are increasingly more complex or novel forms of text to be read, as long as the text-based tasks to be performed grow more difficult, and as long as the demands on readers' time, attention, and physical capabilities expand, making it harder and harder for them to perform competently or to stay motivated and self-regulated, then reading development continues.

The Science of Reading

Finally, let me turn to the very concept around which this special issue of *Reading Research Quarterly* is framed: the science of reading. As someone who has been conducting empirical studies of reading for 40 years, I see the science of reading as contributing to a vast interdisciplinary store of critical information about reading-related skills, processes, antecedents, and outcomes, representing linguistic, cognitive, social, cultural,

neurological, and psychological dimensions. Thus, to see the phrase "science of reading" used in such a limited and pejorative manner is bewildering. Regardless of what may appear in the cybersphere, the science of reading is not "code for intensive phonics" (Thomas, 2019, para. 14), except perhaps for those who are intentionally or unintentionally using this phrase to fan the flames of this contentious debate. In fact, the very challenges of reading in this digital age that I will highlight have come to light as a result of scientific and interdisciplinary reading studies. So described, it is essential to understand that it is not the science of reading that is the problem. Rather, it is the misrepresentation and even weaponization of that term to serve some personal, pedagogical, or political agenda.

Reading Challenges in the Digital Age

When I first conceived of this contribution to this special issue on the science of reading, my intention was to widen the vista on the ongoing dispute. Specifically, I wanted to call attention to various reading challenges that students now occupying K–20 classrooms are confronting daily. I organized these challenges, along with the insights garnered from recent research, into three general areas that relate to information saturation, information seeking, and information communication and justification. Before I overview these three areas, however, let me first forward an important caveat. What I present here is but the tip of the iceberg. I intend to touch on only a small segment of the vast body of research and the associated literacy concerns that have grown exponentially over the past 20 years. The full scope of that literature is far too complex to be covered in this brief commentary. For those who wish to pursue the subject of digital reading or digital literacy further, there are excellent overviews (e.g., Coiro, 2020; Goldman et al., 2016) and entire volumes (Braasch, Bråten, & McCrudden, 2018; McKenna, Labbo, Kieffer, & Reinking, 2013; Van Meter, List, Lombardi, & Kendeou, 2020) that would be invaluable resources.

Information Saturation

The expression "too much of a good thing" accurately captures the world in which students currently live and learn. They are truly inundated with information from a multitude of sources 24-7 (Pew Research Center, 2019). Paradoxically, even though students are drowning in information, they almost obsessively crave more, and they want that information delivered at lightning speed to their digital devices, which are invariably near at hand, if not in hand (Perrin & Kumar, 2019). Moreover, although these iGens appear hungry for the latest information, they prefer it to come in the form of short pithy texts such as memes and tweets. Indeed, many find reading more extended texts, such as textbook chapters, downright painful (Twenge, Martin, & Spitzberg, 2019). Why read a newspaper article, for instance, when you can get news flashes on your phone or computer? These students also engage in multitasking, which permits them to attempt several tasks at once but to the detriment of comprehension and overall performance quality (Foehr, 2006; E. Wood et al., 2012). Similarly, iGens' frequent use of shorthand in text messages has come to invade their academic writing (C. Wood, Kemp, Waldron, & Hart, 2014). It also appears that elementary, high school, and college students' ability to engage in quality discussions is suffering and can benefit significantly from direct intervention (Murphy et al., 2018).

In addition, there is evidence that students' attention spans and their perceptiveness (i.e., awareness of what is occurring in real time around them) is suffering (Graber, 2014; Richtel, 2010). Another noticeable corollary of this new age of information saturation is an orientation toward information management over knowledge building in academic contexts (Alexander, 2018). By that, I mean that today's students are less likely to engage with school texts for the purpose of retaining what they have learned in perpetuity. Instead, students more often report a goal of remembering content just long enough to complete assignments, pass tests, or get good grades. Once those goals are met, the content can be purged from memory.

Another interesting pattern documented across multiple studies is that undergraduate students overwhelmingly prefer to read texts digitally as opposed to in print (Singer & Alexander, 2017), in what Coiro (2020) referred to as digital spaces. The students also report that their performance on a comprehension test taken immediately after reading is better under the digital than print condition. Perhaps that sounds logical given that these iGens have come to see themselves as digital natives (Prensky, 2001). Surprisingly, what we have consistently found is that these undergraduates' comprehension was significantly better when they read in print rather than on a computer (Singer & Alexander, 2017). Others have reported similar outcomes for elementary students, as well (Støle, Mangen, & Schwippert, 2020). Why students are so poorly calibrated remains perplexing. One clue to this puzzlement may be that the students in our studies (Singer Trakhman, Alexander, & Berkowitz, 2019) read significantly faster digitally than in print. In effect, although there is generally a speed–accuracy tradeoff in performance (Wickelgren, 1977), the students may have mistakenly equated faster processing with higher proficiency.

Information Seeking

Another familiar instructional activity for students is conducting online information searches. Although information searches have long been a staple in teachers' repertoire, the current conditions have complicated this process for students in multiple ways. Those complicating conditions include a universe of digital sources at students' fingertips that can contain content authored by any person regardless of expertise or aims (Goodwin, 2020). Further, online information sources cover the spectrum in terms of their forms (e.g., websites, blogs, news articles, research articles) and their credibility (Bråten, Strømsø, & Salmerón, 2011; Coiro, 2020; Coiro, Coscarelli, Maykel, & Forzani, 2015). There is also a surprising amount of online content that is either unintentionally misleading or purposefully deceptive, which can make the information search process a precarious undertaking (Sinatra & Lombardi, 2020).

Researchers who investigate online search behaviors have repeatedly reported that students often engage in case building, overrely on search engines to guide their text choices, seem unable to distinguish between more and less credible sources, and struggle with synthesizing and integrating content across texts (Bråten et al., 2011; List & Alexander, 2017). Case building means that those who initiate an information search around a controversial topic, such as the science of reading, either consciously or unconsciously select sources that reflect their preexisting beliefs, biases, or prejudices (List, Grossnickle, & Alexander, 2016). Thus, instead of using the search as an opportunity to investigate a specific topic with a critical-analytic eye, the process becomes an exercise in supporting and even strengthening one's existing views.

What literacy researchers have also found is that even mature and fluent readers' bases for selecting online sources leave much to be desired (Coiro et al., 2015). For instance, students at every academic level appear overly reliant on Google or other search engines to determine their source selections (List et al., 2016). This is evidenced by the fact that students often opt for the first sources that pop up on the search page and rarely bother to look at offerings on page 2 or beyond. Perhaps these behaviors are indicative of some misguided notion that search engines list sources in terms of their relevance or credibility. In actuality, the algorithms that search engines use to build lists of sources are well-guarded secrets and likely involve factors unrelated to credibility. Also, when asked how they select their sources, students' criteria have included nonepistemic factors such as the length of the text or the catchiness of titles (Grossnickle Peterson & Alexander, 2020).

Information Communication and Justification

One unwanted behavior that occurs not only in undergraduates but also in younger and older populations is a tendency to communicate complex, multifaceted, and often contentious issues in overly simplistic, black-or-white terms. This orientation leaves no room for any grays, the nuanced or nonextreme iterations that invariably lie between opposing positions. The resulting misrepresentation is referred to as a false dichotomy (Gehlbach & Roeser, 2002). Contrasts such as good or poor, effective or ineffective, and appropriate or inappropriate may sound clean and simple on the surface, but they belie the true complexity of whatever is being evaluated. Literacy researchers have documented such false dichotomies in written arguments that students generated after completing online searches about controversial topics such as the death penalty, corporal punishment, and vaccinations (Bråten et al., 2011). Students' written arguments more commonly took a strong pro or con stance on the issue and rarely voiced a more nuanced position (Barzilai & Weinstock, 2020). The students' actions may reflect their perception of argumentation more as convincing others that their position is the only right or just one. However, this process only serves to reinforce false dichotomies.

It is interesting to note that this problem of dealing with contentious issues in black-or-white terms is what I encountered in the rhetoric surrounding the "science of reading" controversy (Hanford, 2019). I found certain writings rather polemic, where one side, be it phonics or whole language, was characterized favorably and the other described in unflattering terms. This remains the case even though there is ample evidence that few individuals are purists in their instructional approach but instead modulate their teaching depending on an array of learner, text, and contextual factors (Moats, 2019). Of course, positioning oneself in the grays requires the ability to ascertain when, where, or for whom instruction should intentionally lean toward one side of the issue or the other (Pearson, 2004).

Other challenges manifest for today's students when they attempt to consolidate information from various sources into a coherent and well-supported piece of exposition or argument (McNamara, Crossley, & McCarthy, 2010). One problem for students in this consolidation process is determining what content is important and relevant enough to be included in the final document (Alexander & Disciplined Reading and Learning Research Laboratory [DRLRL], 2012). Also, when addressing a contentious topic, students do not routinely incorporate counterpoints or strong arguments on the other side of the issue from their own (Singh, Sun, & Zhao, 2019). Moreover, I was honestly surprised to find that the high-achieving students, like those in my university class, had little awareness of what it meant to justify whatever claims they made verbally or in writing (Alexander & DRLRL, 2020). They also did not appreciate that their experiences did not constitute good enough evidence for certain kinds of claims (Mason, Boldrin, & Ariasi, 2010). As Aristotle

(2018) proclaimed in *Rhetoric*, the pathos that such human-interest stories generate can be powerful tools of persuasion. Yet, the astute readers and listeners recognize that more compelling forms of evidence are warranted before arguments are accepted.

What is also apparent is that even skilled adult readers can find themselves swayed by pathos and can find it difficult to justify claims with viable text-based evidence (Alexander & DRLRL, 2012). The reliance on personal experiences over solid research evidence is sadly far too common and not just in students' writings. If one looks at some of the writings populating social media on the science of reading, you will encounter such personal stories used in support of one side of the phonics or whole language debate or the other. As Goodwin (2020) rightly observed, the voices of this controversy are more often bloggers, journalists, parents, or teachers sharing their personal experiences on both sides of this debate. In contrast, as Goodwin noted, members of the reading research community had appeared less willing to enter into the public discourse pertaining to the science of reading. This is the case even for those whose work could serve as viable counterpoints to some of the weakly evidenced proclamations that have been communicated via social media, where credibility seems more dependent on the number of retweets, likes, or followers than on the quality of the empirical data gathered.

Where Do We Go From Here?

As I stated at the outset of this article, I contend that it is imperative to expand the conception of reading that populates current discourse on the "science of reading" debate. It is also critical to recognize that reading development carries well beyond the primary grades and long after young learners have broken the linguistic code. Moreover, concerned parties cannot turn a blind eye to the serious challenges that today's students face on a daily basis—challenges that call for interdisciplinary inquiry and meaningful collaborations among teachers, researchers, parents, and policymakers. I briefly overviewed several reading challenges that can be ascribed, in part, to this digital age in which we live. The good news is that those potential barriers that I described regarding information saturation, information seeking, and information communication and justification are by no means insurmountable obstacles to optimal reading development for all students.

In fact, there is much that researchers, teachers, school administrators, parents, policymakers, and students themselves can do to maximize the literacy benefits accrued from the multitude of online and offline technologies that exist both in and out of school. Here, I offer a few instructional guidelines shown to be effective in dealing with the challenges of reading in the digital age.

- Draw on students' personal interests and experiences as the foundation for instruction.
- Guide students to use smart technologies in smart ways.
- Foster student interactions and collaborations around meaningful problems using diverse text mediums and genres.

Draw on Students' Personal Interests and Experiences

One principle that has been demonstrated in the research for more than a century is that personal interest can be a powerful, driving force in what students learn and what they do (Alexander, 2005; Dewey, 1903, 1913). When students are truly invested in the content or processes being taught, they learn more easily, acquire a deeper and richer understanding, and retain the knowledge longer than when they perceive the content as abstract, esoteric, or unrelated to their lives or personal identities (Hidi, 2001; Moje & Luke, 2009). That principle was repeatedly illustrated in informative case studies of effective learning environments that Ito et al. (2013) compiled in their *Connected Learning: An Agenda for Research and Design* report.

The instructional implication of this principle is that teachers must help students recognize their personal connection to the texts being read or the activities in which they are embedded (Hattan, 2019; Moje & Luke, 2009). In effect, educators need to attend to elements of a poem, story, or subject matter text that are potentially relevant to students, reflect their interests, or mirror experiences in their own lives. This principle should not be misconstrued to mean that teachers should dress up the content to make it more enticing or palpable to students. Such momentary piquing of interest, called situational interest, can be detrimental to deeper and more enduring learning (Schiefele, 1999). As Dewey (1913) warned, such an approach "implies the same divorce between object and self. When things have to be *made* interesting, it is because interest itself is wanting" (p. 11).

Guide Students Toward the Smart Use of Smart Technologies

I do not want to leave the impression that digital technologies are inherently the enemies of reading or reading development. That is by no means the case. Technology is an integral part of the networked lives that we live (Leu et al., 2015). Moreover, today's technologies are equipped with an array of tools not available in the print-only world that can facilitate students' reading and learning from texts, including apps for annotation and translation,

digital glossaries, and tools for collaborating (Dalton & Palincsar, 2013). My objections pertain to the mindless, unregulated, and passive use of such technological tools both in and out of school (Alexander, 2018). Mindful use of technology is not solely an issue for students, however (Forzani, 2018). Teachers, too, should be cognizant of when and why to employ technologies during reading instruction or when content-based instruction involves text. Parents can assist in this regard, as well, by creating guidelines on when, where, and for how long their children are online (Alexander & Singer Trakhman, 2017).

Moreover, teachers should help students acquire strategies for engaging with digital texts in a manner that fosters rather than thwarts their comprehension (Alexander & DRLRL, 2012; Cho & Afflerbach, 2015). Strategies that have been found to be effective include reading digital texts more slowly, periodically stopping to reflect on or ask questions about what was read, annotating digital texts, or writing down key points or questions on paper (Cho & Afflerbach, 2017; Singer Trakhman, 2019). It may seem ridiculous to teach students who have grown up with digital technologies how to engage them more effectively, but in actuality, students are not always the savvy digital natives we think them to be (Coiro, 2012; Forzani, 2018; Ng, 2012). It is true that students have a wealth of knowledge about maneuvering in hyperspace and about the latest tech features and apps, but they still require instruction that focuses on locating, evaluating, synthesizing, integrating, and communicating digital information (Bråten et al., 2011; Leu et al., 2015). They also need help to recognize biased, inaccurate, and prejudicial sources written to mislead them (Sinatra & Lombardi, 2020).

Foster Interactions and Collaborations With Diverse Texts and Meaningful Activities

Finally, one of the advantages of living in this digital age is the wealth of written language that is literally at our fingertips. Entire libraries of texts exist for almost any subject one may wish to explore. Further, those texts are not limited to the standard canon to which many adults were exposed (Moje & Luke, 2009). Instead, they cover the spectrum in terms of time, domain, culture, mediums, and genre. Students should be able to locate appropriate texts to match whatever interests or purposes they have for reading. This diversity of texts can be individually read and relished for entirely personal reasons or can become part of collaborative learning activities carried out in and out of school (Ito et al., 2013). Such freedom allows students to identify with the people, places, and experiences described in texts. It allows students to explore cultures other than their own and other times and places than those they know more intimately. Such breadth and diversity of texts can empower students to acquire information needed to tackle complex or controversial issues and real-world problems of importance to them or their communities (Jeong, & Hmelo-Silver, 2010).

When the universe of relevant and appropriate texts is made available to students, under the guidance and with the support of teachers and parents, the motivation to engage with written language can grow (Wigfield, Gladstone, & Turci, 2016). In addition, students demonstrate more commitment to building knowledge than to simply managing information to get by or to do only what is required (Alexander, 2018). There can be more personal value placed on reading and more emotional investment in the knowledge and abilities gained from reading (Stutz, Schaffner, & Schiefele, 2016). In effect, the connected learning that Ito et al. (2013) described not only pertains to shared literacy experiences among students but also can manifest between parents and their children or as a private and deeply personal experience between reader and text.

Concluding Thoughts

What I have set out to accomplish in this critique is to reorient the current controversy over the science of reading by broadening the conceptions of reading, reading development, and the science of reading that presently dominate that debate. I have drawn on reading research from multiple disciplines to make the case that reading is an expansive activity that occurs whenever a person and written language interact. I have also sought to widen the parameters regarding what constitutes texts within this digital age. Further, I have argued for a conception of reading development that extends far beyond the primary grades and the initial stages of learning to read. This alternative view conveys reading development as a lifelong process of growth and transformation. Finally, I set out to demonstrate that an overly constrained perception of reading and reading development comes with serious consequences, including a disregard of challenges faced by students living and learning in this digital age. The scientific study of reading in its many manifestations has been crucial in bringing such challenges to light and in offering guidance for addressing them, too. I shared several recommendations found to circumvent or ameliorate such challenges for younger and older students representing a diversity of interests and backgrounds.

What conceptions of reading, reading development, and the science of reading emerge in the decades to come I cannot say. However, what remains clear is that students, then as now, cannot be expected to deal with those reading-related challenges without the insights garnered from the research, without the instructional guidance and support of knowledgeable teachers, and without the

assistance of informed and concerned parents. Further, all concerned parties must be willing to let go of past conceptions of reading and reading development if the goal is the preparation of students with the competencies and motivation needed to succeed in today's world and the world of tomorrow. As Dewey (1944) so rightly cautioned, "if we teach today's students as we taught yesterday's, we rob them of tomorrow" (p. 167).

REFERENCES

Alexander, P.A. (2005). The path to competence: A lifespan developmental perspective on reading. *Journal of Literacy Research*, *37*(4), 413–436. https://doi.org/10.1207/s15548430jlr3704_1

Alexander, P.A. (2018). Information management versus knowledge building: Implications for learning and assessment in higher education. In O. Zlatkin-Troitschanskaia, M. Toepper, H.A. Pant, C. Lautenbach, & C. Kuhn (Eds.), *Assessment of learning outcomes in higher education: Cross-national comparisons and perspectives* (pp. 43–56). Cham, Switzerland: Springer.

Alexander, P.A., & Disciplined Reading and Learning Research Laboratory (2012). Reading into the future: Competence for the 21st century. *Educational Psychologist*, *47*(4), 259–280. https://doi.org/10.1080/00461520.2012.722511

Alexander, P.A., & Disciplined Reading and Learning Research Laboratory (2020). Relational reasoning: The bedrock of integration within and across multiple representations, documents, and perspectives. In P. Van Meter, A. List, D. Lombardi, & P. Kendeou (Eds.), *Handbook of learning from multiple representations and perspectives* (pp. 401–424). New York, NY: Routledge.

Alexander, P.A., & Singer Trakhman, L.M. (2017). The enduring power of print for learning in a digital world. *The Conversation*. Retrieved from https://theconversation.com/the-enduring-power-of-print-for-learning-in-a-digital-world-84352

Aristotle. (2018). *Rhetoric* (W.R. Roberts, Trans.). Hollywood, FL: Simon & Brown.

Barzilai, S., & Weinstock, M. (2020). Beyond trustworthiness: Comprehending multiple source perspectives. In P. Van Meter, A. List, D. Lombardi, & P. Kendeou (Eds.), *Handbook of learning from multiple representations and perspectives* (pp. 123–140). New York, NY: Routledge.

Braasch, J.L.G., I. Bråten, & M.T. McCrudden (Eds.). (2018). *Handbook of multiple source use*. New York, NY: Routledge.

Bråten, I., Strømsø, H.I., & Salmerón, L. (2011). Trust and mistrust when students read multiple information sources about climate change. *Learning and Instruction*, *21*(2), 180–192. https://doi.org/10.1016/j.learninstruc.2010.02.002

Cho, B.-Y., & Afflerbach, P. (2015). Reading on the internet: Realizing and constructing potential texts. *Journal of Adolescent & Adult Literacy*, *58*(6), 504–517. https://doi.org/10.1002/jaal.387

Cho, B.-Y., & Afflerbach, P. (2017). An evolving perspective of constructively responsive reading comprehension strategies in multilayered digital text environments. In S.E. Israel (Ed.), *Handbook of research on reading comprehension* (pp. 109–134). New York, NY: Guilford.

Coiro, J. (2012). Understanding dispositions toward reading on the internet. *Journal of Adolescent & Adult Literacy*, *55*(7), 645–648. https://doi.org/10.1002/JAAL.00077

Coiro, J. (2020). Toward a multifaceted heuristic of digital reading to inform assessment, research, practice, and policy. *Reading Research Quarterly*. Advance online publication. https://doi.org/10.1002/rrq.302

Coiro, J., Coscarelli, C., Maykel, C., & Forzani, E. (2015). Investigating criteria that seventh graders use to evaluate the quality of online information. *Journal of Adolescent & Adult Literacy*, *59*(3), 287–297. https://doi.org/10.1002/jaal.448

Dalton, B., & Palincsar, A.S. (2013). Investigating text–reader interactions in the context of supported etext. In R. Azevedo & V. Aleven (Eds.), *International handbook of metacognition and learning technologies* (pp. 533–544). New York, NY: Springer.

Dewey, J. (1903). *Interest as related to will*. Chicago, IL: University of Chicago Press.

Dewey, J. (1913). *Interest and effort in education*. Cambridge, MA: Riverside.

Dewey, J. (1944). *Democracy and education*. New York, NY: Macmillan.

Foehr, U.G. (2006). *Media multitasking among American youth: Prevalence, predictors and pairings*. Menlo Park, CA: Henry J. Kaiser Family Foundation.

Forzani, E. (2018). How well can students evaluate online science information? Contributions of prior knowledge, gender, socioeconomic status, and offline reading ability. *Reading Research Quarterly*, *53*(4), 385–390. https://doi.org/10.1002/rrq.218

Gabrieli, J., Christodoulou, J.A., O'Loughlin, T., & Eddy, M.D. (2010). The reading brain. In D.A. Sousa (Ed.), *Mind, brain, and education: Neuroscience implications for the classroom* (pp. 113–137). Bloomington, IN: Solution Tree.

Gehlbach, H., & Roeser, R.W. (2002). The middle way to motivating middle school students: Avoiding false dichotomies. *Middle School Journal*, *33*(3), 39–46. https://doi.org/10.1080/00940771.2002.11494673

Goldman, S.R., Britt, M.A., Brown, W., Cribb, G., George, M., Greenleaf, C., … Project READI (2016). Disciplinary literacies and learning to read for understanding: A conceptual framework for disciplinary literacy. *Educational Psychologist*, *51*(2), 219–246. https://doi.org/10.1080/00461520.2016.1168741

Goodwin, A. (2020). The role of research: The speed, source, and scale of science in the science of reading debate. *Literacy Today*, *37*(5), 14–15.

Graber, D. (2014, April 30). Kids, tech and those shrinking attention spans [Web log post]. Retrieved from https://www.huffpost.com/entry/kids-tech-and-those-shrinking-attention-spans_b_4870655

Grossnickle Peterson, E., & Alexander, P.A. (2020). Navigating print and digital sources: Students' selection, use, and integration of multiple sources across mediums. *The Journal of Experimental Education*, *88*(1), 27–46. https://doi.org/10.1080/00220973.2018.1496058

Gutiérrez, K.D. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, *43*(2), 148–164. https://doi.org/10.1598/RRQ.43.2.3

Hanford, E. (2019). At a loss for words: How a flawed idea is teaching millions of kids to be poor readers. *APM Reports*. Retrieved from https://www.apmreports.org/episode/2019/08/22/whats-wrong-how-schools-teach-reading

Hattan, C. (2019). Prompting rural students' use of background knowledge and experience to support comprehension of unfamiliar content. *Reading Research Quarterly*, *54*(4), 451–455. https://doi.org/10.1002/rrq.270

Hidi, S. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Educational Psychology Review*, *13*(3), 191–209. https://doi.org/10.1023/A:1016667621114

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., … Watkins, S.C. (2013). *Connected learning: An agenda for research and design*. Irvine, CA: Digital Media and Learning Research Hub.

Jeong, H., & Hmelo-Silver, C.E. (2010). Productive use of learning resources in an online problem-based learning environment. *Computers in Human Behavior*, *26*(1), 84–99. https://doi.org/10.1016/j.chb.2009.08.001

Leu, D.J., Forzani, E., Rhoads, C., Maykel, C., Kennedy, C., & Timbrell, N. (2015). The new literacies of online research and comprehension: Rethinking the reading achievement gap. *Reading Research Quarterly*, *50*(1), 37–59. https://doi.org/10.1002/rrq.85

List, A., & Alexander, P.A. (2017). Cognitive affective engagement model of multiple source use. *Educational Psychologist*, *52*(3), 182–199. https://doi.org/10.1080/00461520.2017.1329014

List, A., Grossnickle, E.M., & Alexander, P.A. (2016). Undergraduate students' justifications for source selection in a digital academic context. *Journal of Educational Computing Research*, *54*(1), 22–61. https://doi.org/10.1177/0735633115606659

Loewus, L. (2019, May 12). What teachers should know about the science of reading (video and transcript) [Web log post]. Retrieved from https://blogs.edweek.org/teachers/teaching_now/2019/03/what_teachers_should_know_about_the_science_of_reading_video_and_transcript.html

Mason, L., Boldrin, A., & Ariasi, N. (2010). Epistemic metacognition in context: Evaluating and learning online information. *Metacognition and Learning*, *5*(1), 67–90. https://doi.org/10.1007/s11409-009-9048-2

McKenna, M.C., L.D. Labbo, R.D. Kieffer, & D. Reinking (Eds.) (2013). *International handbook of literacy and technology* (Vol. 2). New York, NY: Routledge.

McNamara, D.S., Crossley, S.A., & McCarthy, P.M. (2010). Linguistic features of writing quality. *Written Communication*, *27*(1), 57–86. https://doi.org/10.1177/0741088309351547

Moats, L. (2019, October 16). Of 'hard words' and straw men: Let's understand what reading science is really about [Web log post]. Retrieved from https://www.voyagersopris.com/blog/edview360/2019/10/16/lets-understand-what-reading-science-is-really-about

Moje, E.B., & Luke, A. (2009). Literacy and identity: Examining the metaphors in history and contemporary research. *Reading Research Quarterly*, *44*(4), 415–437. https://doi.org/10.1598/RRQ.44.4.7

Murphy, P.K., Greene, J.A., Firetto, C.M., Hendrick, B.D., Li, M., Montalbano, C., & Wei, L. (2018). Quality talk: Developing students' discourse to promote high-level comprehension. *American Educational Research Journal*, *55*(5), 1113–1160. https://doi.org/10.3102/0002831218771303

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, *59*(3), 1065–1078. https://doi.org/10.1016/j.compedu.2012.04.016

Pearson, P.D. (2004). The reading wars. *Educational Policy*, *18*(1), 216–252. https://doi.org/10.1177/0895904803260041

Pearson, P.D., & Cervetti, G. (2013). The psychology and pedagogy of reading processes. In W.M. Reynolds & G.E. Miller (Eds.), *Handbook of psychology: Vol. 7. Educational psychology* (2nd ed., pp. 257–281). New York, NY: John Wiley & Sons.

Perrin, A., & Kumar, M. (2019, July 25). About three-in-ten U.S. adults say they are 'almost constantly' online. *Fact Tank*. Retrieved from https://www.pewresearch.org/fact-tank/2019/07/25/americans-going-online-almost-constantly/

Pew Research Center. (2019, June 12). *Internet/broadband fact sheet*. Retrieved from https://www.pewresearch.org/internet/fact-sheet/internet-broadband/

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon*, *9*(5), 1–6. https://doi.org/10.1108/10748120110424816

Richtel, M. (2010, November 21). Growing up digital, wired for distraction. *The New York Times*. Retrieved from https://www.nytimes.com/2010/11/21/technology/21brain.html

Schiefele, U. (1999). Interest and learning from text. *Scientific Studies of Reading*, *3*(3), 257–279. https://doi.org/10.1207/s1532799xssr0303_4

Seidenberg, M.S. (2013). The science of reading and its educational implications. *Language Learning and Development*, *9*(4), 331–360. https://doi.org/10.1080/15475441.2013.812017

Shanahan, T. (2019, May 25). What is the science of reading? [Web log post]. Retrieved from https://shanahanonliteracy.com/blog/what-is-the-science-of-reading

Sinatra, G.M., & Lombardi, D. (2020). Evaluating sources of scientific evidence and claims in the post-truth era may require reappraising plausibility judgments. *Educational Psychologist*. Advance online publication. https://doi.org/10.1080/00461520.2020.1730181

Singer, L.M., & Alexander, P.A. (2017). Reading across mediums: Effects of reading digital and print texts on comprehension and calibration. *The Journal of Experimental Education*, *85*(1), 155–172. https://doi.org/10.1080/00220973.2016.1143794

Singer Trakhman, L.M. (2019). *Reading in print and digitally: profiling and intervening in undergraduates' multimodal text processing, comprehension, and calibration*. Dissertation Abstracts. College Park, MD: University of Maryland. https://doi.org/10.13016/msqn-60er

Singer Trakhman, L.M., Alexander, P.A., & Berkowitz, L.E. (2019). Effects of processing time on comprehension and calibration in print and digital mediums. *The Journal of Experimental Education*, *87*(1), 101–115. https://doi.org/10.1080/00220973.2017.1411877

Singh, A., Sun, Y., & Zhao, H. (2019, April). *Defining and assessing integration in the context of argumentative essays based on multiple sources*. Symposium presented at the annual meeting of the American Educational Research Association, Toronto, ON, Canada.

Støle, H., Mangen, A., & Schwippert, K. (2020). Assessing children's reading comprehension on paper and screen: A mode-effect study. *Computers & Education*, *151*, article 103861. https://doi.org/10.1016/j.compedu.2020.103861

Strauss, V. (2019). March 27). A case for why both sides in the 'reading wars' debate are wrong—and a proposed solution. *The Washington Post*. https://www.washingtonpost.com/education/2019/03/27/case-why-both-sides-reading-wars-debate-are-wrong-proposed-solution/

Stutz, F., Schaffner, E., & Schiefele, U. (2016). Relations among reading motivation, reading amount, and reading comprehension in the early elementary grades. *Learning and Individual Differences*, *45*, 101–113. https://doi.org/10.1016/j.lindif.2015.11.022

Thomas, P.L. (2019, February 14). *The big lie about the "science of reading" (updated)*. Retrieved from https://radicalscholarship.wordpress.com/2019/02/14/the-big-lie-about-the-science-of-reading/

Twenge, J.M. (2017). *iGen: Why today's super-connected kids are growing up less rebellious, more tolerant, less happy—and completely unprepared for adulthood—and what that means for the rest of us*. New York, NY: Atria.

Twenge, J.M., Martin, G.N., & Spitzberg, B.H. (2019). Trends in U.S. adolescents' media use, 1976–2016: The rise of digital media, the decline of TV, and the (near) demise of print. *Psychology of Popular Media Culture*, *8*(4), 329–345. https://doi.org/10.1037/ppm0000203

Van Meter, P., A. List, D. Lombardi, & P. Kendeou (Eds.). (2020). *Handbook of learning from multiple representations and perspectives*. New York, NY: Routledge.

Wickelgren, W.A. (1977). Speed-accuracy tradeoff and information processing dynamics. *Acta Psychologica*, *41*(1), 67–85. https://doi.org/10.1016/0001-6918(77)90012-9

Wigfield, A., Gladstone, J.R., & Turci, L. (2016). Beyond cognition: Reading motivation and reading comprehension. *Child Development Perspectives*, *10*(3), 190–195. https://doi.org/10.1111/cdep.12184

Willingham, D.T. (2017, November 25). How to get your mind to read. *The New York Times*. Retrieved from https://www.nytimes.com/2017/11/25/opinion/sunday/how-to-get-your-mind-to-read.html

Wolf, M. (2008). *Proust and the squid: The story and science of the reading brain*. New York, NY: Harper Perennial.

Wood, C., Kemp, N., Waldron, S., & Hart, L. (2014). Grammatical understanding, literacy and text messaging in school children and undergraduate students: A concurrent analysis. *Computers & Education*, *70*, 281–290. https://doi.org/10.1016/j.compedu.2013.09.003

Wood, E., Zivcakova, L., Gentile, P., Archer, K., De Pasquale, D., & Nosko, A. (2012). Examining the impact of off-task multi-tasking with technology on real-time classroom learning. *Computers & Education*, *58*(1), 365–374. https://doi.org/10.1016/j.compedu.2011.08.029

Submitted April 8, 2020
Final revision received June 23, 2020
Accepted June 23, 2020

PATRICIA A. ALEXANDER is a Distinguished University Professor and the Jean Mullan Professor of Literacy in the Department of Human Development and Quantitative Methodology and the director of the Disciplined Reading and Learning Research Laboratory at the University of Maryland, College Park, USA; email palexand@umd.edu. Her research interests include reading comprehension, learning from text, multimodal and multitext processing, epistemic beliefs, and academic development.