Follow the Reader: E-Book Readers as Tools for Increasing Reading Comprehension

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Abstract

In the United States, an astonishing 83% of low-income students in the fourth grade cannot read up to proficiency. At the same time, a rise in digital technology—a luxury the aforementioned students cannot afford—is seen as a means for reducing reading level discrepancies. The e-reader, a portable electronic reading device, is one of the latest tools to approach the problem. To answer the question of whether or not e-readers should be used for enhancing reading, I explore a number of areas including: how to measure reading comprehension and how e-readers can help facilitate the process; the history of computers and e-readers; the benefits and disadvantages of the device; the effects of a tactile reading experience; and the impact on technology for learners. After examining all of these facets, I conclude that we do have the technological capability to improve reading comprehension for students by the time they reach the fourth grade. However, without an adequate understanding of how to best implement them for both student and teacher uses, we can expect to see the same results no matter how many new technological devices arise.
Last year, Amazon released a Kindle ad called “The Book Lives On.” It presents young adults using the Kindle in a variety of settings, showing off its features and slyly alluding to the glare the iPad creates while highlighting the Kindle’s e-ink. The ad showcases a world of digital readers as the standard format for reading and emphasizes the increase in e-books, as opposed to print books. In fact, Mark Hachman of PCMag, reports that Amazon sold more e-books than paperback books; in 2010, for every 100 paperback books sold, Amazon sold 115 Kindle e-books. Most interesting is that the tag line at the end of the ad, “The Book Lives On,” which implies that the physical book died at some point and that the Kindle is somehow saving the book industry.

The book may not be dead, but the rise of technology, and certainly e-books, allows us to interact with text in new ways. In turn, the school system must react to the technological advances in a way that benefits the students. Ralph Smith, executive vice president of the Annie E. Casey Foundation, argues that the end of third grade is a critical point in intellectual development (Paulson). He goes to say that in fourth grade, school curriculums require a higher level of analysis and comprehension; they will encounter more sophisticated writing in different subject areas, including word problems in math. Furthermore, the article quotes numbers from the National Assessment of Educational Progress (NAEP), claiming that 83% of low-income fourth-graders taking the NAEP cannot attain reading proficiency. Jeanne Chall and Vicki Jacobs (2003) surmise that low-income students struggle with lack of fluency and automaticity—the quick and accurate recognition of words and phrases—because the vocabulary is less familiar to them. This results in children reading less, avoiding difficult materials, and ultimately, falling behind in literacy development.
This is a call to action across the nation to bring all students up to reading proficiency. One way of tackling the situation is through integration of new technology. The International Reading Association (Leu, 2000) stresses the importance of integrating information and communication technologies with current literacy programs.

In this paper, I examine the merge of reading with technology, but more specifically on e-book readers. I explore the history of technology in classrooms, how to measure reading comprehension, the benefits and disadvantages of using e-readers for educational purposes, and the effects of tactile reading. I hope to show that e-readers can supplement physical books in the classroom, if properly used, but that physical books still have a place in this ever-expanding digital world.

**A definition**

An e-book (electronic book) is just that: an electronic version of a print book that can be read on a computer or digital device. E-books can also exist without a print counterpart. Another name for an e-book that I will use interchangeably is digital book. E-book readers—or sometimes simply known as e-readers—are portable electronic devices meant to support e-books and other digital texts or periodicals. For simplicity, I restrict my definition of e-book readers to devices whose main purpose is for reading; smartphones, computers, laptops, and in some cases, tablets, do not apply.

For the purposes of this paper, I will use the latest Kindle version (4th generation), as the preferred classroom e-reading device. The three brands I considered were Apple’s iPad, Barnes and Noble’s Nook, and Amazon’s Kindle. The Google Tablet is still new and has not been used in classrooms as frequently as the others. At $499, the iPad is too expensive for most classrooms and it functions more like a computer than an e-reader.
Because Apple entered the e-book industry with their iBooks later than the others, they also do not have as wide of a variety of books. Amazon boasts 800,000 e-books for $9.99 or less and Barnes and Noble offers over 1 million (Wahba). While the Nook is comparable in price and functionality to that of the Kindle, the Kindle is more talked about and therefore more familiar to teachers and students. As far as e-readers go, according to the above description, the Kindle is the most popular device to read on at 32% market share over the Nook’s 9%. The Kindle is also the most talked about e-reader, according to Twitter analyses (Fiegerman). Lastly, the e-ink technology is a plus for those who worry about potential eyestrain from standard electronic devices. Any of the three e-book readers would be appropriate for classroom usage, but the Kindle is the best option, with its book selection, popularity, and e-ink technology.

MEASURING READING COMPREHENSION

Quantitative

When I use the term reading comprehension, I rely on Park and Day’s *Developing Reading Comprehension Questions* (2005) assessments and measurements. The following is how I would define comprehension and how to best qualitatively analyze improvement. The comprehension questions were chosen for their success in creating interactive readers and some of them build upon prior concepts. There are six types of understanding in this method: literal comprehension, reorganization questions, inferential questions, prediction comprehension, evaluation, and personal responses. Literal comprehension is the ability to understand superficial or basis information about the text.

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1 Amazon customer service could not verify how many digital titles (not including magazines, audio books, etc.) they offered that were not under the $9.99 price bracket. Barnes and Noble customer service was unable to give a number at all, aside from the 2 million free sample books, which included book previews and out-of-copyright books.
This is the simplest form of comprehension. Reorganization questions are slightly more complex. Readers must piece together various parts of the text to create additional understanding, such as subtracting years to determine a character’s age. Reorganization questions demand that readers analyze the book in its entirety. The next comprehension type is inferential questions; they require a literal comprehension in addition to their own knowledge and instinct to create a better understanding of the material outside the text. Prediction comprehension involves the student to understand the material and then to make an educated guess as to what will happen next. Since there is not necessarily a right or wrong answer to a prediction, the student must use textual evidence to support their answer. The fifth kind of comprehension is evaluation—or how well the reader judges a component of the text—given their text’s literal meaning and knowledge of the text and its related issues. The last type of comprehension is personal response, which requires the participants to submit their feeling to the book and subject matter. While a personal response never incorrect, answers should relate to the book for evidence of literal and thematic understanding. These last two comprehension types require a global understanding of the texts that the others do not. Of course, cultural upbringings may prevent a student from sharing personal or evaluative responses. In these cases, teachers in the Park and Day study showed appropriate responses to the students.

Together, these six kinds of reading comprehension create a holistic measurement. Having an accurate portrayal of reading comprehension is integral to the study’s validity. If students fare better on the assessment based on the Kindle experience, it ought to be based on an accurate measurement of what reading comprehension is.
The five forms of questions are meant to stimulate the readers’ knowledge of the book. The questions format the reading comprehension type to create quantifiable results. Yes/no questions are an easy way to measure comprehension, but because the format allots the students a 50/50 chance of getting the right answer from guessing, the initial yes/no question precedes follow-up questions. Alternative questions combine yes/no questions, but add another dimension by including ‘or’ into the question. These kinds of questions should also be followed up with other forms to avoid problems in the yes/no discussion. Alternative questions do not work well for evaluation or personal response, but fare better in the other four reading comprehension types. The third type of question the study uses is true/false. The Wh- questions, or sometimes known as the five Ws and one H are: who, what, when, where, why, and how. These questions are most useful in literal, reorganizational, evaluative, personal response, and predictive comprehension. The last question type is multiple choice, which comprises of typically four or five options from which to select an answer. These questions are flexible in their comprehension use and in lower grade settings often used for literal understandings. These five different question formats help readers develop a more complex grasp of the text, especially when combined with other previously mentioned techniques.

**Qualitative**

While measuring literacy and reading comprehension in terms of test scores are important, equally important is instilling a curiosity for learning and enthusiasm for reading. Among the qualitative aspects I would look for when using a Kindle are enthusiasm, engagement, and confidence. This can be achieved by observing their
reading habits, interviewing the students, teachers, and parents about the students’ reading habits inside and outside of the classroom.

Enthusiasm is the degree to which someone is interested in the subject at hand. In this case, it is enthusiasm for the texts as evidenced by classroom behavior and interviews. Was he or she actively listening or alert? If I were a researcher I might ask the students, teachers, and parents if the student liked school, how they respond to homework assignments, and if they take school seriously. I would look at non-verbal cues from the student during the reading time, such as smiling. Was he excited to read that day and was that excitement retained during the reading time? Enthusiasm is an important aspect of high reading comprehension because good readers enjoy the reading and learning process.

Engagement can be measured by the amount of participation the students contribute to classroom activities. Do they participate in routine school activities? Do they attend class on time, complete and submit homework, or follow directions? Newmann (1992) describes student engagement as seeking “a psychological investment in learning,[Students] try hard to learn what school offers. They take pride not simply in earning the formal indicators of success (grades), but in understanding the material and incorporating or internalizing it in their lives” (p. 2-3). Engaged students evoke positive emotional attitudes that carry on to their schoolwork. They also focus on their reading and spend most, if not all of their time absorbed in the material.

Confidence can be overall confidence and it can also have an academic component (Sanders & Sander, 2003). In the academic context, it is “self-reliant, bold; sure of oneself, one’s cause, etc.; having no fear of failure” (3). Confidence can be
determined by how sure the student is in his ability to read the text and to talk about it candidly. Confident readers were also more comfortable with the text than non-confident readers. According to Sanders and Sander, confident readers also attend class regularly, ask questions in front of the rest of the class, complete assignments on time, and ask for help when needed.

**HISTORY OF TECHNOLOGY IN THE CLASSROOM**

Imagine today’s educational setting without technology can be difficult. A room without laptops hooked up to screens, interactive whiteboards, TVs, or any other electronic devices would be hard to identify as a modern learning space. Although technology seems commonplace in classrooms today, it was a rarity until the past few decades. Michael Lewis says the “new new thing” in school reform is computers (Cuban, 2001). With the latest wave of technology, the “new new new thing” in school reform, one might say, is e-readers.

This section includes a brief history of technology in American classrooms, focusing solely on computers and e-readers. Because e-readers have a shorter and less extensive history, the uses for computers for academic achievement will be a driving force to similarly analyze e-readers and their effectiveness for improving reading.

**Foundations**

In the beginning, computers in education were primarily used for math and science problem solving for university research purposes. In 1963 at Dartmouth, John Kemeny and Thomas Kurtz transformed the use of computers toward an academic use. They sought to make the computer language accessible to everyone by creating the
BASIC (Beginners All-purpose Symbolic Instruction Code) programming language, which allowed students to write their own programs (Dartmouth Computer Science).

Meanwhile, at Stanford, Patrick Suppes and Richard Atkinson developed CAI (computer assisted instruction), an interactive teaching technique that utilizes the computer to present instructional material and test student learning. They experimented with using computers to teach math and reading to elementary school students. This developed into self-paced programs that pushed students to be more active in the learning process because they received almost instantaneous feedback. CAI supported B.F. Skinner’s theory of behavioral reinforcement learning; through repetition and drill-and-practice, these individualized programs were a primary means of obtaining mastery in an area (Taylor, 1980).

Although thought of by many as computer programming, Seymour Papert’s LOGO, is oftentimes considered an example of CAI. Though CAI was influenced by behaviorist theories, LOGO was based on a constructivist approach, one in which learners create mental models to understand the world around them. This cognitive focus was meant to make programming accessible to young children so they could understand non-numerical problems. They were given feedback and guidance by a turtle robot. Papert sought to move people from “computer literacy” to “computer fluency” to solve real world problems (Harel and Papert, 1991).

In the late 1960s, The NSP (National Science Foundation) commissioned thirty regional computing networks, which included 300 institutions of secondary and higher education schools. In 1963, only 1% of the country’s secondary schools used computers
in the classroom. In 1975, 55% of the schools had access to computers and 23% were using computers for instructional purposes (Molnar, 1975).

In 1975, Apple notably donated their Apple 1 computers, with fully assembled circuit boards, to classrooms. Although the Altair 8800 is considered the first personal computer, the Apple computer was easier to use and came more or less pre-assembled. Personal computers began to appear not only in schools, but also in workplaces, homes, laboratories, and libraries. As more and more computers were seen in classrooms, CAI gained more acceptance. This marked the end of mainframes and the beginning of personal computers as the norm (Murdock, 2004).

**Modern Uses**

Even so, computers did not gain rapid popularity because programming language like BASIC was difficult to understand, yet essential for use. Computers were simply not as user-friendly as they are today until GUI (graphical user interface, which essentially gave us the mouse and desktop icons) and word-processing software were introduced. Still, Murdock notes that the modern era of educational computing began in the 1990s with the rise of multimedia PCs. Technology such as CD-ROMs, productivity tools like PowerPoint, and the Internet, were introduced in 1995, adding to computer usability. With word processors, spreadsheets, databases, and art applications, teachers did not have to be a master programmer in order to use computers in the classroom.

During the 1990s, we also saw the rise of personal laptops, more efficient storing devices (e.g. floppy disk, USB), and electronic whiteboard or smartboards utilized in schools. Furthermore, in 1996, Bill Clinton, through over $2 billion in grants for the Technology Literacy Challenge Fund, challenged schools to make computers available to
every student. Indeed, in 2003, 100% of all public schools in the United States had access to the Internet and 93% of those classrooms had Internet access (Schifter, 2008).

**E-book and E-reader History**

The history of e-books has unclear beginnings, but is largely credited to Michael Hart in 1971 when he created the first e-book by typing Declaration of Independence on his computer (Flood, 2001). Project Gutenberg, the first digital library, launched soon after, and is still in existence today with over 38,000 items in its collection. E-books were also created and stored on floppy disks and CD-ROMs throughout the 1980s and 90s. Other notable milestones include: 2000- Stephen King’s *Riding the Bullet* was only offered in digital format; 2002- Random House and Harper Collins began to sell electronic versions of their books; 2004- Google launched a project to digitize library collections, now known as the Google Books Library Project; 2006- BooksOnBoard launched and sold e-books and audiobooks in various formats and two years later, became the first company to sell books for the iPhone.

E-readers have a slightly longer history. In 1968, the Dynabook was created by Alan Kay, which was designed as an educational tool for children, so they could access media. Kay’s vision sounds much like today’s tablet. In his 1972 research paper, he describes his idea for file storage, size, display, and even the keyboard, suggesting, “the display panel covers the full extent of the notebook surface. Any keyboard arrangement one might wish can then be displayed anywhere on the surface” (8). His description is essentially a virtual keyboard, much like the ones on an iPad. His ideas developed into the Xerox Alto, a prototype, but it was more like today’s netbook rather than an e-reader.
Nonetheless, in 1992, Sony launched an e-reading device called the Data Discman. Encyclopedias, dictionaries (including foreign ones), and novels were all pre-recorded on a disc for users to browse.

The first dedicated e-book readers appeared in the market in 1998—the Softbook and Rocket eBook Reader. The Softbook had a leather cover that users could flip behind the device, so it felt more like a book. It was touchscreen, had note-taking/highlighting capabilities, and featured built-in Internet. The Rocket eBook could connect to a computer and sold its books through Barnes and Noble. Gemstar purchased the rights for both readers, merged them together, and created a new e-reader. Because of the limited book selection and high costs, the e-readers did not sell well and both Gemstar and Barnes and Noble discontinued their respective products.

In 2004, Sony released the LIBRIé, the first e-reader to use e-ink for its screen, instead of the backlight, which improved eyestrain. Two years later, Sony marketed the Sony Reader, which was user-friendlier and had more storage than the LIBRIé.

Amazon became a game-changing force when it released the Kindle in 2007. It sold out in five and a half hours and remained out of stock for five months. The buying experience was much simpler than before, as books were purchased through the user’s Amazon account and immediately downloaded onto the device. Amazon is currently on its 4th generation with various types of Kindles, including the Keyboard, Touch, Fire (an Android-based tablet), DX (has a larger screen and global 3G) and the standard, which is controlled with a cursor and minimal keys. In 2011, approximately 23 million e-book readers were sold (Poeter, 2012) with Amazon taking about 16 million (Townsend, 2011). Other competitive e-readers have since appeared, including the Barnes and Noble
Nook in 2009 and the Apple iPad in 2010. Both have also come out with later editions as well.

**E-READERS PUT TO THE TEST**

**Pilot Program for E-readers: College**

While digital textbooks are emerging into the market at a slower rate than novels, California legislature enacted a law requiring that companies create electronic versions of their college textbooks by 2020 (Moore, 2010). A number of universities (i.e. Princeton University, Reed College, Pace University, Case Western Reserve, and the University of Arizona) have already conducted e-reader pilot programs to evaluate the viability of e-readers as a substitute or a complement to traditional printed course materials.

One of the main complaints of using e-readers for schools is the fact that companies still have not figured out a way to aid the visually impaired. While the text to speech function (a read aloud function) is available on the Kindle and other digital devices, students cannot properly navigate the menu or keyboard. Requiring or offering digital editions of texts would be illegal under the Americans with Disabilities Act, unless they were fully accessible to blind people. Amazon says they are working on expanding the Kindle’s features to accommodate the needs of the blind. (Dunn, 2010) Meanwhile, researchers may have found a viable solution for the future. Stanford undergrads at the Army High Performance Computing Research Center developed an application that allows blind people to use keyboards on touch-screen devices by mimicking the Braille keyboard. Traditionally, the user must find the eight keys, but this method enables the application to position itself according to where the fingers touch the screen (Tea-
Mangkornpan, 2011). People using the Braille keyboard would not need to learn how to use a new technology and it would most likely meet federal disability requirements.

Students personalized the text using features and tools unique to the Kindle to their advantage. For example, in Larson (2010) participants “adjusted the font size, listened to parts of the story by activating the text-to-speech feature, highlighted key passages or vocabulary, used the built-in dictionary, and searched for keywords or phrases within the book” (17).

The researchers transcribed and coded the interviews and notes within the books. They were previously trained to code certain themes similarly, so as to increase the reliability of the research workers. Training also involved clarity of what the codes meant, specificity, and practice. The codes were grouped into categories based on how well they addressed the reading comprehension types. Based on prior research, their notes were categorized into five predetermined categories: “understanding of story, personal meaning making, questioning, answering, and response to text features/literary evaluation” (18). These overlapped with the reading comprehension types to best understand their progress.

Although the area I’m most interested in is grade school, particularly 4th grade, Larson’s research of second graders in “The Next Chapter in E-Book Reading and Response,” is a realistic account of how e-readers can be used in the classroom. The teacher, Mrs. Miles, uses two Kindles for the classroom and shows the students how to use the various features, though they are not required to use all or even any of them. She identifies two students of various demographic backgrounds to use as a case study. Larson found that e-readers promote “new literacies practices and extends connections
between readers and text as engagement with and manipulation of text is made possible through electronic tools and features” (17). She saw the tools as advantageous to the students; the e-book readers invited the participants to engage with the text and put them in more control than reading printed text.

**Pros**

The college pilot program and other grade school classrooms found a number of benefits for the students. The most obvious benefit is the size of the Kindle. It is thin, portable, and light. The Kindle 4 is about 6.5 x 4.5 x .34 inches and weighs just under six ounces. Another practical advantage is for teachers; e-books drives down printing costs and purchasing time, as the books are either downloaded or transferred from a PDF or similar file to the Kindle.

The other benefits are its features that make it distinct from physical books. Students can find key words or passages with the search option instead of leafing through pages. Toward the latter half of elementary school, students will start learning to annotate, highlight, or mark up their texts, which they can do on their Kindle. However, what makes e-readers unique is that students can easily share their notes electronically as well as see popular highlights and notes that others have made. The latter is particularly helpful because it models to students which passages are important. Students soon distinguish between important and non-important components, as well as just highlighting things they like or find amusing. They can also enlarge the text to suit their reading style. Teachers can create interactive quizzes for independent study and enable commentary sharing between students. The built-in dictionary function helps them define
and pronounce words; they can also enable text-to-speech to hear the passage read out loud (though it is a somewhat robotic voice, unlike a recorded audiobook).

A social benefit is that students can also hide some of their insecurities with an e-reader as they catch up. Although struggling readers might be embarrassed to be caught with a small chapter book, e-readers hide the size of books, giving them the privacy they desire. Additionally, unless looked upon closely, for slower readers, other students cannot see how much progress has been made. This could help boost confidence for lower-performing students as they eventually catch up to their peers.

**Cons**

What does not seem to work in the classroom is primarily navigation and distractibility. Flipping through pages is tedious, as students can skip page-by-page or chapter-by-chapter, unless they use the page number or search tool, which makes it difficult to find passages or textual evidence. Similarly, if students want to compare readings or refer to multiple texts, smoothly navigating between texts is nearly impossible.

The devices easily distract some students, particularly if the students are new to them. If teachers supply their own copies of articles or books, the Kindle sometimes loses the PDF annotation functions throughout the conversion process. If students have already developed their own sense of highlighting or note-taking, switching over to a digital device can be difficult; the Kindle’s e-ink does not allow for colors and there is no writing utensil to star, write outside the margins, or signify other unique note-taking styles. E-readers are also more prone to theft, particularly if students are allowed to “check out” the Kindles to take home with them.
TACTILE READING

The Reading Experience Suffers

A common social criticism of the rise of the digital culture is losing the tactile sensation associated with books. Reading is a multi-sensory activity, but is dulled down by electronic texts (Mangen, 2008). The experience of a book is more than the content itself, but also the book jacket, touching the embossed lettering of a cover, smelling the musty scent of an old book, and noticing the worn spine of a classic novel. Flipping through pages is replaced with scrolls or buttons and bookmarking a page is now a simple number indicating the percentage of the book completed. But aside from nostalgia of print books, why should we care about these sensory details in reading? In particular, the haptics of reading is overlooked in favor of eco-friendliness and convenience. In this section, I will explain why the loss of tactile features of print books is not merely a cultural one, but also an educational one. I will discuss how the affordances of a digital device inhibit an imaginative and thus immersive experience. Moreover, it negatively affects kinesthetic learners who rely on tactile events. Then I will address the ways in which technological advances address some of these issues.

Anne Mangen of Winthrop University says that when we read print text, we are “physically and phenomenologically” (and literally) in touch with the material substrate

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2 “Phenomenological immersion- the sense of being immersed in a fictional world which is largely the product of our own mental, cognitive, abilities to create that fictive, virtual (in the figurative sense of the word) world from the symbolic representations – the text, whether purely linguistic or multi-modal, digital or print – displayed by means of any technological platform. This is the kind of immersion we experience when reading a page-turner novel. In this kind of immersion, the physical and technical features of the material support – the book – are ideally transparent in order to facilitate, and not disturb, phenomenological immersion.”

Follow the Reader: E-Book Readers as Tools for Increasing Reading Comprehension
of the text itself” (406). Whereas digital screens are more adept for technical immersion (like playing an action game on a computer), they are less compatible for phenomenological or sensory immersion, because the medium of text matters. Mangen uses hypertext fiction—a genre of electronic literature that capitalizes on hypertext links to propel the plot and increase interactivity, similar to Choose Your Own Adventure—to illustrate her point. The sensory-motor capabilities of print allow us to perceive the dimensions of the book and to utilize the senses for an immersive experience, equating the book with the reading experience. Because digital text is so intangible, we cannot activate the same sensory activity. Instead, we treat hypertext fiction like we do other digital mediums, like the Internet, by scanning its pages and dividing our attention between links.

By scanning, browsing, and clicking, we end up focusing on the technological functions of the hypertext piece, rather than the storyline. Each time we visit a new link or plotline, the visual display changes and brings us out of the narrative flow. This occurs because we have to allocate our attention to various places at once instead of focusing on the text’s content. In order to achieve this phenomenological immersion, we need to read in a consistent way that does not interfere with our cognitive ability to process the text (Douglas, 2000a; Douglas & Hargadon, 2000b; Nell, 1988, as cited in Mangen, 2008).

When children move behind picture books and start reading chapter books, they need to be able to imagine the plot, characters, and setting. Dennis Sumara (2002), author of Why Reading Literature in School Matters, suggests that being immersed in reading both during and after the book enhances hermeneutics, the practice and theory of interpretation. According to Sumara, reading strengthens one’s ability to relate the story
to the reader and to identity development. In this way, Mangen would argue that reading on a digital medium takes away from the creative components. Not only does imagination make them able to better handle their emotions, it also has a positive cognitive effect, enabling them to do better in school. It improves problem-solving, social skills, and allows them to cope with more complex problems in the future. Reading on print, however, allows for immersion and creativity that aids in cognitive growth.

Aside from the lack of the immersive and imagination reading experience, the haptics of reading also has a more direct educational implication that has been overlooked by many e-reader advocates. For kinesthetic learners, e-readers may hinder a student’s ability to learn effectively.

In the University of Washington study of the Kindle DX, researchers found that e-readers made cognitive mapping more difficult to accomplish. The physical act of turning a page, locating a passage, or a position in the book initiates this cognitive mapping, helping students study or recall information more quickly and accurately. For example, think about when you read a book and want to revisit a particular detail in a passage. You remember that the paragraph is only a few sentences long on the bottom left hand corner of the page in the last third of the book. You can skim the pages looking for something that looks like that. With an e-reader, the skimming is not only slower, but the spatial relationship is gone, hurting the cognitive mapping process.

Reading is also less natural on an e-reader than a physical book. Bookmarking is common for paper books, but for e-readers, people have a hard time with the same visualization process. People are unable to flip ahead to visually evaluate how much of the book or section is left. They cannot quickly look up a reference at the end of the book
and then continue where they left off, by holding a finger in place or inserting a piece of paper. This has a discouraging effect on readers. Because the device is used for every book, the multi-sensory aspects are reduced to the same reading experience. Additionally, if readers, especially young ones, cannot navigate the e-reader effectively, they might give up and not look forward or flip back to find that particular piece of information they initially sought.

Furthermore, when people physically take notes (including highlighting, margin writing, customized markings, etc), they have to evaluate and prioritize the information, noting the most important ones. This process, as opposed to the notes themselves, leads to greater recall and thus betters comprehension and memorization. For young learners, the loss of perceptual processing affects how they read and comprehend the material. For tactile learners, e-readers are not helpful. They may, in fact, deter students from becoming better readers by stifling creativity as well as their cognitive mapping.

The University of Washington authors said that e-readers do not have the best design features to support how students read, but are hopeful that such capabilities are in the near future. Better design and programming would mimic books more realistically. One problem with the touch-screen e-readers is that the interface sometimes incorrectly guesses how many pages readers want to turn. On the other hand, the non touch-screens only turn one page at a time or chapter by chapter. New software would need to detect the way the finger interacts with the screen in order to gage the number of pages the user is trying to turn.

**New Technology**
To make e-readers function more like traditional books, prototypes are entering the technological scene, particularly in Asia. In Japan, a team led by Osaka University professor Yuichi Itoh, has created the Paranga, a prototype that resembles an open-faced book and creates the sensation of turning pages. The device was inspired by the flipbook and seeks to create a more traditional reading experience. The left side of the book has an LCD screen where the images and text is displayed. The right side holds the page turning mechanism, a roller with multiple strips of paper attached to it. The roller has sensors to detect how far the book is bent; the more bent, the faster the pages turn. The Paranga is currently geared toward children and the elderly, because of how much it resembles print books. Itoh hopes the later versions of the device will simply attach to an e-reader in order to drive down the costs, as the current model costs $260 (Danigelis, 2012).

In Korea, researchers focused not on a separate device, but an iPad app to create a better user experience. It is an interface prototype from KAIST Institute of Information Technology Convergence that solves the bookmarking problem and page turning problems mentioned earlier (Hoffelder, 2012). It allows people to both flip through and fold pages. With a stroke of a finger, users can quickly flip through pages, previewing or looking back on the rest of the book. Readers have the option of folding a page of the book to see what is next or even to bookmark bookmarking while holding their place in the book. It also allows users to flip a few pages at a time based on the number of finger gestures on the screen; turning the page with two fingers will turn the book two pages (it goes up to four fingers and pages).

While these technological advances have not addressed the issue of divided attention or other lost sensory feelings, researchers have started to respond to the...
consequences from the lack of tactility. With the rising pervasiveness of such devices in educational settings, further software and interface designing is essential. By mimicking page turning of physical books, educators may be one step closer to minimizing drawbacks of e-readers in the classroom.

**IMPACT OF COMPUTERS ON LEARNING, AND SUBSEQUENTLY, E-READERS**

*No Conclusive Answer*

There are conflicting studies about the effectiveness of computers as a learning tool in classrooms. Schifter (2008) argues that such evaluation is too complicated and complex to be assessed through traditional research designs. The following are merely a few examples that highlight the different perspectives on computers as educational tools. The research on the effectiveness of computers will be the framework for e-readers and their potential success.

John Kulik of the University of Michigan used a meta-analytic approach to examine the effectiveness of CAI, or what he calls CBI (computer-based instruction). His 254 controlled evaluation studies generally show positive effects on all age levels. CBI increases scores from ten to twenty percentile points and reduces the time to attain such goals by a third. Computer-based education also raised test scores by .30 standard deviations (Kulik, 1991). While Kulik’s work bodes well for future computer use in classrooms, it is a bit outdated, given the advancements since the experiment was conducted and the research was presented. However, other studies a few years later have also shown similarly positive results, though they look at different types of technology. (Schacter, 2001; Sivin-Kachala, 1998; Wenglinsky, 1998, as cited in Schifter, 2008).
On the opposite end of the spectrum, a report from the Heritage Center for Data Analysis used data from the NAEP (National Assessment of Educational Progress) to also analyze the effect of computers on reading scores. The NAEP is administered to 4th, 8th, and 12th graders. The analysis by Kirk Johnson (2000) examined six factors: frequent in-class computer use by trained teachers; race and ethnicity; parents’ education; home environment (number of reading materials in the home); income (free or reduced-price lunch participation); and gender. The results show that although race, income, home situations, and parents’ educational attainment were significant, students who use computers at least once a week in school do not perform better on the NAEP than students who use them fewer than once a week.

**Myths and Recommendations**

In the following criticisms, computers can be replaced with e-readers to discuss their effectiveness. The mere presence of computers cannot improve scores. In a 1998 Forbes Magazine article, Diane Ravitch stated, “Certainly everyone needs to learn to use a computer and to develop technological literacy. But we must not forget that computers are tools, not an end in themselves. They are no substitute for the academic skills and knowledge that children must master to participate in the modern world economy.” Glenn M. Kleiman (2000) introduced five myths about computers in school.

1. *There is a direct correlation with improved learning and more computers.* In fact, without sufficient training, technical support, software upgrade capabilities, and integration of computers into the curriculum, schools will not see improvement.
2. **There are standard or agreed-upon techniques and practices that all teachers should use in their classrooms.** However, the way computers should be utilized is dependent upon the goals of the curriculum and the student demographics.

3. **Once teachers are trained to use a computer, they are capable of effectively using it in class.** Mastery and pedagogy are not the same. The Apple Classrooms of Tomorrow project showed that there are five stages of evolution before teachers master integrating technology into the classroom.

4. **The average school district has adequate plans for effectively putting technology into use.** However, most of the plans prioritize having the technology over incorporating it into the curriculum.

5. **Giving schools in impoverished neighborhoods the same student to computer ratio as in wealthier areas can attain educational equity.** Again, there is no one step to reduce the achievement gap. As mentioned earlier, just having computers at schools will not solve the problem.

E-readers are similar to computers in that their existence is seen as a potential educative tool. However, they differ in their functions. Computers have a broad array of capabilities (i.e. their initial educational purpose was mathematical), but e-readers have a narrower focus. There is no CAI or immediate feedback, but the readings are self-paced and users can annotate the passages. In this way, e-readers may seem less practical than computers. However, I would argue that the singular focus has advantages for learners. In a world that is becoming more digitized and electronic devices are becoming more multi-purpose, people often divide their attention. Separating the devices can help learners internally associate say, e-readers with English class and calculators with math or
science. Additionally, if these devices become more specialized, they will be become stronger at their target goal. If teachers focus on a device that is meant for their subject area, that may reduce their learning curve and increase their understanding, because they do not have to be bogged down by learning irrelevant programs or troubleshooting if they used an all-purpose computer. Of course, these are merely conjectures!

E-readers could become the “new new new” technology that teachers are itching to have in their classrooms. However, like computers, E-readers are useless unless teachers: encourage learning and not merely learning to use the technology; have adequate experience themselves; and have enough e-readers for the students. Future studies will hopefully bring to light any successes or fallbacks of these technological devices.

CONCLUSION

As stated earlier, fourth grade is an important time for students to develop their reading skills. Jeanne Chall created the term, “fourth-grade slump” to describe the large gap in literacy development between third and fourth grade. Increased reading and the functions of e-readers can reduce the disparity between comprehension levels.

Although e-readers have made vast improvements since their introduction in the Dynabook in the 1960s, developers still have a ways to go in usability. Bill Gates expressed his preference for print in which he said,

“Reading off the screen is still vastly inferior to reading off of paper. Even I, who have these expensive screens and fancy myself as pioneer of this Web Lifestyle, when it comes to something over about four or five pages, I print it out and I like to have it to carry around with me to annotate. And it’s quite a hurdle for technology to achieve and match that level of usability” (Darnton, 69)
The idea of usability is a strong one, but it should not be the only consideration. The basic premise of Larry Cuban’s *Oversold and Underused: Computers in the Classroom* is that computers have the capability of enhancing teaching and learning, but if under or ineffectively used, they have little to no educational use. One of his recommendations for policymakers and practitioners is for teachers to have more professional development. With even the most advanced computers, or in this case, e-readers, students cannot benefit unless teachers understand the technology, believe in its educational advantages, and can incorporate it into their curriculum.

Throughout this paper, I have tried to show that there are as many drawbacks as advantages to using e-readers. The means of measuring reading comprehension is manageable, but how e-readers can support that means is more complicated. They have the potential to improve reading comprehension, but both the educators and the developers need to have the same goals in mind if they truly want to reduce the reading achievement gap. As more studies on the effectiveness of e-readers become available and as society adjusts to the ever-expanding digital society, I hope we will have a better grasp of how to best utilize technology for children’s educational purposes. The book does, in fact, live on, whether in print or electronic form. They both have their purposes and will not die anytime soon.
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Follow the Reader: E-Book Readers as Tools for Increasing Reading Comprehension


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