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# Electronic books: Are they effective educational tools for students who are deaf or hard of hearing?

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# ELECTRONIC BOOKS: ARE THEY EFFECTIVE EDUCATIONAL TOOLS FOR STUDENTS WHO ARE DEAF OR HARD OF HEARING?

by

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*Abstract: This literature review will examine the effectiveness of electronic book features on students' reading development in the general education population and investigate whether or not these digital tools could be a useful tool and/or supplement in literacy for students who are deaf and hard of hearing.*

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## Introduction

Because of our rapidly growing, technologically oriented society and the need for students to be "career ready," there is a push for technology literacy on a national and state level. Technology has become the answer to all of our questions about the world. People of all ages use technology every single day for their careers, education, and increasing their own personal knowledge about a topic. Technology serves as a collaborative tool to share and learn from one another; as technology evolves, improvement and efficiency of all of these areas increase. Technology helps people develop into continuous learners and informed citizens.

With technology use booming, education must commit to integrating technology into the classroom so that students will be *tech literate* of all types of electronic devices. Tech literacy is the ability to understand and use technology efficiently to enhance learning and communication. Technology integration can be used effectively in all academic content areas to enhance students' learning as well as technological experience. In 2008, Edutopia wrote about the importance of technology integration in schools by saying that technology equips students by providing them with a "realistic snapshot of what the modern office looks like" which helps with this "career readiness" national educational expectation ("Why Integrate Technology into the Curriculum?", n.d.). Schools everywhere are implementing times during the day in which students use computers, schools loan laptops and iPads to students, and provide access to electronic books. Through access to this technology, students can augment their in-class learning and bring the classroom everywhere they go throughout their everyday lives. Learning should be a continuous process in and out of the classroom, and with the use of technology, students are able to accomplish this goal.

In this independent study, I will explore the use of technology in literacy education. Use of technology in literacy education has many different forms including electronic books. All of these are known to be implementable, easily accessible, and relatively inexpensive for schools to adapt. First, I will describe the national push for technology integration in education from the U.S. Department of Education. I will then describe technology used in teaching literacy, and review research literature on the benefits of using e-books in the classroom with the general education population. Next, I will examine the digital features of e-books to determine if they are beneficial to students who are deaf or hard of hearing. Finally, because research shows that students who are deaf or hard of hearing tend to be struggling readers (Traxler, 2000), I will investigate whether one type of technology—the electronic book—can be a useful tool and/or supplement to literacy education for this population of students.

**Review of the National Education Technology Plan (2010): The Importance of Integrating Technology into the Classroom--Technology Literacy**

In November 2010, the U.S. Secretary of Education, Arne Duncan, presented a plan for the national push of technology integration called the National Education Technology Plan (NETP), *Transforming American Education: Learning Powered by Technology*.

> The National Education Technology Plan calls for applying advanced technologies used in our daily personal and professional lives to our entire education system to improve student learning, accelerate and scale up the adoption of effective practices, and use data and information for continuous improvement (NETP, 2010, pg. ix).

Within this plan, the Department of Education presented goals and recommendations in five essential areas to help integrate technology in schools and the classrooms. The five essential

areas are learning, assessment, teaching, infrastructure, and productivity. In this plan, each essential area has an over-arching goal, explanation, and a set of recommendations for achieving this goal in education and ultimately transforming American education.

The first essential area written in the NETP is learning, referring to how technology can open up a new way of learning in the classroom. "All learners will have engaging and empowering learning experiences both in and out of school that prepare them to be active, creative, knowledgeable, and ethical participants in our globally networked society" (NETP, 2010, p. 9). Examples are provided for how technology can enhance student learning, so students can ultimately be prepared for their future careers and endeavors. For instance, consider how a doctor's office uses a technological filing system for patient charts, so that the physician can display X-rays and files to his or her patients during an appointment quickly and effectively. Without preparation and exposure to technology, students will fail to meet the nation's "career ready" expectation.

Above all, students become lifelong learners and bring the classroom everywhere they go when given the opportunity to use technology. The NETP refers to using technology in the classroom as an equivalent to having a "set of flexible educators at their fingertips" thus making it compatible for differentiated instruction and varying types of learners (NETP, 2010, p.11). With each student bringing something different to the table in a classroom, application and programs via mobile devices or computers can help supplement instruction by reaching each student's needs for learning. Not only can technology supplement instruction of a diverse population of students within a classroom, but it can also motivate and engage students in learning by using appealing digital content, thus creating a positive image of a continuous learner.

In addition, students with disabilities can not only benefit from all aforementioned uses of technology in the classroom, but they can also use assistive devices to combat the everyday expectation of keeping up with their peers. Features on desktop computers and mobile devices now allow students with disabilities to easily access and use technology. Text-to-speech and alternative keyboards are just two examples of features used to help make technology more accessible.  Sign language dictionaries (online or through an application) are used for students who need sign support in class.  Calculators and spell check features can quickly be used for students with a learning disability. The use of technological devices in the classroom aids and benefits students with disabilities, so they can stay on track with their peers in the classroom.

For this essential area of learning, the NETP makes multiple recommendations. The writers of the NETP believe that states should infuse technology within their education standards that "reflect the 21$^{st}$ century expertise" (NETP, 2010, p. 23).  They also write that states should take advantage of using technology as a learning resource in all areas of academic content. States are recommended to implement learning resources within technology to make learning accessible inside and outside of school. In order for students to be prepared for any STEM (science, technology, engineering, and math) professions, technological programs and learning resources must be developed in state educational standards.  Under these few guidelines, schools will meet the goal of enhancing learning through technology.

Assessment is the second essential area in the National Education Technology Plan: "Our education system at all levels will leverage the power of technology to measure what matters and use assessment data for continuous improvement." (NETP, 2010, p. 25) Technology has opened up so many doors for assessment in education.  With technology, teachers can more efficiently measure critical thinking, inquiry, problem solving, entrepreneurship, and creativity skills.

Assessment can take place anywhere, whether during a school day or while students work from home. With different devices allowing features of anecdotal note taking, teachers are able to quickly determine what their students are learning and taking away from a reading or a lesson. Technological systems can also gather more in-depth and detailed data that will help teachers improve students' understanding of academic content more quickly and effectively. Lastly, assistive technology can also make assessments more accessible and easier to manage for students with disabilities. "Assistive technology can make it possible for students who have disabilities that require special interfaces to interact with digital resources to demonstrate what they know and can do in ways that would be impossible with standard print-based assessments." (pp. 31-32).

The writers of the NETP recommend that states and school districts give technology a chance to give "actionable feedback about student learning to improve achievement and instructional practice" (NETP, 2010, p. 37). This use of technology would be ideal for formative and summative assessment use, as teachers and students will be able to pinpoint areas for improvement with this feedback. The writers also recommend "build[ing] the capacity of educators, educational institutions, and developers to use technology to improve assessment." Because technology offers so many programs and platforms for students to gain unique experience through simulations and virtual experience, the NETP recommends that educators and experts research the best way to use these programming features effectively in the classroom for student motivation and learning. When using technology for assessing students with disabilities, educators and experts must check the validity of the assessment in order to see accurate results of students' learning. Accommodations should be made in order for students to participate in technology programming in the classroom. Finally, privacy measures should be

taken when providing and sharing student data in education, so educators and experts should take caution when using or choosing to use technological assessment.

The third essential area in the National Education Technology Plan is teaching: "Professional educators will be supported individually and in teams by technology that connects them to data, content, resources, expertise, and learning experiences that can empower and inspire them to provide more effective teaching for all learners" (NETP, 2010, p. 39). The writers of the NETP introduce a new model of teaching called *connected teaching*. Connected teaching is when "educators are fully instrumented, with 24/7 access to data about student learning and analytic tools that help them act on the insights the data provide" (p. 40). Teachers who use connected teaching are "connected to their students and to professional content, resources, and systems that empower them to create, manage, and assess engaging and relevant learning experiences for students both in and out of school" (p. 40). With this model, teachers have the ability to effectively collaborate with other teachers, parents, students, and youth development workers while pulling from resources, content, data, tutorials, and online courses to help support the learning and teaching that takes place in this collaboration. As teachers gain knowledge of the technological content, online communities, and resources available, they are able to personalize students' learning based on their needs while engaging and motivating the student, thus creating an optimal learning environment. With video sharing, educators have the opportunity to get immediate feedback from other educators within an online community creating the opportunity for educators to become continuous learners and reflective educators.

In order to reach this goal of preparing teachers in this connected teaching model, the NETP recommends that schools give teachers access to the technological resources needed for their classroom (2010). Another recommendation is that social networking platforms must be

created for teachers to collaborate with each other and share knowledge and information through a *community of practice*. Online learning environments will provide educators the opportunity to develop and enhance their own pedagogy. Technology should not only be used to motivate the students but it should also be used to motivate pre-service teachers to use technology as a part of their teaching materials for assignments. Lastly, the NETP recommends that there is a need to develop a "teaching force skilled in online instruction." An online skilled instructor will know how to supplement technology with content that will in turn help motivate and enhance student learning in the classroom.

The fourth essential area of the National Education Technology Plan is infrastructure: "All students and educators will have access to a comprehensive infrastructure for learning when and where they need it." (NETP, 2010, p. 51) There are several recommendations in the plan to address this goal. Schools are suggested to provide broadband Internet and wireless access in and out of the school. This will enable students and educators to use their devices and have access to continuous learning in the classroom, around campus, and out in the surrounding community. Research, communication, digital multimedia content creation, and collaboration will happen if teachers and students are provided broadband access and wireless Internet. In addition, the writers recommended that students have access to at least one Internet-connected device. Like previously mentioned, students will have the ability to use these devices to their benefit in education, and teachers can provide students with the reason to use these devices through everyday lessons and teaching of content. Schools are recommended to have open education resources, so educators have equal opportunity of accessing and sharing certain resources like online books. For example, students might have a digital copy of their textbook via the cloud, so they can access it at all times. Books can be opened at any time as long as the student has

Internet access, and the learning begins to carry over from school to the home or in the community.

With all of these newfound technologies and ideas comes the idea of redesigning and transforming education to fit the needs of technology integration. This leads to the fifth and final essential area of the National Education Technology Plan: productivity. The goal for this section is as follows: " Our education system at all levels will redesign processes and structures to take advantage of the power of technology to improve learning outcomes while making more efficient use of time, money, and staff" (NETP, 2010, p. 63). In this concluding essential area, the writers discuss the need for educational leaders who understand the importance of technology integration. A written plan is the first step, followed by implementation. Productivity should be measured in education, so goals will not subside and turn into years without any accomplishments. States are recommended to keep data on technological purchases, number of devices, and Internet connections. Lastly, states are suggested to "design, implement, and evaluate technological-powered programs and interventions to ensure that students progress seamlessly" (NETP, 2010, pp. 73-74).

With a national plan in place, some states and even some school districts have their own technology plans. For example, the state of Missouri does not have a statewide technology plan, but select districts throughout Missouri include these plans. Although varying from state to state, these plans have very similar goals to those in the National Education Technology Plan.

**Technology and Reading in the Classroom**

Technology is used in literacy instruction in several different forms, including electronic books. Electronic books, also known as *e-books*, are books in digital format and read using a

mobile device such as a tablet, portable device (e.g., Kindle, Nook), or computer via application, CD-ROM, or the Internet.  E-books are bought online from various third-party sellers (e.g., Amazon).  E-books can also be borrowed through a public library and sent directly to the borrower's mobile device or computer.

Some schools replace or supplement the standard textbook with an electronic book. For example, the textbook publishing company McGraw Hill uses *ConnectEd* as their platform for digital versions of McGraw Hill textbooks. Students can access their own textbook in digital format on their computer or mobile device with this program at school or at home (assuming, of course, that the students have access to the internet and a mobile device or computer).

E-books provide many features for students to help enhance their digital reading experience.  Each device, whether a mobile device or a computer, offers many different features that can individualize reading.  These features vary and are dependent upon the program or publishing company.  E-books are customizable to the reader and provide reader involvement within the text. Text-size, font, page orientation, and line spacing allows the reader to manipulate the pages to his or her preference. In addition, e-books have built-in programs to enhance reading comprehension. In an article about the use of e-books, Hoffman and Paciga (2013) discuss how the e-book and its features can be described on a spectrum, with simple digital print on one end, and elaborately animated and interactive features on the other end.

For example, text-to-speech is a feature of many e-books that allows the book to be digitally read to the reader. Readers can follow along on the pages as the book is audibly being read to the individual.  Some e-books allow the option of recording the reader's voice, so that the reader can listen to his or her book being read in his or her own voice.  In a case study by McClanahan and colleagues (2012), a pre-service teacher used an e-book with a recordable

feature in teaching a 5th-grade child who was delayed in reading level by 3 years. The child listened to himself read while following along with the electronic book pages, allowing him to think "metacognitive[ly] about his reading." The child made generalizations about his reading and talked about how he could improve his performance. Because the child knew he was being recorded, it allowed him to slow down and catch his mistakes while reading the second time. By using these electronic features and others the Apple iPad had to offer, the student's "comparisons of pre- and post-assessments showed that the student had gained one year's growth in reading within 6 week's time period" (p.20).

E-books also provide reader involvement by allowing the reader to take notes and highlight the text. Larson discusses this in her 2013 article about digital reading. She writes that e-books "can be used to differentiate instruction, enhance literacy learning, and support Common Core State English Language Arts (ELA) Standards at the fifth-grade level" (p. 169). She notes that the highlighting tool "can be used to emphasize key passages or important facts and to identify literary elements, parts of speech, or anything else that students are learning" (p. 171).

Depending on technological equipment available to the educators of the school, classroom teachers could have the option of projecting the e-book for the whole class to participate in whole group instruction or reading. With e-books, readers and teachers have many options to manipulate and customize their reading experience.

E-book programs and publishing companies provide many built-in programs to enhance comprehension of the text. An example of a built-in program would be an electronic dictionary. Electronic dictionaries are a resource an electronic book can offer to define unknown words within in the text quickly by the tap of a screen. Different electronic book readers have an array of programming features that enhances comprehension of the text and motivates readers to keep

reading. One of these includes the *Vocabulary Builder* program, found on the Amazon Kindle, which takes inventory of the words that are unknown and chosen to define via the built-in dictionary. Then the reader can quiz himself to develop knowledge of those words. Kindle *X-Ray* is another example of a program focused on enhancing the comprehension of the text. It compiles all notes taken and sentences and concepts highlighted for a comprehensive look of information gathered. Another program from Amazon Kindle is called *Achievement Badges*. This program is a motivational reading tool for children, as it awards badges to readers who accomplish milestones in their reading journey like number of books read, time of reading, etc. Parents have the ability to print out a progress report to monitor their child's progress in reading (http://www.amazon.com). As these are only a few examples of features and programs available to readers reading electronically, the overall goal is to customize the reading experience, develop word knowledge, and increase reading comprehension.

E-books can also offer multimedia features to help enhance the reader's conceptual knowledge. Some e-books have hyperlinks that lead to other Internet sites if the reader is interested in learning more about certain topics. Videos might be linked to help the reader see concepts in another presentation to help with understanding of learned material. With multimedia features, the text becomes animated and brought to life to the readers, which in turn helps with improving/gaining world knowledge.

Overall, electronic books are said to have a wealth of features that help enhance reading comprehension and vocabulary. The following will describe a sampling of studies that demonstrate the positive benefits of digital books on children's reading skills.

In 2008, Korat and Shamir conducted a study on the effects of e-books with a sample size of 145 Israeli children, ages 5 to 6 years old, within low and middle SES groups. They

found "the lively and attractive features of the e-book to be a possible means for supporting young children's literacy and language development…" (p. 122). In 2007, Grimshaw and colleagues studied 132 children, ages 9 to 10 years, to compare enjoyment and comprehension of using a print book (supplemented with a print dictionary) or the CD-ROM electronic book (supplemented with a built-in online dictionary). The study showed that the presentation of the books (print vs. e-book) did not necessarily lead to reading motivation. However, the features of the electronic book led to the motivation of reading and positive reading comprehension scores. The text-to-speech feature improved reading comprehension scores, and the online dictionary was utilized more than the traditional print dictionary.

In 2011, Jones and Brown investigated the effects of e-books on 22 third-grade students' reading engagement, comprehension, and enjoyment. The students were divided into four reading groups with a mixture of boys and girls based on reading level. Three different phases of *bump readings* were conducted in this study. Bump readings were when students took turns reading aloud within a reading group. During the first phase, each reading group read the first three chapters of a print copy of a third-grade reading level mystery book. During the second phase, students were given school computers and access to an electronic book library website via the Internet. Students were instructed to read a different third-grade reading level mystery e-book. When it was their turn to read, they were allowed to use the e-book's features: text-to-speech, links to the glossary, and auditory pronunciations of words. Phase three was essentially the same as phase two, but the students used a different electronic book title within the same website. Within each phase, students were given a mapping comprehension activity during the story, a comprehension test, and enjoyment survey after the group bump reading. The comprehension scores revealed that phase two scores were significantly lower (mean score=

65.8) than phase one (mean score=80.3) and phase three (mean score=81.6). On the measure of enjoyment, the book in phase two received the lowest score (2.11), while phase one and three were identical (2.32). With these numbers, the researchers concluded that the students' scores were not swayed because of the format of the book but rather the enjoyment of the book. The electronic book version did not hinder the results, but this study showed the importance of picking out an engaging book for students.

In 2013, Taiwanese researchers conducted a study on the effects of extensive reading via e-books with a group of 46 college students who were learning English as a foreign language (Chen, C., Chen, S., Chen, S. E., & Wey, S., 2013). This ten-week program was expected to lead to improvement in reading attitude, comprehension, and vocabulary learning of the freshmen students. Pre-tests and post-tests were used to measure reading attitude, comprehension, and vocabulary. The results supported the researchers' hypothesis: There were significant gains with the experimental group compared to the control group in reading attitude, comprehension, and vocabulary learning.

**Reading Challenges for Students Who are Deaf or Hard of Hearing**

For children with typical hearing, reading skills are developed over time, starting well before he or she can decode a single word. For children who are deaf or hard of hearing, reading is often a tremendous challenge because of deficits in language, background knowledge, and phonemic awareness.

Successful readers must have the following literacy processes: "conceptual knowledge, language components (phonology, semantics, syntax/morphology, and pragmatics), decoding, fluency, memory, text processing strategies, and comprehension"

(Easterbrooks & Estes, 2007, pg. 106). Children who are deaf or hard of hearing may understand how to use phonemic awareness and phonics while decoding at a reasonable rate, but are these students comprehending or gathering meaning? This is the ultimate question for children who are deaf or hard of hearing. Successful readers use background knowledge and vocabulary knowledge in order to comprehend a text. Therefore, students who are deaf or hard of hearing who are lacking these skills are not able to make reading meaningful, and struggle to learn new things through reading.

> "Children with hearing loss have a quantitative deficit in vocabulary (breadth or number of words known) and also a qualitative deficit (depth of understanding of a word). Lack of the words used to teach a new word compounds the vocabulary deficit. Although the child who is deaf or hard of hearing may have seen a knife, fork, spoon, dump truck, and dentist, she may not necessarily have had the opportunity to hear, overhear, and learn by "auditory osmosis' (i.e. incidental learning) what the words for those entities were." (p. 114)

Teachers of children with hearing loss give these students explicit instruction on all skills of reading, but most importantly students with hearing loss need to enhance their conceptual and vocabulary knowledge. With multiple-meaning words and all of the rules and exceptions of the English language, learning vocabulary can become a daunting task. If this knowledge is enhanced, it will improve the students' overall comprehension of the text and decrease the struggle of reading.

**Question: Are electronic books an effective educational tool for students who are deaf or hard of hearing?**

Knowing the reading challenges of students who are deaf or hard of hearing, electronic book or digital textbook features could help enhance reading comprehension.  To my knowledge, there are no studies of students who are deaf or hard of hearing using e-books in the classroom, so it is unknown whether they have positive or negative effects on literacy development. However, we can glean from the literature on typically hearing children that e-books may be beneficial.

For example, electronic book features could help foster vocabulary growth with the built-in dictionary and programmable vocabulary quizzes features. A built-in electronic dictionary and vocabulary builder could help with explicit vocabulary instruction by giving an automatic exposure to its meaning, especially when the definitions are provided at an appropriate reading level.

E-books could help students who are deaf or hard of hearing foster the gathering of conceptual knowledge by giving access to the world via hyperlink to online materials. For example, a student may read a digital text on the life cycle of an animal, and then click on a hyperlink in the margin to watch a captioned video about the American bullfrog in his habitat. This link provides these students with an explicit, concrete example of the content.

Students who are deaf or hard of hearing could become aware of their reading fluency (or dysfluency) with the text-to-speech and recording features.  When a child hears the story being read to them and then records his or her own voice, the student becomes more metacognitive about his or her reading, which could lead to self-correction and improvement in reading errors.

In summary, the National Education Technology Plan suggests that students be exposed to different types of technology in order to motivate, engage, and promote learning in and outside of the classroom. If we expect students who are deaf or hard of hearing to be college- and career-ready, exposure to and use of this technology could benefit them greatly, and possibly *more* than hearing students. Above all, it is necessary to conduct research on the effectiveness of e-books on reading comprehension and vocabulary knowledge of students who are deaf or hard of hearing.

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