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Enhancing Preservice Science Teachers' Use of Text Through E-Readers

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The future for primary and secondary school textbooks is moving to digital ones, and faculties of schools, colleges, and departments of education (SCDEs) need to prepare preservice teachers for this change. Already, legislatures in 23 states have mandated that school systems use digital textbooks or digital resources as part of their textbook resources, thus shifting the definition and conceptions of the term textbook. In addition to added functionality (i.e., highlighting and dictionary functions), electronic textbooks allow the teacher to choose, edit, and modify text, becoming a more active consumer of curricular materials. This shift brings challenges as preservice teachers adapt to integrating this new technology into their practice. They need greater opportunities to manage this technology to select and adapt text to better match the curriculum to student need and interest. To better prepare preservice science teachers, the researchers adapted the secondary science teacher education methods class to integrate digital textbooks into coursework. Their purpose was to investigate preservice science teachers' views about the uses of e-readers and e-text prior to their science methods course and their views of their use of this technology when they are required to incorporate them as a resource in their lesson planning.

A textbook can do much more than be on the one hand a mere statement of the results of reasoning, such as the ordinary geography or German grammar is, or on the other hand a mere statement of problems, such as the ordinary arithmetic or German reader is. (Thorndike, 1912, pp. 165-166)

To put things in a historical context, the textbook has been an evolving curriculum artifact for a long time. Just after the turn of the last century, education thinkers like Thorndike (1912) were already reconceptualizing the textbook and its role in schools. Now, over 100 years later, educators are still trying to determine how the textbook should be used to aid instruction most effectively.

The fundamental issues remain similar (e.g., teachers or textbooks as drivers of the curriculum, student challenges when using text in courses, cost of books); however, the advent of new technologies, like electronic text (e-text) and reading devices (e-readers) have added more complexity to the discussion. E-text and e-readers might be seen as a means to deliver traditional static text at a cheaper cost, but this view fails to capitalize on the power and versatility of editable, open-source text and e-reader applications.

In science classrooms, teachers have been known to rely heavily on textbooks (Driscoll, Moallem, Dick, & Kirby, 1994). Additionally, science textbooks have tended to be written above the typical student's reading ability (Budiansky, 2001; Chall & Conard, 1991; Merzyn, 1987) and have been especially difficult for students who are reading below grade level (Curtis & Millar, 1988).

In this article, we describe our work with preservice science teachers to more fully leverage the potential of this technology to modify the typical science text. The purpose of this project was to examine how preservice science teachers viewed their use of e-readers and e-text prior to their science methods course and how or if these views changed after they were required to incorporate as a resource in their lesson planning.

The increase in state and district mandates to use e-text helped drive the inclusion of this topic and the design of instructional activities in a secondary science methods class. The goals of these activities were to develop preservice science teachers' understanding and skills when using editable e-text and e-reader technology in their curriculum planning, an area in which there has been little focus in the research literature. To help meet these goals, we examined a sample of preservice science teachers' orientations toward the use of e-readers and e-text, in general, and as applied to their prospective classrooms using survey data. Next, based on this information, preservice teachers developed the technical skills regarding the use of this technology when addressing the needs and interests of their students through activities and projects in the methods course. Finally, we examined our preservice teachers' perceptions of this technology for use in instruction.

The Instructional Environment: Textbooks as Drivers of the Curriculum

To understand the contexts that surround the use of e-text and e-readers in K-12 classrooms, it is important to comprehend the prominent role traditional textbooks have played within their curricula. The concept of the textbook seems to have a fixed identity, often having an iconic and unchanging position in how people perceive education (Driscoll et al., 1994). Historically, commercially published curriculum materials such as textbooks were the mainstay for teaching in the United States (Goodlad, 1984). These published materials provided the framework, objectives, standards alignment, assessments, and more for many teachers, guided the curricula, and served as the daily concrete teaching materials to the students. Academic information was a relative scarcity, and the textbook was the only resource besides the teacher that provided content to students.

Still today, for many courses, textbooks act as a default-setting for curricula, often presenting students the facts learned in most subjects. Although more current data are not available, Stein, Stuen, Carnine, and Long (2001) estimated that "textbooks serve as the basis for 75 to 90% of classroom instruction" (p. 6), even though pedagogical content knowledge for teaching now would include the ideas of appraising, selecting, and modifying textbooks (as recommended by Ball, 2000).

Teachers have often used these books to help them organize their courses, decide what is most important to teach, and provide background content information (Ball & Feiman-

Nemser, 1988; Hutchinson & Torres, 1994). School districts typically have some kind of evaluative process for selecting their textbooks (as they have for many years; see Carus, 1990) that are used to create common curriculum across schools. Teachers often have little input in the choice of book assigned to their course (as noted much earlier by Ball & Feiman-Nemser, 1988), however, and may feel obliged to follow the book closely.

Another factor that contributes to the dominating role of the textbook in the curriculum is the teacher's content background. Science teachers may not be comfortable with the subject matter, especially when they work out of their certification area (e.g., biology instructors teaching physics). In these cases, the textbook has taken a prominent role in the curricular experience for K-12 students (Geddis, 1993). Experiences with such teaching methods has led a large portion of the public to regard these texts as the authoritative teaching tool, composed of accurate information and necessary to instruction.

Indeed, many teachers also rely on them to organize lessons and structure subject matter (an ongoing issue, as in Tyson-Bernstein, 1988). Published textbooks have been seen to both constrain and control knowledge and teaching (Apple & Jungck, 1990; Ball & Feiman-Nemser, 1988), which can then have the effect of limiting a student's opportunity to learn about that topic (Elliott, 1990).

In some ways these views toward textbooks as a driver of the curriculum is surprising. Many educators would say that these materials should be used as resources and assert that teachers who only follow a textbook's contents are teaching in a limited way (as did Hamachek, 1969; Romberg & Carpenter, 1986). However, today textbooks themselves are currently undergoing a shift from a static, paper-based tool to one that is dynamic and digital, providing a new opportunity for teachers to use these resources in a way that supports their instruction in a deeper way. In the next section, we discuss some of the factors fueling the increasing emphasis on electronic text in K-12 schools.

K-12 Schools Moving to Electronic Textbooks

The U.S. Department of Education's (U.S. DOE) Office of Educational Technology is working toward systems that allow educators to move beyond traditional, paper-based textbook models in which all students use the same textbook to one in which the content is more appropriate for the learner. The U.S. DOE's National Education Technology Plans of 2010 and 2016 promoted the concept of using open educational resources, such as digital open textbooks, as being more dynamic and responsive to the context of the classroom over print-based textbooks, while also providing a significant cost savings to school districts.

The Federal Communications Commission's (2015) E-rate program, a federal initiative to support technology in educational settings, is adapting to meet current school situations to help ensure that America's students receive effective education and skills to meet 21st-century challenges. E-text and e-readers can be more accommodating as teaching and learning tools for students and teachers over printed materials. For example, onscreen dictionaries can be used to address students' needs, including those for English for speakers of other languages (ESOL), and adaptable fonts and size on displays can be used with exceptional student education (ESE) students.

In an effort to increase access to this technology, Congress established the E-rate program to bring connectivity to all schools and libraries in America. The program now includes a component called Learning on the Go Mobile Pilots. Schools can use Learning on the Go E-rate funds to install mobile learning solutions through off-premises wireless connectivity for mobile learning devices, including digital textbooks (Federal Communications

Commission, 2012b). This connectivity allows students to use these devices even when they are not in school.

In addition to the national push toward digital textbooks by 2017 (Federal Communications Commission, 2012a), there is local and regional support for this change. For example, the governor of Florida signed legislation that will change the nature of textbooks in primary and secondary schools in the coming years. The passage of Florida Senate Bill 2120 in spring 2011 signaled to educators that the state legislature had decided the future of classroom textbooks will be digital. In the 2015-2016 school year, Florida PK-12 students switched from opening a paper book to flipping through one on an iPad, Kindle, or Nook Simple Touch (K-20 Education Code of 2010, 2012).

Florida is not isolated in this regard, as several states have called for the use of e-text. For example, the California state legislature passed a law that provides for the creation of free, openly licensed digital textbooks and the use of e-readers. Not only is state legislation changing technology and textbooks, but several schools and districts have made the shift to digital textbooks. Arizona's Empire High School in Tucson was one of the first U.S. public schools to switch to electronic textbooks in 2004 (Murray, 2004), and a 2006 Project Tomorrow NetDay survey found that 22% of middle and high school students were already using electronic versions of textbooks (Evans, 2007).

The creation of these options for these resources is not limited to states that use a state-adopted textbook model. For example, education officials in Georgia are working with CK-12 flexbooks (Williams, 2013). A flexbook is a digital textbook authoring platform, offered by the CK-12 Foundation (http://www.ck12.org/), which allows users to produce and customize content by repurposing it using different modules. Teachers can draw information from several sources to build the fullest picture of content. For example, when teaching a unit in chemistry on biochemical processes, the instructor can excerpt text directly from a biology textbook to provide salient, in-depth content about chemical processes. Teachers can select material that most directly relates to students' interest, backgrounds, and curricula. They can also choose the order in which the text topics are presented to match local curricular guidelines.

In Utah, a state network of school officials developed its own digital mathematics textbooks and worked on adding more e-books in mathematics, science, and language arts (Utah Education Network, n.d.). Nationwide, teachers have been creating even more digital texts (DiLaura, 2013; Jackson, 2013; Niederberger, 2012; Schencker, 2013).

As an additional motivation for adopting digital books, the cost of paper textbooks has been on the rise: The U.S. Government Accountability Office reported that between 1988 and 2005, the cost of textbooks had nearly tripled (Government Accountability Office, 2005). An evaluation of five U.S. higher-education textbook publishers, representing more than 85% of college textbook sales, found an 82% increase in textbook prices since 2002, as compared to a 28% rise in the overall Consumer Price Index during the same period. Today, a quick perusal of a local college bookstore will show many books costing well over $100. In fact, according to Greco (as cited in National Public Radio, 2012) the average high school science textbook costs $105 (para. 15).

Upfront costs may be a source of resistance when K-12 schools consider e-text and e-readers, though upon closer examination this perspective may be shortsighted. An e-reader device that costs approximately $100 may look like an even greater expense than a pricey textbook, but the cost of the device is only paid once and allows the owner to load free e-texts or purchase others, often at a much lower expense than a print copy. To provide a content methods class with a set of traditional grade-level or discipline-specific science

or mathematics textbooks is very expensive. By using e-readers, tablets, laptops, or desktop computers loaned by the college or owned by individuals, users can have access to a variety of current, up-to-date e-texts for far less expense and in many cases for free.

Lowering textbook costs may have appeal to most affected stakeholders (e.g., school administrators, taxpayers, and college students,), but focusing only on this benefit fails to capture fully the opportunities e-readers and e-text offer educators to transform their practice. These resources provide teachers the ability to reimagine the relationship between course text and curricular decisions. To be sure, with these opportunities come specific challenges to teacher educators and preservice teachers. To better address these challenges, educators need to understand how e-text and e-readers are being used both by the general public and preservice teachers.

The Increase of E-Reader and E-Text Use

Overall, e-readers are increasing in prevalence. In January 2012, researchers from the Pew Research Center's Internet and American Life Project conducted a survey to gather data about ownership and use of e-readers or tablets (Rainie & Duggan, 2012). According to the report, 33% of Americans 16 years and older owned an electronic reading device such as a Kindle or an iPad, an increase of 18% when compared to survey results from the previous year. There was a similar change with the general population, with the number of people who read e-books rising in 2014 to 28% (an increase of 7%), and a drop in printed book readers to 69% from 2011's 71% (Zickuhr & Rainey, 2014). This shift from print to digital reading has been found in younger ages as well, as might be expected. In Scholastic's (2013) report, titled *Kids and Family Reading Report*, researchers found that approximately half of the pupils aged 9-17 reported they would read more books for fun if they had greater access to e-text. The pressure to shift to digital also applied to the classroom: A majority of K-12 pupils have stated that they also want to start using their mobile devices within the school classroom not only for reading, but for all content areas (Booker, 2013).

These trends hold when examining e-text use and ownership among students at our university. In surveying a sample of preservice teachers who were in the process of entering a college of education, a group of mostly freshmen and sophomores, Cavanaugh and Eastham (2014) found that 87% had smartphones with Internet and application abilities, 41% already had their own e-text reading devices, 29% had their own tablet device such as an iPad, and 12% were limited to using a desktop or laptop for e-text access. They also reported that a majority (69%) was already reading e-text for their own enjoyment, choosing digital content more often.

Electronic reading devices in the form of e-readers, tablets, and smartphones are commonly used technology in the general population. From 2010 to 2012, the number of tablets in use has approximately doubled each year, from 5% of the population in 2010, to 10% in 2011, and 19% in 2012. It was estimated that in 2012, 29% of adults had either a tablet or an e-reader (Rainie, 2012). Some individuals have multiple devices that can act as readers (i.e., smartphones, tablets, and e-readers).

Other studies are finding similar results. In Project Tomorrow's (2013) Speak Up survey, researchers found that approximately 50% of high school students and 40% of middle school students owned or had personal access to a smartphone — a 400% increase in 5 years — with 67% of their parents having smartphones. At slightly less than a majority of the total population, digital device saturation is nonetheless significant.

Because of financial, legislative, and technological changes, the use of open-source digital textbooks is likely to increase in the future. Therefore, it is important to integrate digital textbooks into preservice teacher education programs. To help preservice teachers in our program to be effective in this digital environment, we introduced the use of e-readers and e-text into the science education curriculum in our secondary science methods courses.

Purpose and Research Questions

The primary goals of the project were to increase preservice science methods teachers' understanding of e-readers and e-text and for them to incorporate this technology into their curriculum planning. Toward this end, and to better comprehend their perspectives concerning this technology prior to instruction, we administered a survey that examined their attitudes toward the use of e-readers and e-text and the ways they might use such technology in their classrooms. Preservice teachers were taught how to use the technology and modify text for use in their science curriculum. After the instruction, we examined how our preservice teachers viewed the potential use of e-readers and e-text in their future classrooms. The research questions that guided this work were as follows:

1. How did the preservice secondary education science methods teachers in our study view and use e-readers and e-text prior to their methods course?
2. Were there differences in preservice secondary education science methods teachers' views of their use of e-readers and e-text after they were required to incorporate them into a lesson plan as part of their methods course?

Method

The instruction described in this article incorporated several textbook resources, including CK-12 Foundation (www.ck12.org) and Florida's Orange Grove (http://florida.theorangrove.org), both of which provide current open-source text appropriate for the secondary science curriculum. As part of an undergraduate secondary science methods course, the university faculty member Brian Zoellner guided the preservice secondary education science methods teachers through the open textbook design, showing them flexible book options for adapting and building their own textbooks, as well as exploring options for differentiated instruction.

Preservice teachers incorporated e-text and e-readers into a lesson design project to give them the means to better address the needs and interests of their students. We undertook this work to understand better how preservice secondary education science methods teachers viewed and used e-readers and e-text prior to their science methods course and how they viewed this instructional resource after incorporating it into their lesson planning as part of a course project.

Participants and Context

The project took place at a midsized regional public university in the southeastern U.S. within a college of education with a student population of approximately 1,000 students. It was conducted within two semester-long secondary science teaching methods courses. The course was chosen as a sample of convenience; however, because of the challenges K-12 students typically face with both the terminology and the abstract nature of science subject matter, we believed that the nature of the e-reader and e-text technology would be useful in addressing this subject.

Participants were recruited from the secondary science methods course via email to complete online surveys pre and post instruction. The courses had 14 preservice secondary education science methods teachers each, for a total of 28 across two semesters during fall 2012 and 2013. The population included students of mixed ages (span of 18-45 years of age), backgrounds, interests, and personal commitments (i.e., families, full-time jobs, etc.). Ethnicity was predominately Caucasian. Of the 28 students in the two courses, 15 agreed to participate in the preinstructional survey (60% female) and 14 agreed to complete the postinstructional survey (71% female). Participants for both surveys were drawn from the same pool of students, with one participant failing to complete the postinstructional survey after completing the first survey.

To teach the preservice secondary education science methods teachers e-text and e-readers technical skills, they were loaned a Nook Simple Touch e-ink e-reader to use throughout the semester. These were purchased using a college teaching improvement grant from the university foundation fund. The Nook Simple Touch was chosen because of its nonpropriety e-text format (ePub) and the support facility in close proximity to the university. Providing preservice teachers an opportunity to work with the e-reader platform and using digital text is important in teacher education, as this type of technology is becoming a mandated format in area K-12 schools.

The first step in teaching the preservice teachers about the Nook was to familiarize them with the Nook's Simple Touch platform. After receiving their devices, they were tasked with loading class readings onto their loaned devices for their own use. The intent of this activity was to provide the preservice secondary education science methods teachers with a straightforward task that allowed them to use the devices. Tasks like loading a PDF document onto the e-reader were intended to help preservice teachers become more familiar using the technology.

For the novices, these activities allowed them to explore the technology and develop skills. The more experienced users learned how to use a new platform, since none of them owned a Nook Simple Touch. The preservice teachers were encouraged to work with each other to troubleshoot issues and use the e-readers for in-class activities in the science methods course. Those users who had difficulty were ultimately successful and able to learn multiple ways of working with the devices.

As the second set of experiences to promote the preservice teachers' use of the Nook Simple Touch devices, they were asked to prepare science lesson plans with them. As part of the project requirements, preservice teachers designed their lesson to (a) delve deeply into an important scientific topic (lasting from one to five class periods), (b) help their students answer an important research question, and (c) address a pressing societal issue. Within the design of those lesson plans, they articulated their use of these devices in accessing specific content knowledge appropriate to their lesson plans. Additionally, they identified opportunities for the use of e-text to differentiate instruction for students with identified exceptionalities, such as ESOL learners.

Part of this process was to inform them about free electronic text sources available, specifically the Orange Grove Digital Repository and CK-12 websites (see Figure 1), which provide open textbooks for math and science at a variety of grade levels and courses. After learning about the websites and their capabilities, the preservice teachers selected text that was relevant to their respective secondary school science topics that included climatology, plate tectonics, and genetics.

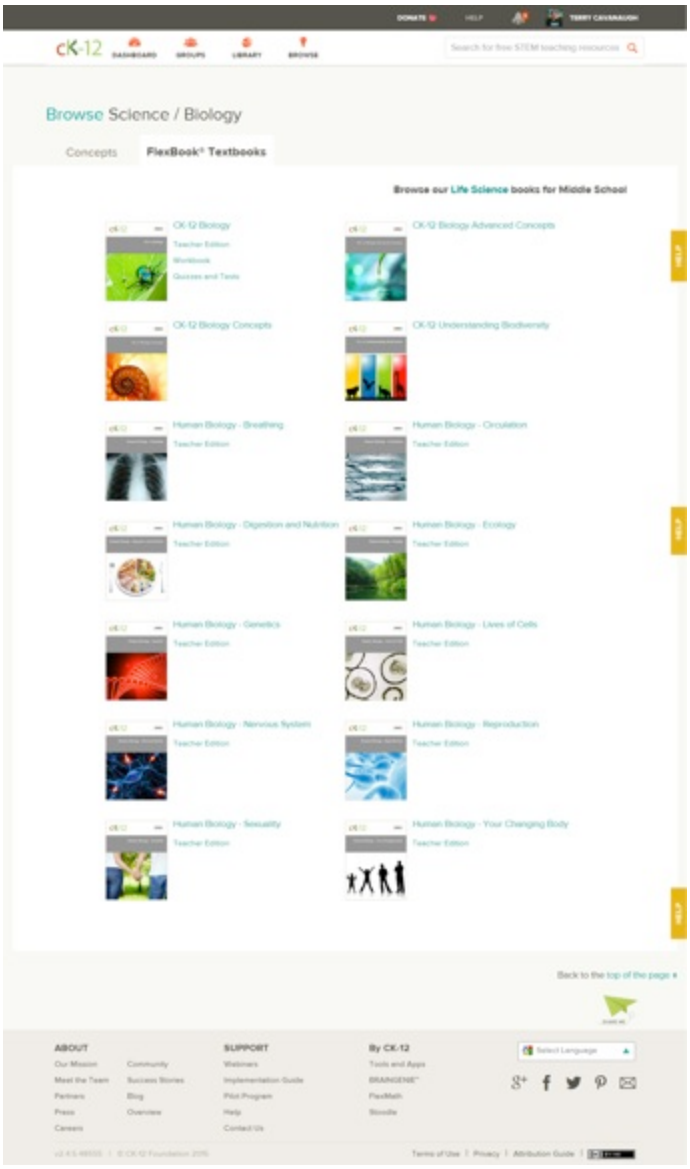

Figure 1. *Screenshot from CK-12 website. This figure shows several open-source biology e-books on the website.*

As the third step, the preservice teachers were taught how to use software such as Microsoft Word to rate the reading level of the texts they selected to provide ESOL students with appropriate material to match their reading skill level. Additional available adaptive technology included the use of text display options, a search function instead of an index, and text-to-speech applications, digital annotation, and auto-summary tools. They also chose different sources of editable e-text to create reading materials most relevant to their lesson topic. Figure 2 shows an edited physical science e-text.

Figure 2. *Screenshot of edited physical science e-book. This figure shows how preservice teachers can edit text to meet the specific needs of their classrooms.*

Finally, the preservice teachers described explicitly how they incorporated the e-reader and e-text into their lessons. As a reflective component, they justified their e-text and pedagogical choices to explain how they met the needs of their students and created relevant readings for their lesson topic. This requirement is outlined in our rubric (see Figure 3).

e-Book/e-Reader Incorporation	0	5	7	10
	No use of e-Reader or e-Book as part of plan	Use of e-Reader or e-Book mentioned as part of the lesson plan	Use of both e-Reader and e-Book discussed and made a key resource to students	Use of both e-Reader and e-Book discussed and made a key resource to students. Analysis of e-Book use included and tied to the needs and interests of students

Figure 3. *Excerpt from lesson plan rubric. This excerpt describes the e-book/e-reader elements necessary for preservice teachers' lesson plans.*

The uses of e-text and e-readers included gathering supplemental readings for background information related to the topic of the lesson plan.

The instructional activities centered on both developing basic skills using e-text and the Nook Simple Touch e-reader and incorporating this technology into an inquiry-based lesson plan related to an important topic in science. All preservice teachers used the e-text and e-readers in their science methods classes to explore and create resources for digital text to be used as a tool for differentiated instruction.

Instrument

To assess participants' background and dispositions about technology through their self-reported skills and attitudes toward the use of e-readers and e-text, we administered pre- and postinstructional surveys online. Outside of class time, 54% of preservice teachers volunteered to complete the preinstructional survey in the first weeks of the course.

The preinstructional survey contained 37 items. We began with general demographic questions (e.g., age, gender, and occupation), and a block of 17 questions was used to capture preservice secondary education science methods teachers' descriptions of their personal use of technology and e-readers (e.g., the use of the Internet, smartphones, and e-readers for their university courses and work within secondary classrooms). Likert-type questions were also used to investigate the preservice teachers' attitudes about various statements (e.g., "I love technology," and "I rush out to buy the latest electronic gadget."). The preservice secondary education science methods teachers were provided a range with five items (1 = *Strongly Agree*, 3 = *Neutral*, and 5 = *Strongly Disagre*e). To justify and support their ratings, students were given open-ended questions.

The questions of the postinstructional survey concerning the project were the same as the preinstructional survey; however, the postinstructional survey included 10 additional questions about their specific use of e-readers in the secondary science methods course for both lesson design and use for course readings and ways they might use the technology in the future. Fifty percent of the preservice teachers completed the postinstructional survey outside class time.

Data Analysis

We analyzed the pre- and postinstructional surveys through both quantitative and qualitative methods. We conducted descriptive statistical analysis by calculating the means of the closed-answer and Likert-style questions to determine trends in agreement, disagreement, or neutrality toward survey statements. We tallied technological and e-reader and e-text usage and preferences using number counts using these questions. Finally, short answer responses were examined for emerging themes and used strictly to support Likert- and closed-answer questions. Here, we looked for positive, negative, or neutral attitudes toward the use of e-readers and e-text and specific examples that participants used to support their positions.

We coded and tallied the qualitative responses to these questions for preservice secondary education science methods teacher views toward e-readers (as in Glaser & Strauss, 1967; Strauss & Corbin, 1998). A response to justify a negative view toward e-text would be, for example, "[I prefer paper text] because I can write notes on the pages and use highlighters."

We also examined and tallied open-answer responses to find emerging themes. For example, the storage capacity of e-readers became a recurring response among the preservice secondary education science methods teachers. Responses coded for "storage capacity" included, "It contains a lot of books on hand," and "There are many books that can be on it at any one time."

Limitations

Due to the exploratory purpose and the design of this study, there are several major limitations important to note. First, the instrument used was not validated and was limited in the depth in self-reported responses. Second, the small sample size at a single institution

and recruitment focused on strictly future secondary science teachers limits the generalizability of our findings. Without comparison groups, causal claims cannot be made. Finally, e-book technology is in a state of flux, with new versions being released on a regular basis, and as such, the device in this project is a limitation as applied to this situation.

Results

To answer our first question, we examined how preservice science teachers viewed and used e-readers and e-text through the preinstructional surveys. With the diversity of preservice teacher background and technology within the participant pool, we anticipated high variability in their use and views of e-readers and e-text, and the preinstructional survey data supported this assertion.

As related to usage of e-readers, some had their own devices that they used for recreational reading or to retrieve class materials, but this minority was small. According to the data they did not use e-text or e-readers as their primary reading source for course materials. The open-ended responses presented us with a view of preservice teachers as either being resistant or ambivalent to e-text and e-readers. However, they reported feeling at ease using electronic content for secondary school use, with 100% of the preservice teachers reporting being comfortable using the Internet to find class materials and 80% agreeing or strongly agreeing with the statement "I have incorporated content from the Internet into lesson plans."

Although 67% of respondents had used e-readers or e-text, most preservice teachers reported preferring to read from paper text, with 67% stating that they agreed or strongly agreed that they preferred paper to electronic text on the preinstructional survey. The following are exemplar quotations reported in the open-ended questions:

- "I don't have to remember to charge my book."
- "I seem to retain information better when I read it on paper. Something about physically holding the materials makes me feel more connected [to] it. I also find that I am able to actually find the information I need much faster when I'm using a physical source."
- "[e-text] hurts my eyes."
- "I have never really used an [e-reader], but if [I] have to read long articles [I] prefer to print them out and have a hands-on copy."

Preservice teachers reported completing their readings in other courses through iPads (and brought them to class to use), but others preferred to print the e-text and then handwrite notes on the hard copies.

E-reader ownership was higher when compared to available data on the general public (Hitlin & Rainie, 2005; Jones, 2002; Stage of Life, 2012), with 47% of preservice teachers owning an e-reader of some kind; however, those who did not own a reader had no plans to buy one. Justification for the choice not to buy a device included not having to deal with functionality issues (five of nine open-ended responses addressed functionality) associated with technology (e.g., challenges taking notes on the text), the preference for holding a physical copy of a course-required reading, and a desire to read from paper texts.

The preinstructional data also shed light on preservice teachers' perspectives when using this technology in their own classrooms. None of the 15 had negative responses to the statement: "I see the potential of using e-readers in a classroom to enhance

instruction." They observed issues using e-readers, but they also saw possible benefits. They liked the portability (60% of open-answer responses addressed portability) and the capacity (67% of open-answer responses focused on capacity) to store multiple books on the devices.

They viewed e-readers as being fragile and were concerned about the costs of upkeep, but they liked their ability to link to more information than a hardcopy textbook. Preservice teachers were willing to use the technology but were vague in their descriptions of how they would use it in their teaching practice. For example, they discussed the increased storage capacity of the e-readers, but did not discuss how it might support student learning in their classrooms.

In summary, preservice science teachers were hesitant to use e-books and e-readers for their own uses, but they saw some potential for using them with their future students once they become classroom teachers.

To answer our second research question, we examined the differences in preservice science teachers' views of their use of e-readers and e-text after the inquiry lesson project in the secondary science methods course. We discovered differences in preservice teachers' views of their use of e-readers and e-text. Overall, their ability to describe examples of how to use the technology in their secondary classrooms increased. The postinstructional survey data showed that most preservice teachers considered themselves users of e-books (86% respondents). Only 14% of participants said that they would not buy an e-reader.

Analysis of the postinstructional survey data showed that the preservice secondary education science methods teachers still had some resistance to e-books and e-readers when they shared some of the challenges and drawbacks of using the technology. In their open-ended answers discussing their reading, 43% of preservice teachers made negative statements toward e-readers in their responses. Seventy-nine percent stated that they preferred reading on paper due to perceived issues with the functionality of e-readers. This response included a preference for the tangibility and notation methods they used with books (e.g., ability to note progress when reading, handwriting notes and highlights directly onto the text). They also described some difficulty converting some text files to a format compatible to the device.

Although preservice teachers still saw drawbacks with the Nook Simple Touch, they were more specific about the features they could use in their classrooms. The preservice teachers noted the advantages of utilizing these devices to help students with exceptionalities. They discussed the use of the zoom functions, referring to the resetting of text size and the ability to control the amount of material on each page. Examples of loaded e-books on an e-reader can be seen in Figure 4.

They reported being more likely to use e-reader and e-text technology in their own instruction; 57% of respondents saw potential in using e-readers in their classroom, while three were neutral and one disagreed with this idea. Ninety-three percent of the preservice teachers agreed or were neutral toward the statement, "I would feel comfortable using e-readers as part of teaching a lesson." This was an improvement over 67% of the preservice teachers disagreeing or being neutral to the same statement in the preinstructional survey.

Figure 4. *Screen capture of science e-books from CK-12 on a Nook Simple Touch.*

In the postinstructional survey, 50% of preservice teachers reported liking the portability (e.g., size and weight) and the ease of loading documents. Fifty percent of the preservice teachers also shared functionality as an advantage of e-readers and e-text to address the needs of their students. This functionality included bookmarking, highlighting, note taking, audio, and built-in dictionary features, which was not noted in the preinstructional survey. In the postinstructional survey, they described some of the benefits of using the technology in their classrooms:

- "They are easily portable!"
- "The ability to link to other sources of information or to go online to learn more. I haven't seen this done particularly well yet, but the ability to present in-line video and animations of concepts is a huge advantage over physical books."
- "Pages are not ripped out, students have all their books in one place that they can take to all classes."
- "Access to more information."
- "Less weight for students carrying several books."

When examining the differences in preservice science teachers' views of their use of e-readers and e-text after the inquiry lesson project in the secondary science methods course, we discovered that preservice teachers were more specific in describing the benefits and limitations of using e-readers and e-text in their classrooms. As with other choices about instructional methods and materials, they saw benefits and drawbacks when choosing to use this technology.

Discussion

E-readers and e-text are becoming more prevalent in general society, and much is now known about the usage of e-readers within the general public (Anderson 2015). However, little research has been published about preservice teachers' preparation for the use of this technology in their classrooms. This understanding is overdue and will become increasingly important as governments push to make the textbook an electronic resource within classrooms. To provide perspective, during a 2006 National Science Foundation-funded workshop at the U.S. National Academy of Science, 50 scientists, educators, and technology professionals discussed the role of the textbook in the science curriculum (Bierman, Massey, & Manduca, 2006).

Sharing the shortcomings of printed text (e.g., student difficulty with vocabulary and finding relevant information and limited relevance due to long procurement cycles), participants highlighted the potential of e-text as adaptable and more responsive to student interest and need. However, they also identified a challenge of convincing faculty to embrace the technology. Our findings suggest that with professional development, preservice teachers report being more receptive to using e-text and e-readers to adapt text for use in their classrooms.

Existing research on in-service teachers indicates that greater support around the use of electronic text resources supporting textbooks is necessary (Eddy, Ruitman & Marsh, 2011), demonstrating a need for teacher preparation programs to develop skills around these technologies. Examining our data, we learned that if preservice secondary education science methods teachers already owned an e-reader device, they reported being more comfortable with their own platform and preferred reading on paper. This finding is important, as it indicates that they may not explore with devices on their own to become comfortable with differing e-reader platforms.

These preservice teachers assumed the role of consumers of text materials (i.e., using assigned text as opposed to choosing and modifying text for their own purposes). Restructuring and developing K-12 textbooks is outside the experience of most teachers, let alone preservice secondary education science methods teachers. Because of this lack of experience, they had not experimented with e-text and e-readers on their own. Therefore, creating activities for preservice teachers that require them to explore and understand this technology is important. Their reported positive attitudes toward technology provided a good opportunity for experimentation; however, they needed to be convinced of the utility of the devices for their future teaching.

This finding illustrates an important challenge that faces teacher education programs: helping preservice teachers transition from the role of passive users of educational materials (a student perspective) to being more-active users or prosumers of materials (toward an educator/professional perspective). For example, teachers are often expected to provide differentiated instruction to students in schools today. A hardcopy textbook cannot be differentiated, but with these technological tools, teachers can better differentiate textbooks to the needs of their students, transforming their roles into more

active ones with the textbook by adapting and restructuring content or display. Through these kinds of experiences, future teachers can be shown how to be active users of the technology.

Eddy et al. (2011), when working with Pearson Chemistry, found that teachers reported greater student engagement using the electronic resources; however, they believed they needed additional training to use the electronic support structures effectively. Our study helps demonstrate how a professional development model for preservice teachers might aid in the gap in knowledge surrounding the adaptation of this technology. Additionally, in-service teachers in the study were concerned about the lack of available hardware needed to use the technology (Eddy et al., 2011).

The use of e-text and e-readers was shown to have been an important addition to the assignment, as it forced preservice teachers to consider thoughtfully not only the content of the background information, but also the reading level and length of the reading material. At the end of the science methods course, all preservice secondary education science methods teachers had created modified versions of e-text (i.e., they selected relevant text or modified text for varying reading levels). From this standpoint, a goal of helping preservice secondary education science methods teachers become more active users of the technology was met. They developed the technical skills necessary to implement e-readers and e-text into their planning.

Through the analysis of survey data, we have a greater understanding of preservice secondary education science methods teachers' preferences toward the technology and their need for technical skill development when creating instructional experiences in the science methods courses. However, because of the exploratory nature of this project, more research will be needed to examine this area in greater detail.

Conclusions

The change in textbook format from printed paper to e-text will likely create major challenges to teachers in how they approach planning their courses (Bierman et al., 2006; Eddy et al., 2011); however, it may also provide opportunities to empower them to modify and adapt e-text for their K-12 students.

To guide the design of teacher preparation program activities that address this curricular shift, though, it is critical to comprehend the opportunities and challenges e-readers bring. Although using e-readers and e-text has benefits, some challenges accompany preparing preservice secondary education science methods teachers to use them in their classrooms. The understanding that preservice teachers can have input and control of their textbooks and the ways in which they are used is a major paradigm shift for them.

Today's preservice secondary education science methods teachers have been living in a digital world, but teacher educators may be making assumptions about their ability to translate their personal use of technology into effective classroom pedagogy. Although the preservice secondary education science methods teachers in our study were comfortable with their own personal use of technology, they were not as familiar with its effective strategies and applications in the classroom. Research literature has shown that teachers usually teach as they were taught (Bennett, 1991; Britzman, 1991; Lortie, 1975), so their experiences as students in primary and secondary schools may form their guides to teaching. These days, those guides do not often include the use of digital textbooks.

From a technical perspective, we were concerned that preservice science teachers might not be familiar with the format of e-text or e-readers. For example, even though they might feel comfortable reading a magazine on a personal iPad, they might have difficulty loading and using college course material on a different reading device, such as a Nook Simple Touch. If students bring a device of their choosing or the district issues a different device than what the preservice teacher own, their unfamiliarity could result in a problem. To be better equipped to work with their future students, preservice secondary education science methods teachers must not only be skilled in using their preferred e-reader, but also in adjusting to different texts and devices they may encounter.

Existing orientations toward using traditional texts are changing with the increasing prevalence and uses of e-readers and e-text. In the Digital School Districts Survey conducted by the Center for Digital Education (2016) and the National School Boards Association, 62% of school districts had adapted their curriculum for digital content, an increase of 13% in 1 year, with 38% integrating open educational resources. The efforts described here attempt to address more fully the current needs of both our preservice (2016) teachers and their future secondary students. Our preservice (2016) teachers were experienced using technology in general, but they were not familiar with all the formats and platforms of e-readers and e-text.

Additionally, they have been users of e-text and e-readers, but they may not have been purveyors and guides when helping others work with this technology. In this sense, teacher preparation programs need to improve instruction, not only concerning how to integrate digital text, but also how to help preservice teachers understand the benefits of this technology: This shift will allow preservice teachers to take a more active role in developing curricula, helping them select text, and aiding in their adaptation of text for multiple populations of special needs. Doing so will empower preservice teachers to see themselves as active contributors to the development and use of their textbooks as they shift to an electronic format.

This project's goals exemplified how we are addressing the national standards for teacher competencies and integration of technology (Council for Accreditation of Education Preparation (2013). Within these standards is the statement that teachers should "design or adapt relevant learning experiences that incorporate digital tools and resources to promote learning" (International Society for Technology in Education, 2008, para. 8). In addition, these standards call educators to:

1. Identify structures and abilities related to digital textbooks;
2. Identify the reading and learning components in the digital textbooks;
3. Adapt the digital textbook for differentiated learning experiences and for ESOL instruction;
4. Provide practical experience in the variety of ways students may use digital textbooks to access content;
5. Provide practical experience in using the structure, design, and tools of digital textbooks for more effective learning experiences; and
6. Provide practical experience in use of digital textbooks by teachers in curricular deliberations to more effectively design instructional opportunities.

After this initial work, we plan to expand the use of the e-readers and e-text in our teacher education programs. Future research is needed to provide a closer examination of the design of the instructional activities and ways in which preservice teachers develop curricula using e-text and e-readers. Gathering additional data centered on their ability to incorporate the technology will provide a clearer sense of the success of the methods course activities in supporting a more active role adopting these technologies in their practice.

We need a more structured evaluation of the curriculum created (e.g., modified text and use of e-reader tools) and the effects of instruction (e.g., evaluations tied to student learning gains and student engagement). To move beyond curriculum planning, preservice teachers will also need to implement this technology in the classroom. The design of the project reported here focused on curriculum planning but did not required preservice teachers to use this technology in instruction. As such, an additional area of e-reader and e-book use in teacher education will be developed during the teaching internship.

Subject-area textbooks have long been a part of teacher education, and preservice teachers need to learn and have experiences with effective textbook integration along with other topics, such as reading in the content areas. The textbook as a digital option is something our preservice secondary education science methods teachers are aware of, but many lack experience using them. Our research indicates that teacher educators need to integrate digital textbooks as curriculum tools to better prepare preservice teachers for their future teaching practice.

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