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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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ABSTRACT

Perceived Effects of Open Textbook Usage on
Secondary Science Classroom Practice

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Open Educational Resources (OER) provide openly licensed alternatives to commercial instructional materials. Proponents of K-12 OER suggest that their benefits include cost savings, increased access, improved quality, and increased teacher professionalism or empowerment. While the small body of K-12 OER research is growing, perceived benefits of K-12 OER usage have not yet been proven. The purpose of this qualitative study is to understand whether certain potential benefits were being realized by a group of secondary teachers using open science textbooks. In surveys and interviews, teachers were asked to describe their classroom practice before and after adopting an open textbook, including practices relating to openness. Teachers were also asked to rate the quality of open textbooks they were using in contrast to textbooks used previously. Most participants reported changes to practice, and the most commonly cited changes could be attributed to a combination of openness and online format. For example, participants described linking textbook content to other online resources. In comparisons of current to previous practice, however, teachers did not report increases in the open practices of collaboration, revising, or adapting.

ACKNOWLEDGMENTS

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CHAPTER 1

Introduction

Among the many challenges facing K-12 teachers in the United States is finding a textbook that fully meets teacher and student needs. Available textbooks may fall short in a variety of ways. For one, they may not be adequately aligned to state standards. Each state sets its own standards, but textbook companies are not likely to make separate versions for each set of standards. Even in the 42 states and four territories using Common Core standards, teachers have found that textbooks labeled as Common Core-aligned are not always well-aligned or that alignment was added as an afterthought and not as an intentional design decision (Common Core State Standards Initiative, 2016; Polikoff, 2015; Stern & Roseman, 2001). In cases where standards-aligned textbooks are available, schools that purchased textbooks before new standards were adopted may not replace textbooks again for several years, which means that teachers will have to teach multiple cohorts of students with materials that are not standards-aligned. Furthermore, even if classroom textbooks are aligned with the standards, they may not be developmentally appropriate or may not provide differentiated instruction to meet individual students' needs.

Where commercial instructional materials are not meeting the needs of teachers and students, some schools are turning to Open Educational Resources (OER). UNESCO (2016) defined OER as

> any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them. OERs range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation. (para. 1)

Proponents of open textbooks frequently cite three potential benefits of OER adoption: (a) cost savings; (b) increased access to quality content; and (c) teacher empowerment (U.S. Department of Education, 2015) or improved professionalism (Kimmons, 2016).

First, because OER can be freely copied, used, and shared, they tend to cost less than commercial resources. In a study of open science textbooks, Wiley, Hilton, Ellington, and Hall (2012) found that open textbooks could save schools fifty percent or more compared to commercial textbooks. In an age of shrinking state budgets, potential cost savings are a compelling argument (Hilton, Larsen, Wiley, & Fischer, under review). Money saved on textbooks can be used to pay teachers, to provide other instructional materials, or to balance budgets. However, using OER does not guarantee cost savings. In the same study cited above, Wiley, et al., (2012) found that teachers' printing small numbers of thick textbooks cost more than buying commercial textbooks. There are costs not only for printing, but also for developing and supporting openly licensed resources. Furthermore, reducing costs might not be a sufficient reason to replace commercial materials with OER. Administrators surveyed by K12 Handhelds (2015) reported that quality and features influenced their purchasing decisions much more than cost. Thus, cost savings alone may not lead to widespread adoption of OER in U.S. K-12 schools.

Perhaps more important than the potential cost savings, a second benefit of OER use is increased access to high-quality instructional materials. Because OER can be adapted, they can be updated, improved upon, and tailored to the needs of schools and individuals. These high-quality, low-cost resources can be used in all schools, including those with low budgets, thus improving equity. The challenge, though, is that not all OER are high quality, and identifying quality resources can be difficult. School administrators are familiar with commercial textbook

companies and their products. Most secondary science classrooms use commercial textbooks, and three publishers control 80-90% of the commercial market (Banilower, et al., 2013, p. 92). To most school administrators, OER publishers and products are relatively unknown. Breaking into the textbook market is expensive and complicated, with the textbook adoption process varying from state to state, district to district, and even within districts (K12 Handhelds, 2015). There is no formal body providing objective evaluations of available textbooks, either commercial or openly licensed. To meet student needs, OER must be high quality, and prospective users must be able to efficiently judge their quality.

Third, OER use can empower teachers as they adapt resources to meet student needs. Kimmons (2016) has identified three main professional benefits to openness, that come with OER use: (a) openness supports professional collaboration; (b) openness reduces isolation by connecting teachers and students to a global community; and (c) openness allows teachers to take on the role of content creators. While the flexibility of OER can be empowering, not every educator embraces openness. Administrators may not want teachers to make changes to approved instructional materials; teachers may not have time, inclination, or knowledge to adapt resources; and if teachers are going to take advantage of OER adaptability, they need the support and trust of administrators. Thus, the current power structures and expectations placed upon teachers might not be amenable to a paradigm of OER in which teachers must take on a more active role in curating, adopting, and adapting resources.

Likely due to the perceived benefits of OER, use of OER in the U.S. is growing. The U.S. Department of Education (2015) has promoted the use of OER, launching its #GoOpen campaign in October 2015. Since then, at least 91 districts and 19 states have committed to using openly licensed resources (Office of Educational Technology, n.d.). Through #GoOpen,

districts commit to replacing at least one textbook with an open resource, and states commit to using OER, developing and maintaining an OER repository, and sharing resources with other #GoOpen states (Office of Educational Technology, n.d.).

Statement of Purpose

At this point, the potential benefits of K-12 OER use are mostly theoretical; as of this writing, only a handful of studies have been published that include data indicating whether perceived benefits are being realized in K-12 settings. Most published OER research has focused on higher education, but the contexts are significantly different, so that separate K-12 studies are needed. This study will contribute useful information to the growing body of K-12 OER research by seeking to understand whether proposed potential benefits were being realized by a group of secondary teachers using open science textbooks.

Research Questions

The three research questions guiding this study were as follows:

1. How did use of an open science textbook affect classroom practices related to textbook use?

2. In what ways and to what extent were teachers making use of the open practices of revision and collaboration?

3. What was the perceived value of the open textbook being used?

In the first research question, the term "classroom practices" can be variously interpreted. For this study, I was primarily concerned with those classroom practices related to textbook use, such as how frequently textbook readings were assigned and time spent preparing to teach using the textbook. For the second research question, I focused on two main aspects of openness or open practice: revision and collaboration. According to Wiley's definition of open educational

resources, "open" sources are "licensed in a manner that provides users with free and perpetual permission to … revise–the right to adapt adjust, modify, or alter the content itself" (n.d., para. 1). Collaboration has been cited as a characteristic and benefit of open practice (Bliss & Patrick, 2013; Kimmons, 2016). Addressing the third question helps us to understand whether perceptions of textbook quality may have affected teacher practice.

CHAPTER 2

Literature Review

In the United States, most secondary science teachers use commercial textbooks, but some teachers, schools, and districts are turning to open textbooks to meet their needs. In the few studies to date, student outcomes with and teacher perceptions of OER have been positive. Both adoption and research of K-12 open textbooks are in early stages, but growing. For open textbooks to become mainstream, challenges to implementation must be addressed, and the theoretical benefits of open textbooks must be more thoroughly demonstrated.

In the 2012 National Survey of Science and Mathematics Education, 7,752 science and math teachers described their textbook use (Banilower, et al., 2013). Science teachers reported using "non-commercially published instructional materials most of the time" in only 20% of middle school and 23% of high school science classes (p. 92). When asked about activities used in lessons, science teachers reported that they assigned textbook reading at least once a week in 56% of middle school science classes and 37% of high school science classes, while teachers reported never assigning textbook readings in 4% and 10% of classes (p. 76). Teachers reported using texts published in 2006 or earlier in 52% of middle school and 60% of high school science classes (p. 96). In 71-76% of science classes, teachers rated the textbooks as good, very good, or excellent, yet half reported skipping parts of the textbook or module, and three-fourths incorporated supplementary activities from other sources (p. 98). To summarize, data indicate that in U.S. science classrooms, most teachers use commercial textbooks, rate their textbooks positively, and supplement their textbooks with other resources. But commercial textbooks do not meet every teacher's needs; about 20% of teachers are using non-commercial resources, including open textbooks.

To address these needs, early studies have indicated that K-12 open textbooks can be effective. In one of the first published studies of U.S. K-12 open textbook use, Wiley, et al., (2012) found that in 20 middle and high school science classes, there was no significant difference between standardized test scores of students using open textbooks compared with students using commercial textbooks. In a follow-up study, Robinson, Fischer, Wiley, and Hilton (2014) found that students using open textbooks in secondary science classes scored slightly higher than students using traditional textbooks, and researchers did not speculate on reasons for this improvement.

In a new study of student outcomes, researchers compared mathematic test results of elementary school students using OER with those of students using commercial educational resources (Hilton, et al., under review). No significant difference in test scores was found, "demonstrating that OER can replace conventional materials without impacting student performance, while potentially reducing costs and allowing for local modification" (Abstract). In all three studies, outcomes for OER use, including cost and student test scores, were comparable to or better than outcomes for conventional materials. To date, studies of outcomes have not provided data regarding how adoption of OER affected K-12 classroom practice.

In recent studies involving K-12 teachers' usage and perception of OER, teacher perceptions of OER have generally been positive. In an international study of K-12 teachers' usage and perceptions of OER, de los Arcos, Farrow, Pitt, Weller, and McAndrew (2016) surveyed 657 teachers from 72 countries. Of those surveyed, 85.5% (n=271) reported that they had adapted OER, 38.2% had created OER, and 10.7% had published OER. Most respondents reported that OER helped them meet diverse needs, differentiate instruction, provide broad coverage of curriculum, reflect on their teaching, and increase subject knowledge. They also

reported that OER increased student independence, self-reliance, satisfaction, and engagement. The authors concluded that OER facilitates personalized learning, which teachers were expected to provide. The de los Arcos et al. study provides a broad perspective about usage and perceptions but does not provide detailed examples of individual teachers' practice.

When comparing the quality of open textbooks with that of commercial textbooks, open textbooks may come out ahead. In Kimmons' 2015 study of perceived textbook quality, practicing K-12 teachers (n=30) evaluated three types of textbooks: commercial textbooks they had used, open textbooks offered through CK-12 and OpenStax, and open/adapted textbooks that the teachers had adapted to their classroom needs. Teachers evaluated the open/adapted textbooks as having the highest quality, 38% higher than commercial textbooks and 16% higher than open textbooks. The criteria assessed were accuracy, aesthetics, alignment, conciseness, formatting, media, readability, resources, supplements, and timeliness (e.g., up-to-date information). Open/adapted textbook rated significantly higher than commercial textbooks for each of the ten criteria. Kimmons' study provides a useful comparison of textbook quality but may not have given a complete view of the textbooks' values because the open textbooks being rated had not yet been implemented, and despite the high perception of open textbook quality, they have not yet been adopted widely.

While K-12 OER usage and research are in early phases, awareness, usage, and research are increasing, and this increase reveals a variety of benefits and challenges. In their 2013 evaluation of the state of the OER ecosystem, The Boston Consulting Group found that the movement is growing, but still far from mainstream. Half of the 308 teachers surveyed said they were aware of OER. Among non-users (n=212), lack of awareness was the primary reason cited for their non-use, while the factors that would most likely drive them to adopt OER were

proven efficacy and trusted quality. For those using OER (n=165), the top two reasons for adoption were flexibility and low cost. Users said that the key challenges to implementation were finding quality materials, especially for non-STEM subjects, and having to remix and revise materials to make them useful. Another challenge was knowing whether, according to intellectual property laws, public school teachers can legally share materials they create for their classrooms.

Given these challenges to implementing OER, sustainability is a significant issue for the field. In a summary of adoption and implementation practices for K-12 instructional materials, K12 Handhelds (2015) concluded that for districts purchasing K-12 instructional materials, quality was the key purchasing consideration; price was not a big factor; and additional features, "such as customization, assessments, data gathering and analysis, and professional development" were "essential to adoption" (p. 1). They reported that in survey responses, K-12 administrators showed ambivalence about open practice and the perceived benefits of open licensing. Butcher and Wilson-Strydom (2008) have suggested three keys to successful and sustainable OER development and implementation: (a) development should be demand-driven; (b) users (teachers and learners) should be involved in the creation; (c) investments need to be significant enough to produce high-quality materials. Butcher and Wilson-Strydom's work suggests that in situations where teachers choose to adopt open textbooks, are involved in the creation thereof, and are provided time, training, and compensation to produce high-quality textbooks, OER development and implementation should be successful. Another way to increase sustainability may be to focus on the theoretical benefits beyond cost.

One of the major selling points of OER is its low cost to users. However, the cost of adopting open textbooks may vary significantly depending on the adoption model (Wiley, et al.,

2012). Kimmons (2016) has argued that stakeholders should focus less on cost and more on the benefits of open practices, which promote collaboration, differentiation, and professionalization. As part of his study, practicing teachers (n=101) attended 3-day institutes in which they formed professional learning communities (PLCs), learned about and practiced creating open educational resources. Participants "uniformly believed that openness offers pedagogical, economic, and professional potentials for practice, but that major barriers to diffusion exist at the macro and local levels due to the political and economic realities of the teaching profession" (p. 1). Butcher and Wilson-Strydom (2008) have asserted that through reusability and low consumer cost, OER can support open learning principles, including access, flexibility, cost-effectiveness, and learner-centered education. In their report on K-12 OER state policies, Bliss and Patrick (2013) summarized several benefits of, barriers to, and recommendations for OER policy. The benefits cited were "collaboration and partnerships, increased knowledge sharing, cost savings and efficiency, quality improvements, support for independent learning, and communications and community engagement" (p. 4). The potential benefits for open practice are many and varied, including improved collaboration, differentiation, independent learning, quality, cost savings, access, flexibility, professionalism, empowerment, and community engagement.

Believing in the principles and benefits of openness, a group of educators founded the public charter school Mountain Heights Academy, originally called Open High School (Tonks, Weston, Wiley, & Barbour, 2013). The school's core philosophy hinges on two ideas: first, that education is a universal human right; and second, that education is sharing. Based on this philosophy of openness, the school shares all of the learning resources they produce, online, with Creative Commons licenses. The school uses 100% OER to promote openness, benefit

students, save money, and empower teachers. Tonks et al. asserted that openness benefits students by promoting flexibility in instruction and ongoing quality improvement. While the potential benefits seem like a logical outgrowth of the philosophy, in discussions of openness, the perceived benefits have been primarily theoretical.

The relationships among philosophy and practice, teacher and curriculum, are complex. Remillard (2005) has characterized the teacher-curriculum relationship as "a participatory relationship between the teacher and the curriculum" (p. 236). Remillard's framework is built on the assumptions "that teaching involves curriculum design and that it is multifaceted" (p. 236). Due to the complex interplay between teacher and curriculum, Remillard asserted, "[t]eachers require substantial support in learning to use new curriculum materials" (p. 239). Charalambous and Hill (2012) have applied Remillard's framework to multiple case studies, asserting that in discussions of instructional quality, teacher knowledge and curriculum materials should be considered together. In a 2015 study, Taylor, et al., suggested that there is a pedagogical advantage when a teacher's instructional materials align with the teacher's teaching philosophy. Rather than training teachers to adapt materials to align with their philosophy, the researchers trained teachers in the philosophy and rationale behind research-based instructional resources. Based on these authors' assertions, we could say that a teacher's experience with open textbooks would likely be affected by their teaching philosophy. Furthermore, one might expect that teachers who choose to adopt open textbooks would likely agree with a philosophy of openness, which philosophy would also translate into open classroom practice.

If curriculum and pedagogy are intertwined, then we should see shifts to open textbooks accompanied by pedagogical shifts; this interplay between open resources and open practice has not been previously researched. Drawing and building on previous research regarding the

implications of openness, the current study aims to show whether a group of teachers who began adapting and using open textbooks were realizing certain benefits of openness, including increased collaboration, revising, and adapting of material. Previous studies include large surveys about textbook use and perceptions of OER, as well as smaller studies regarding perceptions, cost, and student performance outcomes. This qualitative study will provide detailed examples of individual teachers' experience with open textbooks and provide some of the first data regarding how open textbook use relates to K-12 classroom practice.

CHAPTER 3

Method

In summer 2015, with the support of the Doceo Center for Innovation + Learning at the University of Idaho, secondary science teachers from a pilot school district adapted openly licensed science textbooks from CK-12, a non-profit foundation that provides free, open, online textbooks and other instructional resources (CK-12 Foundation, 2017). The following summer, 36 teachers from throughout Idaho met for five days to update the science textbooks for adoption in their classrooms (Doceo Center for Innovation + Learning, 2016). In small groups based on their courses of instruction, the teachers adapted five textbooks: Biology, Chemistry, Earth Science, Life Science, and Physical Science. Teachers began using the textbooks in their classrooms fall, 2016. Following the summer 2016 institute, participants continued working with and receiving technical and resource support from the center that provided summer institute training. In surveys administered by the Doceo Center, participants were asked to evaluate the training, to share their perceptions of OER, and to indicate what support they needed. Participants in the current study included 26 secondary science teachers who participated in the 2016 summer institutes and were using openly licensed science textbooks that they helped to create.

Participants

Participants included secondary science teachers in the state of Idaho who had adapted and adopted openly licensed textbooks in five subjects: Biology, Chemistry, Earth Science, Life Science, and Physical Science. Their students were in grades 7-12. Participants indicated a range of teaching experience. Thirty-eight percent had taught 0-5 years, while 31% of respondents had taught more than 15 years. All junior high and high school grade levels were

represented, and there was a fairly even distribution by grade. Eleventh grade was taught by the most participants (50%); ninth grade was taught by the fewest (35%). Several teachers indicated that they taught multiple grades.

All five open science textbooks were represented, but not equally. Only 7% of respondents used the Chemistry book, 11% used Physical Science, 19% used Life Science, 30% used Earth Science, and 33% used Biology. Most teachers reported that students accessed their textbooks online: 40% used online only, 44% used both print and online, and 16% used print only. An equal number of teachers had used commercial resources compared to alternatives (i.e., open textbooks or a variety of resources) during the previous school year.

Research Design

The current study is what Merriam (2009) refers to as a basic qualitative study: "The overall purpose is to understand how people make sense of their lives and their experiences" (p. 23). Data were collected using qualitative methods, including surveys and interviews. Data collection took place in early 2017 (January-April), after most participants had been using the resource for a semester.

Instruments

The instruments for this study included a survey and an interview question bank (Appendices A & B).

Survey. For the purposes of this study, I designed a survey aligned with the three research questions guiding the study:

1. How did use of an open science textbook affect classroom practices related to textbook use?

2. In what ways and to what extent were teachers making use of the open practices of revision and collaboration?

3. What was the perceived value of the open textbook being used?

The survey included a variety of questions about participants' classroom practice, textbook use, and perceptions (Appendix A). Questions about OER usage and classroom practice were modeled after questions from the 2012 National Survey of Science and Mathematics Education (Banilower, et al., 2013). For efficiency of data gathering, most questions were closed-ended, with responses based on a 5-point Likert scale. A few questions solicited open-ended responses to allow for detail, variety, and complexity of responses. At the end of the survey participants were asked whether they would be willing to participate in a follow-up interview. After participants had completed the survey, I ran Cronbach's alphas for two constructs, perceived quality of the open science textbook and perceived quality of the most-recent non-open science textbook. Each construct consisted of 15 items that used a 5-point Likert scale. Cronbach's alphas for the open and non-open perceived quality items were .908 and .932 respectively, indicating that the survey had high internal reliability for the constructs of perceived quality.

Interview. For use in semi-structured interviews, I created a bank of questions aligned with the research questions guiding the study. Potential interview questions were modeled after examples of effective interview questions from Merriam (2009). Through open-ended questions (Appendix B), I asked participants to elaborate on their classroom practice and perceptions of the open textbook.

Procedures

Initial data collection consisted of a survey administered to all participants, followed by follow-up interviews of a small group of participants.

Survey procedures. Cassidy Hall, of the Doceo Center for Innovation + Learning, emailed members of the target population and invited them to participate in the study. The survey had been constructed using Qualtrics survey software and was administered electronically. As stated in the implied consent form (Appendix C), completion of the survey implied consent to participate in the study.

Interview procedures. To triangulate the data and gather more detailed information about practice and perceptions, I conducted semi-structured interviews. In an effort to provide "reasonable coverage of the phenomenon" (Patton, 2002, p. 246; as cited in Merriam, 2009, p. 80), I interviewed five participants. Before each interview, I emailed each participant standard consent and video release forms, which participants signed and returned (Appendices D & E). Based on each participant's survey responses, I compiled an individualized set of relevant interview questions from the question bank. During each interview, I added follow-up questions as needed to gather more useful data about participants' experience with and perceptions of their open textbooks. Interviews were conducted via video conferencing software and lasted approximately 10-30 minutes each, depending on the length of interviewees' responses.

Data Analysis

During data analysis, I used descriptive statistics to identify general patterns regarding how teachers were using the open textbook, changes in classroom practice since implementing the open resource, and perceptions of the textbooks. For open-ended questions, I used content analysis to generate themes. I then sorted survey responses into categories representing the themes identified. From each category of responses, I purposively selected one or two participants who had stated a willingness to be interviewed, and invited them to select an interview time. Eight survey respondents provided contact information for follow-up interviews.

I initially contacted five participants, based on the categories indicated by their survey responses, but due to a low rate of response, I eventually contacted all eight survey participants, of whom five scheduled interviews.

Using content analysis, I transcribed, coded, and classified interview responses. To preserve confidentiality, I assigned each interviewee a non-gendered pseudonym (Table 1). In the initial coding phase, I used line-by-line coding to promote critical analysis of the data, and *in vivo* codes emerged from reading the data (Charmaz, 2006). I then added focused codes to refine, synthesize, and make sense of the data (Charmaz, 2006; See Appendix F). In the analysis process, I looked particularly for relationships between use of an open textbook and classroom practices.

Table 1

Interview Participants' Backgrounds

Pseudonym	Textbook	Grade level	Years of teaching
Alex	Biology	10	11-15
Bailey	Life Science	7-8	11-15
Chris	Life Science	7	6-10
Dana	Earth Science	8	0-5
Eddie	Earth Science	8	0-5

Rigor

Several steps were taken to strengthen the trustworthiness of the study. To enhance validity, survey and interview questions were aligned with the research questions identified for the study, and member checking was practiced in interviews. During analysis, I avoided forcing interview responses into preconceived categories and practiced negative case analysis, looking for alternative explanations that could explain phenomena, in order to strengthen credibility

(Merriam, 2009). While I was looking particularly for relationships between use of an open textbook and classroom practices, I acknowledged that teachers may not have changed their classroom practice after adopting an open textbook, and if they did change their practice, there may have been factors besides openness that led to the changes in practice.

CHAPTER 4

Results

The three research questions guiding this study were as follows:

1. How did use of an open science textbook affect classroom practices related to textbook use?

2. In what ways and to what extent were teachers making use of the open practices of revision and collaboration?

3. What was the perceived value of the open textbook being used?

Survey and interview results are presented separately below.

Survey Results

Twenty-nine survey responses were received; three responses were excluded from analysis, because the participant had provided only background information (e.g., grade taught, number of years taught, textbook used). The survey included branching, so that participants did not see all of the questions in the survey, and respondents were not required to answer every question. Therefore, the number of responses varied slightly among survey items.

Classroom practice. In the survey, several questions were asked about teachers' classroom practice related to their current and previous textbooks (Fig. 1). Overall, respondents indicated similar practices for both the open textbook and the previous textbook. About a quarter of respondents reported that they had assigned readings in more than half of their lessons using the previous textbook (23%); the number was slightly higher for the new, open textbook (29%). About a quarter of respondents likewise reported that for both the previous and the open textbooks, they had assigned questions or activities from the textbook in more than half of their lessons. When asked how frequently they skipped sections of the previous textbook, 42% said

they did so in more than half of their lessons, compared with only 33% who did so in more than half of their lessons using the new, open textbook. When asked how frequently they supplemented the previous textbook with outside materials, 63% said they did so in more than half of their lessons, compared with 48% who supplemented the open textbook in more than half of their lessons.
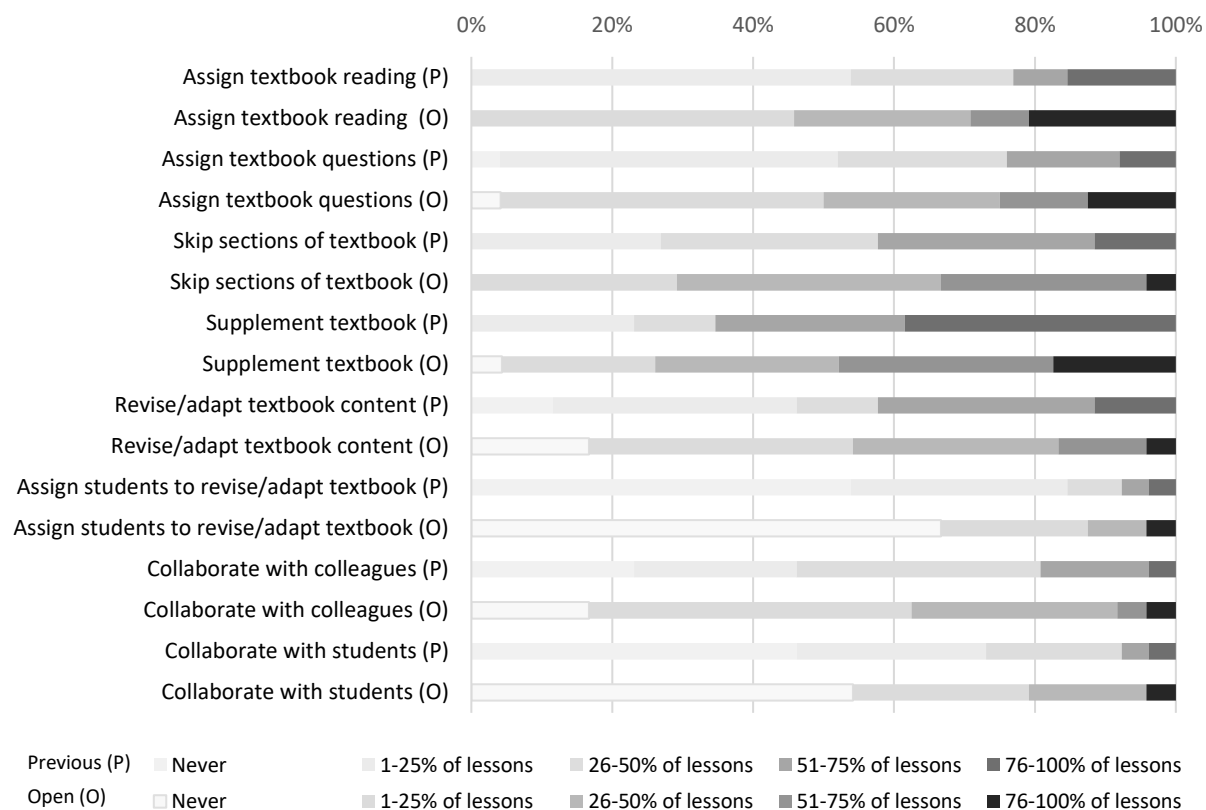
Figure 1. Frequency of certain classroom practices when using the previous science textbook (top bar) and the current, open textbook (bottom bar).

To compare classroom practice relating to open textbooks with practice relating to prior textbooks, we assigned each item response a score corresponding to its place in the Likert scale (1-5), then calculated and compared mean scores for open practice with the mean scores for previous practice (Fig. 2). A positive comparison score indicates that teachers reported higher rates of the practice while using their open textbook; a negative comparison score indicates that

teachers reported higher rates of the practice during use of the previous textbook. Participants descriptively reported that they were slightly more likely to assign readings, questions, or activities from their open textbooks than from their previous textbooks and were less likely to skip sections of the open textbook, supplement the open textbook, revise or adapt the open textbook, or collaborate with colleagues or students to select or adapt instructional materials while using the open textbook. All reported changes were small (less than 0.5). The largest reported changes in practice were a decrease in the frequency with which respondents supplemented the textbook with outside readings or assignments and a decrease in the frequency with which teachers revised or adapted textbook content.
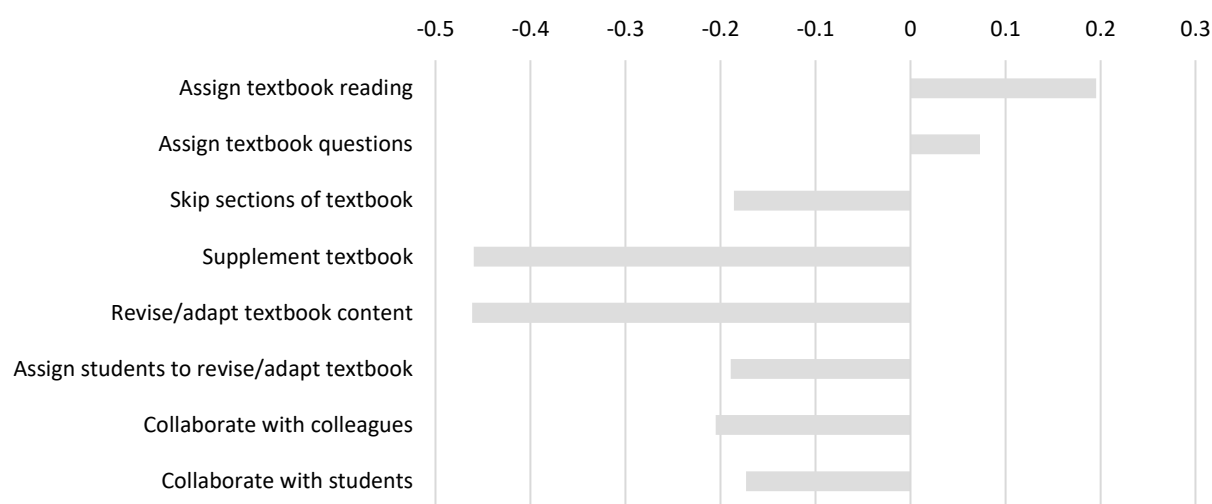
Figure 2. Comparison of frequency of certain classroom practices.

Mean scores for reported practice while using the previous textbook were subtracted from mean scores for reported practice while using the open textbook. In the figure, the scale is truncated to show small differences in mean scores. The range of possible differences was -4 to 4. A difference of 1 would be the difference between any two adjacent points on the Likert Scale.

In a separate question, almost all respondents reported that they had made changes to classroom practice after adopting an open textbook. When asked, "As a result of adopting an open textbook, how much have you altered classroom practice?" 4% chose "Not at all"; 35% chose "Minimally"; 39% chose "Some"; 19% chose "Considerably"; and 4% chose "Almost entirely." Those who reported at least "Some" changes to classroom practice were asked two follow-up questions. First, participants were asked the open-ended question, "What have been the most significant changes in your classroom practice since you adopted an open textbook?" Of thirteen total responses, two responses mentioned changes related to format:

- "Less printing"
- "Using more online."

Three responses mentioned changes attributable to openness, quality, and cost:

- "I don't need to skip around in the book and skip sections because the book is in the order I teach and includes the information my students need. There isn't a bunch of extra stuff."
- "More efficient coverage of required topics."
- "Assigned more reading."

Five responses mentioned changes that could relate to both format and openness:

- "Easier to use the best of all resources available."
- "The use of technology which is built into the text which allows me to add videos and other resources."
- "Flexibility and the allowance of independent student research."
- "The ability to use other online resources in conjunction with the text."
- "I can incorporate materials I want them to have directly into the text."

Two responses mentioned changes in practice that pertained to preparation and expectations:

- "Less time prepping"

- "No need or push to use adopted purchased textbooks."

Finally, two responses related to changes in outcomes rather than practices. These responses suggest that format and openness were the most common reported factors contributing to changes in practice.

Respondents reported that training and format were the factors that had most influenced changes to classroom practice. When asked, "Which factors do you think most influenced you to change your classroom practices since adopting an open textbook?" the factors that ranked most influential were "Involvement in the OER summer institute," "Textbook format (online)," and "Other training (not related to OER)." The factors that ranked lowest were "School or district mandates," "Life events/personal factors," and "Textbook content."

Participants who reported that they had changed classroom practice minimally or not at all as a result of adopting an open textbook were asked, "Why haven't you significantly changed classroom practice as a result of adopting an open textbook?" Of nine respondents, 67% chose "I didn't need to"; 11% chose "I can't think of any changes I would like to make"; and 22% chose "Other." Of those who chose "Other," one said, "I started the year off with a traditional text and need to work time into re-writing the curriculum"; the other respondent said, "Lack of tech to effectively implement." While challenges to implementation were a factor, most respondents who made minimal or no changes to practice indicated that the switch to an open textbook did not necessitate a need to significantly change classroom practice.

Most respondents reported spending about the same amount of time preparing to teach using the open textbook compared with their previous textbook. None of the respondents

reported spending more time preparing than they used to. Among respondents who reported spending less time preparing than they used to, follow-up explanations included the following:

- "I don't have to find as many supplemental resources"
- "I know this textbook better, but still have to find age app[ropriate] activities."
- "I trust that the reading is up to date. Previous textbooks were printed in 1999."
- "It is easier to put material in each section (easy to find)."

For the participants in the survey, adopting an open textbook had not led them to increase class preparation time, and some participants had decreased class preparation time because the open textbook was better, more up-to-date, and easier to use than their previous textbook.

Perceptions of quality. Participants were asked several questions regarding their perception of both their current, open science textbook, and their most-recent non-open textbook. Overall, respondents gave high ratings to both their open textbook and their most-recent non-open textbook but gave higher ratings to the open textbooks. By a ratio of 3:1, respondents said they preferred their current (open) textbook to their most-recent non-open textbook (77% vs. 23%; Fig. 3).
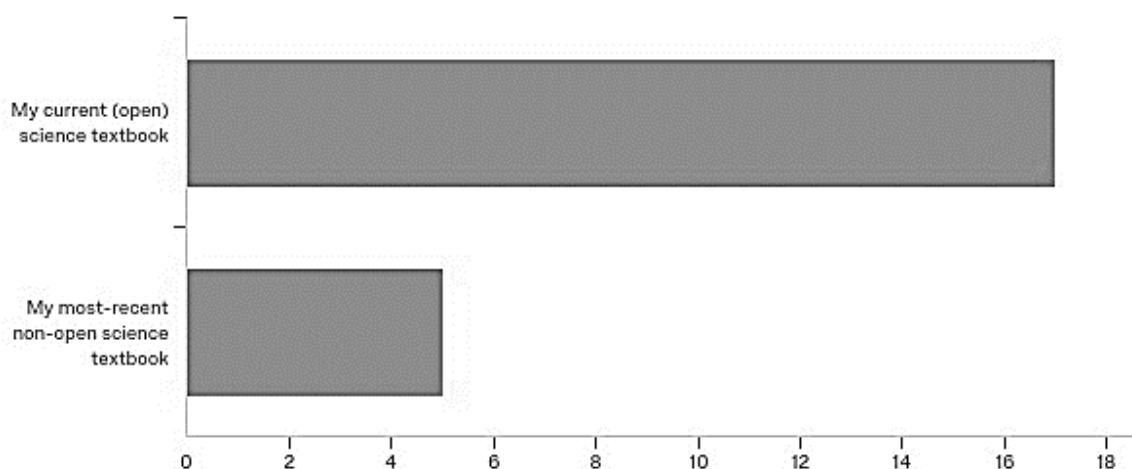
Figure 3. Preferred textbook.

Participants were asked to indicate their level of agreement with 15 separate statements about the quality of their current, open textbook, and their previous, non-open textbook. Regarding their open science textbooks, more than ninety percent of respondents agreed with the following statements (Fig. 4):

- "Content is accurate."

- "The textbook is easy to use."

- "The textbook contains few typos or other errors."

- "I would recommend the textbook to other … science teachers."

More than 80% of respondents agreed with statements that the quality was high; content was relevant, clear, and aligned to state standards; and the textbook was well organized and met their needs.

Fewer than half of participants agreed with the following statements:

- "Content is aligned to provided assessments."

- "Necessary teacher support is provided."

- "The textbook provides differentiation strategies to meet individual students' needs."
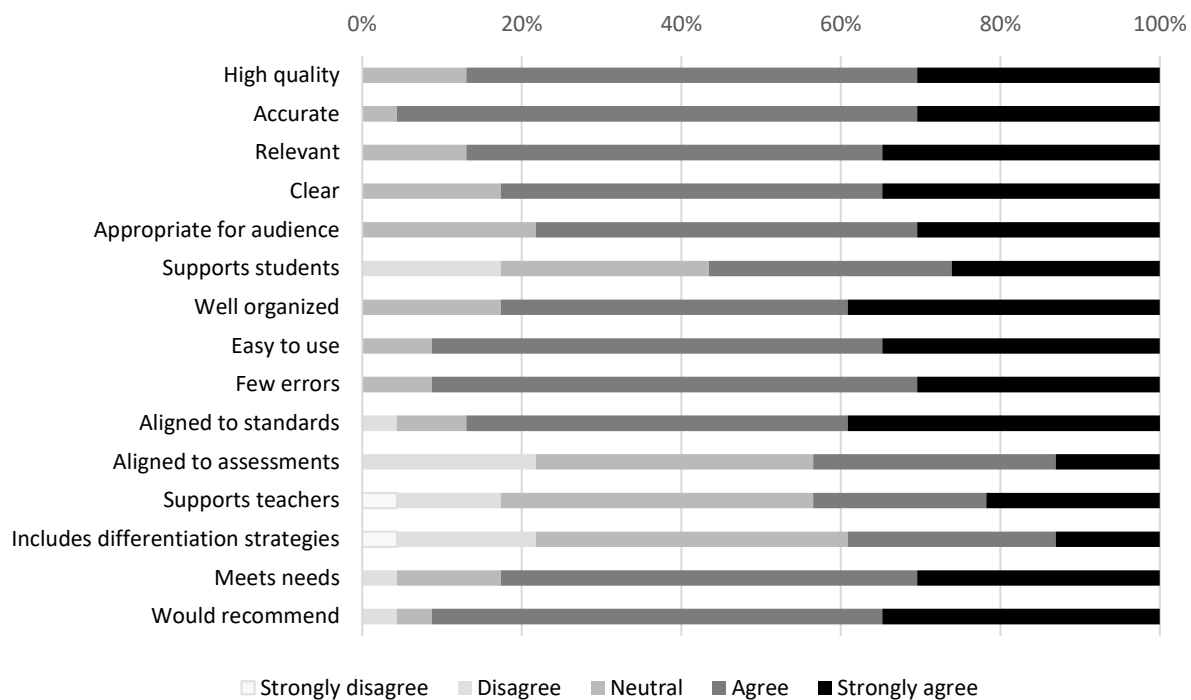
Figure 4. Perceived quality of open science textbooks.
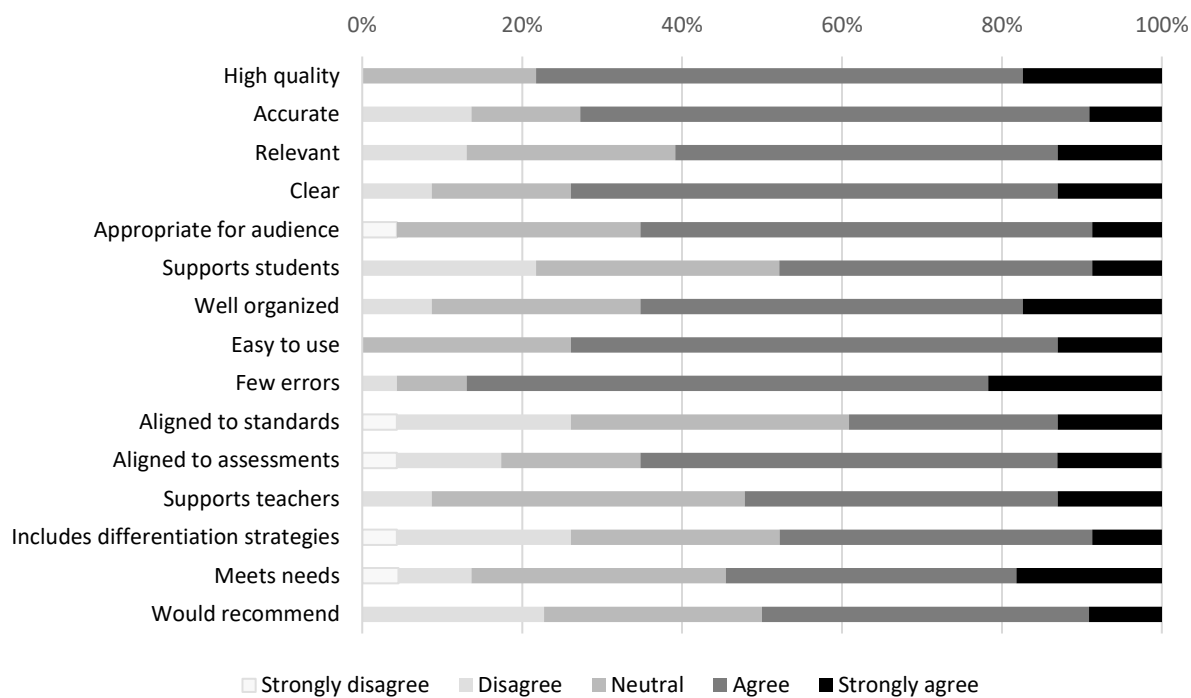
Figure 5. Perceived quality of non-open science textbooks.

Regarding their most-recent non-open science textbooks, more than 80% of respondents agreed with the statement, "The textbook contains few typos or other errors" (Fig. 5). Most respondents likewise agreed with statements that the quality was high; content was relevant, clear, appropriate for the audience, and aligned to state standards; the textbook was well organized, easy to use, and met their needs.

Fifty percent of respondents or fewer agreed with the following statements:

- "The textbook includes supports for above- and below-grade level students"

- "Content is aligned to state standards."

- "The textbook provides differentiation strategies to meet individual students' needs."

- "I would recommend the textbook to other … science teachers."

To compare perceptions of open textbooks with perceptions of non-open textbooks, we assigned each response a score corresponding to its place in the Likert scale (1-5), then calculated and compared mean scores for open textbooks with mean scores for non-open textbooks by subtracting the scores for previous, non-open textbooks from the scores for open textbooks (Fig. 6). A positive comparison score indicates that teachers rated the open textbooks higher than non-open textbooks; a negative comparison score indicates that teachers rated their non-open textbooks higher than their open textbooks. A difference of 1 would be the difference between two adjacent points on the Likert scale, such as "Strongly agree" and "Agree" or "Neutral" and "Disagree."
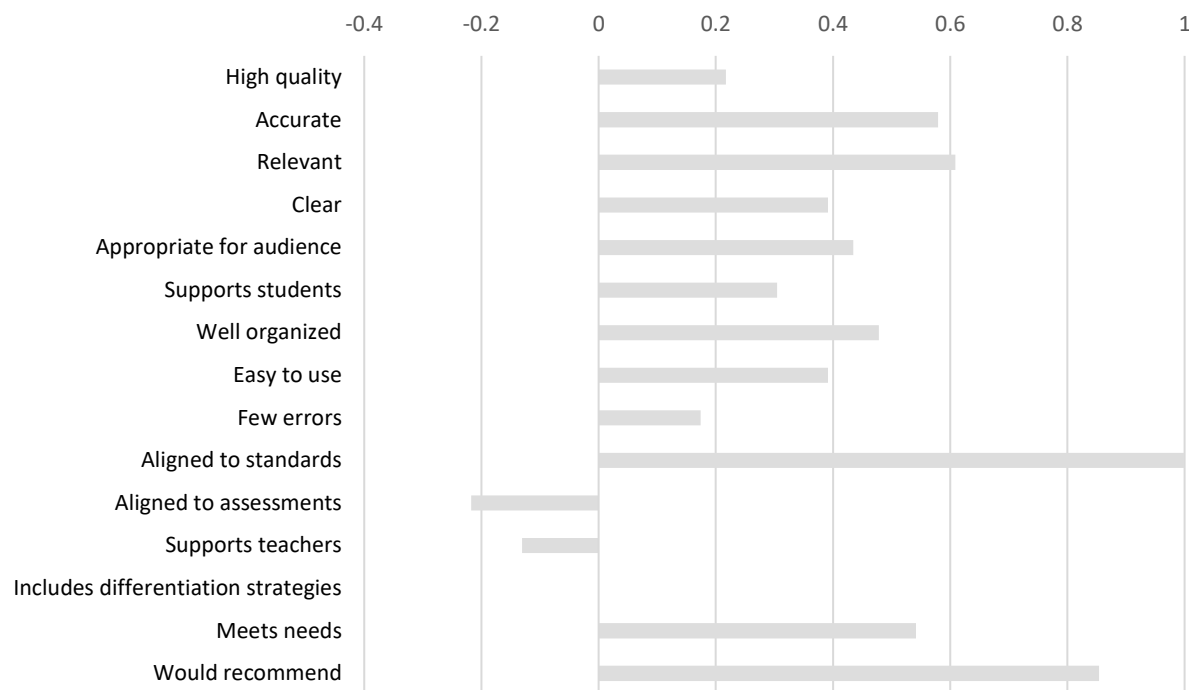
Figure 6. Comparison of perceived quality of open and non-open science textbooks.

Mean scores for previous textbooks were subtracted from mean scores for open textbooks. In the figure, the scale is truncated to show small differences in mean scores. The range of possible differences was -4 to 4. A difference of 1 would be the difference between any two adjacent points on the Likert Scale.

As shown in Figure 6, participants rated their previous, non-open textbooks higher on two measures: alignment to assessments and providing teacher support. Regarding the inclusion of differentiation strategies, mean scores were equal for open and non-open textbooks. For the other twelve measures, participants rated their open science textbooks higher than their previous, non-open textbooks. The categories in which respondents indicated the largest differences in perceived quality were alignment to state standards and whether the respondent would recommend the book to other teachers.

Most respondents who stated a preference for their previous textbook indicated that the previous textbook was higher in quality, while one respondent noted a problem with accessing the open textbook. The following statements explain their choice:

- "I checked non-open science book only because there was no option for both. …"

- [The previous textbook was] "More complete."

- "The non-open science book included more resources and materials, however it was expensive and our subscription to the online aspects expired."

- "The fact that [the previous textbook was] printed in color makes it more engaging for my students."

- Internet "[a]ccess is limited severely at my new school."

Participants who preferred their most-recent non-open textbook were more likely than the total sample to have used print-only versions of the open-textbook and more likely than the total sample to have reported only "minimal" changes to classroom practice. Of those who preferred the previous textbook, 40% reported using print-only versions of the open-textbook, compared to only 16% of the total sample. Of those who preferred the previous textbook, 80% reported "minimal" changes to classroom practice, compared to only 35% of the total sample. Participants who preferred the open textbook reported higher levels of change, but the number of participants who preferred their non-open textbook was too small (n=5) for a very meaningful comparison.

Interview Results

Five participants were interviewed. All five interviewees said that they were currently using an open science textbook in only one subject, though two interviewees were teaching multiple subjects. As shown in Table 1, interviewees used three of the five textbooks and had a

range of teaching experience. The small sample, though self-selected, was somewhat representative of the population surveyed in terms of diversity, but did not represent all textbooks or grade levels taught.

Classroom practice. Two of the three research questions guiding this study relate to classroom practice. In interviews, I asked participants to describe their transition from non-open to open textbooks, their experience with using open textbooks, and changes to classroom practice.

Transition to open. When asked, "What was it like for you when you started using the open science textbook?" interviewees described fairly smooth transitions. Dana said, "Kids didn't really get used to it for about a month, and then they got used to it, then it went fine." Alex said, "It was a little bit of a change," but the district had adopted iPads the year before, "so that made that transition a little bit smoother. … There's still kids that really just want that older—the traditional—just because that's the ones they're familiar with." Another interviewee similarly reported minimal changes to classroom practice after adopting the open textbook, explaining,

> Because we used technology beforehand. … we've had iPads in the classroom for four
> years now. … So, four years ago I switched to using, … all kinds of apps and resources,
> online resources. And then three years ago, when I did [digital textbooks], I again
> designed all kinds of lessons using online resources and open ed resources. And so, now
> that I have a textbook, … I haven't changed my teaching—because I've been using open
> ed sources for four years. (Chris)

When describing the transition from non-open to open textbooks, the changes that participants mentioned related primarily to the online format. For them and their students, adjusting to an

online, open textbook was manageable and was made easier if teachers and students were used to the technology.

 Textbook use. In the survey, about three-fourths of respondents said they used their textbooks in fewer than half of their lessons. In interviews, teachers likewise described limited textbook use. When asked for an example of a classroom practice that had not changed since adopting open textbooks, Alex noted that her instruction was not textbook-focused:

> [M]y instruction doesn't revolve around the textbook in any way, shape, or form. But I do think that it's a resource, and a lot of kids don't take advantage of it. … I still ask them to read, and now I can ask them to do some highlighting, and I can show them some of those different tools that way as well, so I'm still asking them to do some activities where they interact with the text, just to give them one more place to access the information.

Eddie reported increased, but still limited, use:

> I use the open textbook more [than the previous textbook]. I still don't use it a ton—I think it's because I just started my first year not really using a textbook because it was so old, but I definitely use it more than we used our old textbooks. And I plan to use it even more next year.

Over several years of teaching, Chris had observed a diminishing role for textbooks:

> [I]t's a supplemental material. … I think when we had a paper textbook, you relied on that textbook and the supplemental material you got as your teaching method to teach those things. And with open ed resources, I rely on my textbook this much (puts thumb and finger about an inch apart), and I use other resources as well. … I think the role of

the textbook has changed dramatically, where the role of the textbook now is just a small

piece, whereas before it was a large piece.

For participants and their students, textbooks were not the sole or primary resource for classroom

instruction, but one resource among many.

  Changes in practice. In describing their changes to classroom practice, two teachers,

one who had reported "minimal" changes and one who had reported "considerable" changes to

practice, nonetheless described similar changes. In an interview, a teacher who had reported

only minimal changes to classroom practice stated that one of the main changes to classroom

practice since adopting open textbooks was that the assignments could be linked to questions and

other resources. An interviewee who had reported "considerable" changes to classroom practice

similarly reported in the survey that the most significant change in classroom practice was that

she could incorporate materials she wanted students to have directly into the text. In the follow-

up interview, the teacher explained,

> With the open textbook, with the editing features, you can put in YouTube links, or links
>
> to articles, or even different web-based activities, and you can link them right from the
>
> textbook, and so if the kids are reading it and you want them to read through and access
>
> this information, you don't have to say, "O.K. Now, here, read this textbook, and then
>
> click on this link," … it's all kind of in a package deal, and you can make that as little or
>
> as much as you want. (Alex)

Being able to link textbook content to other resources constituted a "minimal" change for one

participant, but a "considerable" change to another participant.

  An interviewee who had reported "some" changes to classroom practice said in the

survey that the most significant change to classroom practice was "less printing." When asked in

the interview why that was the most significant change, the teacher explained, "Just the way I do the classes. I don't have to print the worksheets because they're all online now" (Dana). When asked to give an example of a classroom practice that had not changed since adopting an open textbook, the teacher described his general approach: "They read the book—I give them time in class to read it—and then I go through doing a lecture on each section using the Socratic method, and then they do a worksheet online." While other teachers may have similarly reduced their paper consumption in the transition from a traditional textbook to an open textbook, only Dana mentioned reduced paper consumption as the most significant shift in classroom practice. Again, what was a significant change to one teacher may be minor to another teacher. At the same time, the effect of adopting an open textbook on classroom practice could vary from teacher to teacher, depending on their teaching approach.

Openness. When asked whether changes in classroom practice had more to do with the online format of the textbook or its openness, Alex pointed out the interplay between online format and openness:

> I don't think that you get one without the other. Well, I guess you could have the online stuff without the open. … [O]ne of the real drawbacks to the traditional textbook was, when we were teaching earth science, it was still calling Pluto a planet, and the international space station was still in the planning stages. And so the fact that we can give them current information is huge. And that's one of the things when I put links into articles, it would be links to things that are current for right now. You know, things that are coming up—the new technology with DNA, or … things like that, that are new.

Openness, combined with the online format, allowed teachers to keep their textbooks up-to-date and otherwise adapt books to meet student and teacher needs.

Revising and adapting. While survey respondents reported doing some revising and adapting of textbooks, interviewees reported that they did not revise or adapt textbooks during the school year and instead would wait until summer to make changes. Chris said,

> [W]e don't mess with the textbook during the school year, even on an individual basis … I'm sure at the end of the year the four of us will get together and say, 'What do we want to do with the textbook for next year?'… We're very willing to go ahead and do that over the summer. … we'll probably do it in a day or two and fix it.

Eddie expressed a desire to adapt material, but a lack of time:

> I would like to customize it just a little bit more for the information for my class. It's something that I wanted to do and just didn't have time for. Because what we cover may vary a little bit different than what is covered in the text, and I want to be able to get rid of some extraneous information, and add some in. … So, I think that it would just be making it more streamlined, and maybe reorganized in order for my class. But that's easy to do electronically.

Another teacher explained that besides the lack of time, there were other practical reasons to wait until the end of the year to revise textbooks:

> I usually don't in the middle of a unit. I don't know how that works with what the kids have access to. And I know that we had a couple of technical issues when we were doing some editing and revising with it last summer because if it was shared at a certain point then those new edits didn't really show up. So I'll make some of those changes after we've completed a unit, but I won't—it's not something that I'm going to share and I'm going to ask them to access and change in the middle of it, because I had some technical difficulties with that. (Alex)

All participants were involved in revising and adapting their open science textbooks prior to adoption, but interviewees explained that time and other considerations kept teachers from making changes to textbooks during the school year.

When asked to give an example of how they had adapted or revised textbook material, one teacher mentioned direct revisions to the textbook. Alex described revising the text through "adding articles in, or adding different links in, rewording questions that may be misleading or unclear, changing just the general order of, you know, looking at the textbook and thinking about what makes sense. … Or updating information." Other interviewees told of adapting textbook material in other ways. Eddie described making slideshows from the material:

> I have been using the textbook pretty heavily to put together slideshows to give to my students. So, even though they may not be directly using the textbook in all of my lessons, I use it as one of my resources that I tie in to inform the notes that I give them. So, I do a lot of slideshows with them, or short clips. I've used the textbook a lot to help with that, and I've used it to inform the content standards for my rubrics when we do projects as well.

Chris described making video playlists:

> The things that we do are like, we'll create … a YouTube playlist of the videos that we're going to use along with the book. … Sometimes it's easier just to have this YouTube set of playlists, these other videos that we're going to use, especially when the ones that we have in the book don't work anymore.

Participants recounted various approaches to revising and adapting textbook material.

While the flexibility to alter the textbooks was generally seen as an advantage of open textbooks, the need to alter the textbooks could be seen as a disadvantage. In the survey one

interviewee reported having revised or adapted previous textbook material, but not open textbook material. When asked in the interview, "Why do you no longer revise or adapt textbook material?" the teacher explained, "[I] don't need to" (Dana). When asked, "[D]o you have any plans to revise or adapt the Earth Science textbook?" Dana said, "Maybe. If I get time. I don't have a lot of time." For this busy teacher, having an open textbook that required no revision was an advantage.

Collaboration. One aspect of openness is that it is seen to promote collaboration. In surveys, most participants reported that they had collaborated with colleagues, and some reported that they had collaborated with students, to select, revise, or adapt instructional materials. When asked to share an example of collaborating with colleagues to select or adapt instructional materials, Eddie described significant, ongoing collaboration:

> We meet once a week to talk about what we're doing overall between our classes. And I work especially with one of the other science teachers. Our classes are similar, so we mirror each other quite a bit, so we're always passing resources back and forth, and we're working together to come up with a project that maybe incorporates different materials. We both share projects that we've come up with, with each other.

Collaboration takes time, and teachers who were given time for collaboration expressed appreciation for that support:

> [T]here are four seventh grade science teachers in our district and we collaborate very well together, and our district gives us time to collaborate. … We, thank goodness, love to work with each other and so collaborate on same lessons, we collaborate on NGSS Standards alignment, we collaborate on testing, we collaborate on even what we do in the classroom. Between the four of us, we are continually collaborating for uniformity for all

seventh graders so that they get the same general materials throughout. If I discover something fantastic, I share it with everybody, we'll discuss it … our district science department has been involved in lots of different grants over the last four years that have allowed us … collaborative time. … We've been so lucky. (Chris)

While individual teachers can revise textbooks to meet their students' needs, the participants in this study collaboratively designed textbooks. When collaborating teachers have similar wants and needs, such collaborations tend to work well, but when teachers have conflicting opinions, the resulting textbook may reflect a compromise rather than a customized solution to each individual teacher's needs. Chris described both types of collaborating situations:

> The first time it was just the teachers [from our district], and it was what we teach, and all the seventh grade teachers were there, and we designed the textbook based on our curriculum, based on our calendar, based on NGSS standards that we used, based on exactly what we did … [The next year] there were a few of us … [who] helped the other people from the state edit the book that we designed and edited to meet, supposedly, everybody's needs. … So we're using version two this year and I think some of us … are like, 'No, we liked our book better.' So we're going to go back and change it.

Dana, who helped produce an open science textbook for one subject but is using an open science textbook for a different subject, would have preferred a more customized Earth Science book: "The Earth Science book that we're using, it's not typically very streamlined, where the—I have access to a Physical Science book that's been very much streamlined. It's just the people that did it didn't streamline Earth Science." Open textbooks allow each teacher to customize the book, but most open textbooks represent collaborations, and therefore compromises.

Some teachers collaborate with their students as well. When asked to share an example of collaborating with students to select or adapt instructional materials, one teacher described giving a student independent, online projects to supplement the textbook:

> For example, we went online and found another … lab on el Nino, and I was kind of really curious about it, but I gave it to him to browse, and we worked together, and he would—while the rest of the class was working on a different activity, he came up to me then on the side and said, "I've got a question here," and then I asked him to write [his] comments and [his] thoughts directly on this activity sheet. (Bailey)

Another teacher described a process of soliciting and applying student feedback to help revise and adapt the open textbook:

> It's pretty informal. Like, just talking to the kids when we've done an activity, before or even after I've put it into the book, … ask them, 'What did you think of that activity? How did it work? Did it make sense? Do you feel like you knew more than you did before?' Using that feedback to decide if it's really something that I want to be a part of the book or not. And I think that teachers would normally do that anyway … But this way you kind of embed it and make it more of a package deal. (Alex)

None of the participants mentioned direct collaborations with students to rewrite sections of their open textbooks, but participants did report using student feedback to help guide selection of and revision to instructional materials.

Perceptions of quality. As noted in the survey findings, more than three-fourths of survey respondents said they preferred their open textbook to their previous non-open textbook. Among the interviewees, four had preferred the open textbook, and one had preferred the previous textbook.

Advantages. In interviews, teachers described advantages of open textbooks including flexibility, cost savings, accessibility, independent learning, and quality.

Flexibility. The advantage mentioned most frequently was flexibility, or being able to revise and adapt the textbook. Chris said,

> It's exactly what I need. … When you get a textbook and you get all those resources you
> buy … , you get 50 chapters and you use three. … I like the fact that [this book] is
> designed by us, it excludes anything that we don't need, it is short and sweet, it only has
> what we need. I think that's the best part about it.

When asked, "What do you like most about the open science textbook?" Bailey answered, "Flexibility. Because … I don't feel compelled to do the chapters in order. I just feel like I could jump around as I please. I also really like the different types of online resources that we attached to our content." When asked, "If you had your choice between an online open textbook and an online commercial textbook?" Alex said, "I would definitely choose the open textbook, just for the ability to make those adjustments."

In the survey, one participant indicated a preference for the previous, non-open textbook, but also said she "would not go back to a non-open textbook." When asked in the interview why she would not go back to a non-open textbook, the interviewee said,

> It's not current enough. … you can't keep current with a printed textbook. That's the
> bottom line. … And students now, … the way they learn is different. So, you can't go
> back to a textbook, although when you use a textbook, they think it's very novel … . It's
> just too not changing, too static. They just don't, don't like it. It's boring. They don't
> like to read. … They learn differently now. So I would never go back to a textbook.
> (Chris)

That is, participants pointed out that traditional textbooks do not provide the flexibility or interactivity of online, open textbooks.

Cost. Describing the advantages of the open textbook, Eddie began by saying, "It's a good resource; it's a free resource." Dana explained that cost was a factor in choosing open textbooks: "[O]ur books are wearing out. … if I can use the budget that would normally go to textbooks for online stuff, … they give me more for my spending budget." When asked whether classroom practice would change if the district switched to commercial digital textbooks, Chris described the appeal of commercial digital textbooks, then asserted that the district would never again pay for them:

> Four or five years ago, I went to one of the NSTA national meetings and looked at online … resources. … [S]ome part of me wants to say, 'Oh gosh, it would be so easy to have them.' You could choose from any number of resources that they offer—all of the online resources that they offer, all of the online resources that they've vetted, they've created, they've done—and then I wouldn't have to be the resource. Because of the fact that … we built our book, we made it the way we wanted to, it still takes so much extra time and effort on my part that I could see where it would be—for those districts that could afford it—I could see where that would be enticing to people because, one, they're not techies, they don't want to learn it, they don't want to know it, they just want to use it. So, in our district, because of the way we are, and because of the amount of effort we put into using technology from the get-go, all of us think it would be a waste of money. I'm sure we all would! We would all think it was a waste of money.

While the lower cost of open resources can be compelling, open textbooks have associated costs, including time and training. Once districts have invested considerable time, effort, and money

into open textbooks they may never go back to commercial textbooks. On the other hand, the resources required to make the switch from commercial to open textbooks may keep districts from adopting or successfully implementing open textbooks.

Access. In interviews, teachers noted that an advantage to having online textbooks was increased access. Dana said, "I like it because they have no excuse for not doing the homework [because] it's online." Bailey pointed out, "[S]o many kids leave, they're on vacation, and they need that easy access." Teachers mentioned not only the access to the book as an advantage, but also access to other resources: "there's access to links that the kids can click on. They really like that. And so it's easier—it's more time-effective than me playing YouTube videos in class" (Dana). Eddie said, "I like that [the open textbook] uses a variety of images and videos in addition to the actual text." For these participants, having an online textbook increased students' access to the textbook and other instructional resources.

Independent learning. While teachers did not specifically report observing significant changes in student independence, two interviewees anticipated that the open textbooks would promote independence. Eddie said,

> As a school we are moving toward mastery-learning, so students will be working at their own pace, and using the one-to-one will definitely be helpful with that. I think as we move toward that, and they have—they don't all have me the same time because they're all at different places—that using the textbook will become more and more useful and valuable. So I do think that it will go up in value rather than going down.

Bailey shared a similar opinion: "I'm excited to use this next year because I really want to stress this independent learning." The advantage of increased independence was anticipated by both teachers rather than reported as a change.

Quality.   Interviewees mentioned additional advantages relating to the overall quality of their open textbooks. Eddie appreciated the book's succinctness and accuracy:

> It's a good resource. … I like that it's quite to the point, rather than kind of beating about the bush before it gives you the information … The information I've found to be accurate and good and more straight-forward than a lot of textbooks, which is great.

The same teacher also mentioned specific content in the open textbook:

> I did really like the introduction and the intro to science portion, so it's a big thing that drew me toward that text, because that's something that a lot of other texts don't have very strongly. So I liked that.

In describing their experience with open science textbooks, all of the interviewees had positive things to say.

Disadvantages.   Most of the disadvantages of the open textbooks mentioned by interviewees related to the online aspects of the textbook. More than one teacher reported problems with links not working. Chris said,

> one of the things that's sort of a hassle with open ed resources is the idea that … the links don't work all the time … . [L]ast summer … as we were working, we went through every link in the book and cut out the ones that didn't work. … So I'm using the new book that we created last summer and, even now, the links—some of those links don't work, or maybe they work with Chromebooks, but they don't work with iPads.

When asked what it was like when first using the open science textbook, Eddie said, "linking it at first was tough—I linked things wrong … But now they hit the link just fine and it's not a problem. I can send them straight to the section I want them to read, which is nice." For Eddie,

the problem had largely been resolved, whereas for Chris, the linking problem was ongoing. Another challenge mentioned was a lack of home internet access for some students:

> I live in a school district in a town where not everybody has internet at home. … So there is the disparity. Now we have printed versions of them, but the printed versions, of course, you don't get to use the links, so you don't get to watch the videos … And so that is a bit of a challenge. (Chris)

Alex had only one complaint: "The only thing I've really had an issue with is that if someone doesn't log out or log in, then somebody can … make edits, not necessarily edits to the book, but they can change my highlighting and they can change my notes." While the online format has advantages, it also comes with disadvantages, including trouble with links, limited and unequal access, and having to log in and out.

In addition to the challenges associated with technology, there were calls for more teacher supports. Bailey emphasized the need for a teacher's manual for each textbook: "Especially one that could even highlight the extra activities, and an answer key—things like that. I think that would be helpful." Another helpful addition would be an assessment bank, "because sometimes writing your tests—it's just nice to see those examples of how to assess your kids, and it doesn't have to be formal" (Bailey). A lack of supports for teachers was likewise noted in the survey results.

Ideal textbook. When asked what the ideal science textbook would look like, Dana said, "Streamlined, very following state standards—that way I can get to it faster and so I can use time to do other projects in class." Eddie noted that many of her students lack reading skills and science background, then said, "I don't know if there is a perfect textbook because it would have to be different for every student. But the flexibility of this one is certainly appealing, and I like

that it can be what I need it to be for different students." If the ideal textbook is adaptable, then open textbooks are certainly closer to the ideal than are traditional textbooks.

CHAPTER 5

Discussion

The purpose of this study was to understand outcomes of open textbook use, including effects on classroom practice. Most teachers surveyed reported some changes to classroom practice after adopting an open textbook. Most of the changes to classroom practice described by respondents were related to the online format of the textbook and the capacity to make changes to the textbook. For some teachers, the format may have been the key factor making a difference; their classroom practice might be largely the same whether they used an open online textbook or a non-open online textbook. For other teachers, the key factor affecting practice may have been the openness of the textbook, i.e., the ability to revise, adapt, remix, add links, and update the text from year to year. For the teachers surveyed, the effects of openness could not be entirely divorced from format considerations.

Because of the intertwining benefits of openness and online format, the full benefits of open textbooks can be realized only in areas where students have ready access to reliable internet service and electronic devices. Multiple participants reported problems with broken links—a minor irritation for some and a major hassle for others. Problems with poor links and limited access can be remedied by providing print versions of open textbooks for students, an option that has delivered student outcomes comparable to or better than outcomes for students using traditional textbooks (Robinson, et al., 2014). In their study, students using print versions of open science textbooks scored slightly better on standardized than did students using non-open print textbooks. However, print versions need to be reprinted as they are updated, do not allow the linking of content to other resources, and may cost more than electronic versions. Considering that print versions of open textbooks do not provide the same benefits as online

versions, it is not surprising that in the current study, participants who reported using print-only version of their open textbooks stated a preference for the previous, non-open textbook. Participants indicated that for maximum benefit, students need reliable access to online versions of their textbooks, and open textbooks must be designed to work effectively on multiple platforms so that students with tablets have the same access to material as do students using Chromebooks, laptops, or desktop computers.

In this study, I was particularly interested in understanding whether using open textbooks would increase classroom practices related to openness, such as revising and adapting the textbook and collaborating with colleagues or students. The findings in this study did not show increases in open classroom practices and instead showed some slight decreases in open practices. In the survey, teachers reported that they had revised or adapted their previous textbook in more lessons than they revised or adapted their open textbook. In interpreting these findings, we confront a definitional issue: the open textbook could be directly revised and adapted, while the non-open textbook could not. When teachers reported revising and adapting non-open textbook material, those revisions and adaptations were not likely changes to the textbooks themselves, whereas revisions and adaptations of open textbooks may have been. Furthermore, once teachers made revisions to the open textbook, those revisions were no longer needed, whereas teachers were perpetually dealing with the inadequacies of the non-open textbook. From the standpoint of advocates for openness, a decrease in the amount of revising and adapting might be seen as an adverse effect, but from a teacher's standpoint, less revising and adapting might signify an improvement; survey and interview responses indicated that teachers revised or adapted open materials less frequently than they did their previous textbook

because the open textbook was better suited to their needs and required less adaptation than did the previous textbook.

Before conducting the study, I had expected that some teachers would report making ongoing revisions of their textbooks throughout the school year, but teachers reported in interviews that they saved revising and adapting for the summer. They offered two main reasons: first, teachers were too busy to make changes during the school year; and second, although making changes may be simple, sharing those revisions with students was more complicated. If a teacher were to change a version that has been published and shared, then the students might need to download a new version of the textbook each time changes were made. Thus, expecting teachers to revise and edit during the school year may not be practical. This suggests that administrators should work with teachers to determine how frequently textbooks should be revised and should provide time, training, and compensation for teachers to do so. The finding that teachers were not changing the textbook during the school year also indicates that teachers were adapting the text to local needs, but not to individual students' needs. The open, online textbook may have facilitated differentiation in the sense of providing multiple ways of approaching material by linking to audio, video, and interactive resources, but there was no indication in survey or interview responses that teachers had used the open textbook to differentiate in the sense of providing customized versions of the textbook to individual students.

Respondents also reported decreases in collaboration after adopting their open textbooks. In surveys, teachers reported infrequent collaboration with students to select or adapt instructional material while using the previous textbook and slightly less frequent collaboration while using the open textbook. Teachers also reported decreased frequency of collaboration with colleagues to select or adapt instructional materials after adoption of the open textbook. While

the survey and interview data did not fully explain the decrease in collaboration with students or colleagues, the change was small and could be attributed to a decrease in the perceived need to use supplemental materials. It may be that teachers were collaborating more extensively with colleagues or students previously but for purposes other than selecting or adapting instructional materials. Indeed, interview data indicated that strong collaboration during the process of revising and adapting an open textbook increased teacher satisfaction regarding the open textbook.

While participants did not report significant changes in classroom practice related to specific open practices, respondents praised their open textbooks and valued their openness. Three-fourths of participants said that they preferred their open textbook to their previous textbook, and respondents indicated in open-ended questions and interviews that one thing they liked most about the open textbook was being able to revise and adapt it to meet their needs. As in previous studies (de los Arcos, et al., 2016; Kimmons, 2015), participants rated open textbooks higher than non-open textbooks for various quality measures. For teachers who had been using insufficient numbers of outdated textbooks, open textbooks that could be updated frequently and provided to each student at low cost were a vast improvement. However, participants also reported that open textbooks could be further improved. In particular, teachers surveyed suggested that their open textbooks did not provide enough teacher support or differentiation strategies, could be better aligned to assessments, and could provide better supports for students who are above- or below-grade level.

One theme that came out in surveys and interviews was that the textbook was not the main source of classroom instruction. Fewer than 30 percent of teachers said they assigned readings from their textbooks in more than half of their lessons. Reported use was slightly

higher for open textbooks than previous textbooks, which is consistent with the finding that teachers preferred their open textbooks to their previous textbooks. But with both textbooks, teachers described using the textbook as one resource among many. These findings were consistent with data from the very large 2012 National Survey of Science and Mathematics Education (Banilower, et al., 2013), in which science teachers reported that they assigned textbook reading at least once a week in 56% of middle school science classes and only 37% of high school science classes (p. 76). Given the limited, and perhaps changing, role of textbooks in instruction, the quality of and practice surrounding textbooks may be less important to teachers than are other factors and resources. An advantage of open, online textbooks is that they facilitate the linking of and interaction among resources, but perhaps access to high quality videos and simulations is changing teacher practice more so than access to open textbooks. Furthermore, we cannot fully understand the textbook as an isolated unit, because it is not used in isolation. Moving forward, our understanding of how open resources affect practice could be informed by in-depth studies that encompass a multiplicity of resources and practices.

While the findings from this study are not generalizable to large-scale implementation of open textbooks, I would expect a large-scale study to show less change in classroom practice than was indicated by this small sample. The participants in this study self-selected to participate in training about open textbooks. They were given time and compensation to collaborate with colleagues from across their state to develop open textbooks for use in their classrooms. Because this group was self-selecting and was trained in open practice, their perception of open textbooks might be more positive than that of most teachers, and their practice might change more after adopting open textbooks than would the practice of teachers who were handed open textbooks that they did not help to develop.

On the other hand, participants in this study may have exhibited a variety of open practices before adopting open textbooks, which openness could have led them to choose open textbooks. If such is the case, a large-scale study could, in fact, show greater changes in classroom practice than did this study. Also, if a study were conducted in which participants were selected based on their desire to change classroom practice, they would likely report more changes to classroom practice than did the participants in the current study.

Previous studies have indicated that perceived cost savings were a primary factor in educators' decisions to adopt open textbooks (Bliss and Patrick, 2013; Boston Consulting Group, 2013; Butcher and Wilson-Strydom, 2008; Kimmons, 2016; Wiley, et al., 2012). For the participants in this study as well, cost was cited as a benefit of open textbooks and a factor driving adoption. Openness was perhaps a secondary factor driving adoption, as well as a significant benefit. But the teachers in the study gave no indication that they were looking to change their practice. Instead, they indicated a preference for textbooks that did not require them to change their practice—that, once adopted, were ready to go. The idea that teachers may prefer not to change their practice is in line with Rogers' diffusion of innovation theory (2003). Rogers argued that for an innovation to be widely adopted, it must not only be better than what it replaces, but also align with users' values, experiences, and needs. A teaching resources that requires teachers to change their practice may not be aligned with their values or experiences. In describing why they preferred the open textbook to the previous textbook, teachers seemed most concerned about quality and access, noting a preference for textbooks that were streamlined, aligned with standards and assessments, linked to other media, and were easy for students and teachers to use. These preferences were similar to those stated by K-12 administrators, who indicated that when choosing textbooks, quality and features were more important factors than

cost or openness (K12 Handhelds, 2015). Participants in Kimmons' 2016 study "uniformly believed that openness offers pedagogical, economic, and professional potentials for practice, but that major barriers to diffusion exist at the macro and local levels due to the political and economic realities of the teaching profession" (p. 1). For participants in this study, perhaps the "realities of the teaching profession" outweighed the "potentials for practice" afforded by openness.

Nineteen U.S. states have committed through the #GoOpen campaign to adopting open educational resources (Office of Educational Technology, n.d.). I can imagine state administrators choosing to adopt open textbooks statewide as a cost-saving measure. The most efficient approach to adoption would be to designate a small team to revise and adapt an existing textbook, such as one produced by CK-12, aligning the textbook to state standards and assessments. Such an approach could appeal to administrators who are concerned about ceding control to teachers and to teachers who would prefer not to design their own textbooks. Most teachers are used to being provided textbooks that they did not choose or design, and they may not miss the benefits of designing their own, open textbook. While this more efficient approach could provide an up-to-date, affordable textbook for all students, teachers would lose one of the main benefits of open textbooks identified in this study and in previous studies, which is the capacity to adapt the textbook to local needs. Participants in this study valued their open textbooks because they had fashioned them into their ideal textbooks, and teachers' reported experiences support the assertion by Butcher and Wilson-Strydom (2008) that OER are most successful when users are involved in the creation. A potential compromise would be to provide a state-approved version that teachers could choose to use as-is or adapt as needed. For some teachers, the ideal textbook is the one they help design; for other teachers, the ideal textbook is

the one that comes ready to use. For both groups, a high-quality textbook that allows but does not require teachers to make changes may be ideal.

Limitations

To provide a manageable scope for this project, the focus was necessarily limited. This study involved a population of fewer than 30 teachers in a single state, teaching secondary science. Furthermore, the focus for this study was how use of open textbooks affected classroom practice, but textbooks are a small part of the equation since activities unrelated to textbook use must also be considered to fully understand classroom practice. Another limitation is that participants may have differed in how they interpreted terms such as "revise and adapt." I tried to mitigate the differences somewhat by asking multiple survey questions and follow-up interview questions. Other studies in this area need to acknowledge the definition issue and recognize that participants may not be operating under the same definitions. Finally, out of consideration for participants, who were not compensated for their participation, the survey and interviews were designed to be brief. Given the current focus on a single context, the reader should determine how results may be transferable to their own contexts. Despite limitations, this study provides useful information about the experiences and perceptions of teachers using open textbooks that can aid in understanding the interplay of open textbooks and classroom practice.

CHAPTER 6

Conclusion

To conclude, the three main findings in this study were as follows: (a) participants did not report increases in the open practices of collaboration or revision after the adoption of open textbooks; (b) participants preferred their open science textbook to their previous, non-open science textbook; (c) the effects of online format were intertwined with the effects of openness.

While one perceived benefit of open textbooks is an increase in open practice, in this study, the open practices of collaboration with students or colleagues and revising or adapting instructional materials did not increase after the adoption of open textbooks. Teachers collaborated in the process of revising and adapting their open textbooks before adoption, but having done so, teachers were generally happy with the textbooks and saved further revisions for summer. Among this sample of teachers, the use of open textbooks may have alleviated the need to continuously adapt their textbooks, thus mitigating the theoretical benefits of openness.

Three-fourths of teachers in this study preferred their open science textbook to their previous textbook. Participants' positive perception of the open textbooks seemed to correlate with their involvement in designing their open textbooks. Participants had designed their textbooks to be what they needed and wanted—accurate, relevant, clear, concise, and aligned to state standards—which translated into high perceptions of quality. The findings of this study suggest that teachers may be more satisfied with a textbook they help design than with a textbook designed by someone else.

In this study, the effects of online format could not be disentangled from the effects of openness. The most commonly cited changes teachers made to their books, such as linking to or including other resources in the textbook, could be attributed to a combination of openness and

online format. The data suggest that open textbooks are most effective when they are online, and when students and teachers have reliable access to internet service and electronic devices, both at school and at home.

Promoters of open practice have identified many potential benefits. The goal here was to go beyond theoretical discussions of perceived benefits to examine real practices and outcomes for teachers and students. In so doing, we found that teachers were more concerned with practical considerations than with idealistic ones. Teachers want textbooks that meet student needs, and while open textbooks may do so better than non-open textbooks, openness itself may not be high on teachers' and students' lists of needs.

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APPENDIX A: Survey Instrument

A.   Teacher & textbook background
    1. Not including this year, how many years have you taught secondary science?
        a. 0-5
        b. 6-10
        c. 11-15
        d. 16-20
        e. More than 20
    2. Which grade(s) do you teach? Please check all that apply:
        a. 7
        b. 8
        c. 9
        d. 10
        e. 11
        f. 12
    3. Which **open** textbook do you use? (If you use more than one, please complete a separate survey for each textbook.)
        a. Biology
        b. Chemistry
        c. Physical science
        d. Life science
        e. Earth science
    4. How do your students access their open science textbook?
        a. Online
        b. Print
        c. Both
             1. If both, please explain (e.g., "Students can choose" or "Print in class, online at home")
        d. Neither
    5. Last school year (or during the last school year that you taught prior to this one), which type of textbook did you use most?
        a. Commercial (traditional) print textbook
        b. Commercial online textbook
        c. Openly licensed textbook
        d. A variety of sources that I found
        e. A variety of sources provided for me

B.   Usage

    6. Last school year (or during the last school year that you taught prior to this one), how frequently did you do each of the following?

	Never	In 1-25%	In 26-50%	In 51-75%	In 76-100%

		of lessons	of lessons	of lessons	of lessons
a. Assign reading from the textbook					
b. Assign questions or activities from the textbook					
c. Skip sections of the textbook					
d. Supplement the textbook with outside readings or assignments					
e. Revise or adapt textbook content					
f. Assign students to revise or adapt textbook content					
g. Collaborate with colleagues to select or adapt instructional materials					
h. Collaborate with students to select or adapt instructional materials					

7.   So far this school year, how frequently have you done each of the following?

	Never	In 1-25% of lessons	In 26-50% of lessons	In 51-75% of lessons	In 76-100% of lessons
a. Assign reading from the textbook					
b. Assign questions or activities from the textbook					
c. Skip sections of the textbook					
d. Supplement the textbook					

with outside readings or assignments					
e. Revise or adapt textbook content					
f. Assign students to revise or adapt textbook content					
g. Collaborate with colleagues to select or adapt instructional materials					
h. Collaborate with students to select or adapt instructional materials					

8. Since adopting an open textbook, have you altered classroom practice?
   a. No
   b. Not sure
   c. Yes
      i. What have been the most significant changes in your classroom practice since you adopted an open textbook? (open-ended)
      ii. Which factors do you think most influenced you to change your classroom practice since adopting an open textbook? Please arrange the responses in order from most influential at the top to least influential at the bottom:
         1. School or district mandates prompted changes in classroom practice.
         2. The textbook format (online) prompted changes in classroom practice.
         3. The textbook content prompted changes in classroom practice.
         4. Involvement in the OER summer institute prompted changes in classroom practice.
         5. Other training (not related to OER) prompted changes in classroom practice.
         6. Life events/personal factors prompted changes in classroom practice.
9. Do you spend more or less time preparing to teach using the open textbook compared to

   your previous textbook?

      a. Significantly more

b. Slightly more

    1. (if more) Why do you spend more time preparing than you used to? (open-ended)

c. About the same

d. Slightly less

e. Significantly less

    2. (if less) Why do you spend less time preparing than you used to? (open-ended)

C. Perceptions of Quality

10. For each of the following statements, please select the response that best reflects your opinion about your **current (open)** science textbook.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Quality is high.					
b. Content is accurate.					
c. Content is relevant.					
d. Content is clear.					
e. The textbook is developmentally appropriate for the audience.					
f. The textbook includes supports for above- and below-grade level students					
g. The textbook is well organized.					
h. The textbook is easy to use.					
i. The textbook contains few typos or other errors.					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
j. Content is aligned to state standards.					
k. Content is aligned to provided assessments.					
l. Necessary teacher support is provided.					
m. The textbook provides differentiation strategies to meet individual students' needs.					
n. The textbook meets my needs.					
o. I would recommend the textbook to other Idaho science teachers.					

11.   For each of the following statements, please select the response that best reflects your opinion about your **most-recent non-open** science textbook.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Quality is high.					
b. Content is accurate.					
c. Content is relevant.					
d. Content is clear.					
e. The textbook is developmentally appropriate for the audience.					
f. The textbook includes supports for above- and below-grade level students					
g. The textbook is well organized.					
h. The textbook is easy to use.					
i. The textbook contains few typos or other errors.					

j. Content is aligned to state standards.					
k. Content is aligned to provided assessments.					
l. Necessary teacher support is provided.					
m. The textbook provides differentiation strategies to meet individual students' needs.					
n. The textbook meets my needs.					
o. I would recommend the textbook to other Idaho science teachers.					

12. Which textbook do you prefer?

    a. My current (open) science textbook

    b. My most recent non-open science textbook

13. Why? (open-ended)

14. Would you be willing to participate in a 20-30 minute interview to explain your responses in more detail?

    a. Yes

        i. If so, please include your preferred contact information (email or phone number):

    b. No

APPENDIX B: Interview Questions

The purpose of this interview is to help me understand how use of an open science textbook is affecting classroom practice, how teachers are making use of openness, and how teachers perceive the open textbooks they are using.

1. How use of an open science textbook is affecting classroom practice

    a. What was it like for you when you started using the open science textbook?

    b. Are you finding that using an open textbook is different from what you expected?

        i.   If so, how is it different than you expected?

    c. How do you understand the term, "classroom practice"?

    d. When asked in the survey what were the most significant changes in your classroom practice since you adopted an open textbook, you said that _____ was the most significant change. Why was that the most significant change?

    e. What is an example of a classroom practice you have not changed since you started using an open textbook?

    f. When asked in the survey what factor most influenced you to change classroom practice since adopting an open textbook, you said that _____ had prompted changes in classroom practice. Could you please give me an example of how _____ prompted changes in classroom practice?

    g. Why has classroom practice changed (or not changed) since you started using an open textbook?

    h. What would happen if you went back to your old textbook now—would your practice be different from what it was?

        1. If so, how would it be different?

2. Why would it be different?

2. How teachers are making use of openness

    a. In the survey, you reported that since using the open textbook, you had assigned students to revise or adapt textbook material). Can you give an example of how students revised or adapted textbook material?

    b. In the survey, you reported that since using the open textbook, you had revised or adapted textbook material. Can you give an example of how you revised or adapted textbook material?

    c. In the survey, you reported that since using the open textbook, you had collaborated with colleagues to select or adapt instructional materials. Can you give an example of how you have collaborated with colleagues to select or adapt instructional materials?

    d. In the survey, you reported that since using the open textbook, you had collaborated with students to select or adapt instructional materials. Can you give an example of how you have collaborated with students to select or adapt instructional materials?

3. How teachers perceive of the open textbooks they are using

    a. Could you describe what you think the ideal textbook would be like?

    b. What do you like most about the open science textbook you are using?

    c. What would you change about the open science textbook you are using?

APPENDIX C: Implied Consent Form

You are invited to participate in this research study to help increase understanding of the benefits and challenges of open textbook use.

Your participation will require approximately 5-10 minutes to complete an online survey. If you provide contact information, you may be contacted for a follow-up interview. Your participation will be confidential. You will not be paid for being in this study. The only known risk or discomfort associated with this survey is the time required to attend to it.

Participation in this study is voluntary. You do not have to answer any question that you do not want to answer. We will be happy to answer any questions you have about this study. If you have questions about this project or if you have a research-related problem you may contact me, Stacie Mason, at stcmason@gmail.com. I am conducting this research for my Master's thesis, under the supervision of Dr. Royce Kimmons at BYU.

If you have any questions about your rights as a research participant you may contact the IRB Administrator at A-285 ASB, Brigham Young University, Provo, UT 84602; irb@byu.edu; (801) 422-1461. The IRB is a group of people who review research studies to protect the rights and welfare of research participants.

The completion of this survey implies your consent to participate. If you choose to participate, please complete the attached survey by February 28, 2017. Thank you!

APPENDIX D: Standard Consent Form

Introduction
This research study is being conducted by Stacie Mason, under the supervision of Dr. Royce Kimmons at Brigham Young University, to understand the relationship between open textbook use and classroom practice. You were invited to participate because you are using an open textbook in your secondary science classroom.

Procedures
If you agree to participate in this portion of the research study, the following will occur:

- you will be interviewed for approximately 20-30 minutes about your textbook use, classroom practice, and perceptions of textbook quality

- the interview will be video- or audio- recorded to ensure accuracy in reporting your statements

- video or audio files will be used for transcription purposes only and will be deleted after transcription

- the interview will take place over the internet at a time convenient for you

- if you prefer to write your responses, the interview will take place via email correspondence

Risks/Discomforts
The only anticipated risk is that you may find the time commitment inconvenient or stressful. The researcher will minimize risks by limiting the length of the interview and by interviewing you at a time you choose.

Benefits
There will be no direct benefits to you. It is hoped, however, that through your participation researchers may learn about benefits and challenges of open textbook use. The researcher hopes to publish the results of the study.

Confidentiality
The research data will be kept on password protected computer and only the researcher will have access to the data. For publication purposes, all identifying information will be removed except the grade level and subject taught.

Participation
Participation in this research study is voluntary. You have the right to withdraw at any time or refuse to participate.

Questions about the Research
If you have questions regarding this study, you may contact Stacie Mason at stcmason@gmail.com for further information.

<u>Questions about Your Rights as Research Participants</u>
If you have questions regarding your rights as a research participant contact IRB Administrator
at (801) 422-1461; A-285 ASB, Brigham Young University, Provo, UT 84602; irb@byu.edu.

<u>Statement of Consent</u>
I have read, understood, and received a copy of the above consent and desire of my own free will
to participate in this study.

Name (Printed): _____ Signature _____ Date: _____

APPENDIX E: Video Release Form

As part of this project, I will be making video recordings of you during your participation in the research. Interviews will take place using your choice of Skype, Zoom, or Google Hangout. Video will be recorded for transcription purposes only, and will be deleted after transcription.

I have read the above description and give my express written consent for the recording and use of video as indicated by my signature below.

Name (Printed): _____Signature:_____ Date:_____

APPENDIX F: Example Coding Table

Participant Response	In Vivo Code	Category Code(s)
"Clear, easy to use formatting and resources"	Easy to use	Convenience
"I don't need to skip around in the book and skip sections because the book is in the order I teach and includes the information my students need. There isn't a bunch of extra stuff."	Aligned to needs	Alignment
"The ability to use other online resources in conjunction with the text."	Use online resources	Links
"The non-open science book included more resources and materials, however it was expensive and our subscription to the online aspects expired"	Non-open had more resources; non-open expensive	Resources; cost
"The open text is easily accessible online, up to date, and relevant. It is also more to-the-point."	Open accessible; open relevant; open to-the-point	Access; relevance