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# What Types of Text Are Novice Teachers Choosing to Teach Mathematics?

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***Abstract***

*Student teachers informed their professors that it was no longer the practice to use traditional textbooks to teach mathematics to teens. This notion caused the authors to undertake a nationwide survey to inquire about the types of math text used by novice teachers. Responses showed that a textbook did continue dominance. A majority said they preferred a digital text, favoring the technology, its presumed interactive qualities, and its ability to serve as "teacher." Those who advocated a print text did so because of accessibility, tactile properties and the distractibility of technology. Most taught vocabulary, but did not require their students to read the text.*

## Introduction

It is critical for classroom teachers to carefully consider the types of text they use in their teaching. This consideration is important because a textbook often structures middle/secondary classroom instruction (Alvermann, Gillis & Phelps, 2013). As Olson (2008) pointed out, "Because textbooks frequently serve as the embodiment of the curriculum, they help to define what students will be held responsible for" (p. 288).

Recently, change has been advocated nationwide in terms of text use. Former Secretary of Education, Arnie Duncan, stated, "we should be moving from print to digital…Textbooks should be obsolete" (p. 12). The Obama administration's deadline for removal of printed text was 2017 (Toppo, 2012). Advocates of e-Texts justified these changes by claiming that they would result in cost savings, ease of updating, allowance for differentiation, and portability. The Federal Communication Commission (FCC) went so far as to say that digital textbooks "can revolutionize teaching" (Digital Textbook Playbook, 2012, p. 7).

Not quite as enthusiastic, Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011), found that technology was having some effect on improving achievement. However, the authors noted that "effects must be interpreted cautiously" (p. 17) because of the wide range of factors (tools, learning strategies, modalities) that may account for variability. The findings of a 74 study meta-analysis by Cheung and Slavin (2013) about technology applications in K-12 mathematics classrooms concluded that

> Educational technology is making a modest difference in learning mathematics. It is a help, but not a breakthrough…New and better tools are needed to harness the power of technology to enhance mathematics achievement for all children. (p. 102)

Choosing a quality textbook is a significant undertaking. Teacher educators in literacy are uniquely positioned to collaborate with mathematics teacher educators to assist preservice teachers in thoughtful discussions about text types and choices. This is often done, as at our university, through a required content literacy course. In our course, content textbooks are routinely examined for such aspects as readers' aids, lexile levels, vocabulary and content. University students bring in the text used in their field experiences for this type of analysis. Recent feedback from those with math placements pointed to a shift in text use. While a print textbook has dominated the curriculum of the math classroom from 1977 to 2012 (Banilower et al., 2013), preservice math teachers in this study claimed that print textbooks were not part of their experiences. Instead, they worked with such other types of print and non-print resources as worksheets, guided notes, videos, and electronic texts. Had the ubiquitous textbook disappeared from the mathematics classroom? What were the instructional implications? This situation piqued curiosity and prompted exploration.

Therefore, the purpose of this study was to identify the mathematics text and instructional resources used and preferred by student teachers in middle/secondary mathematics classrooms across the United States. The implications of those preferences and the connections with disciplinary literacy are explored. Student teachers were chosen because researchers have found them to be uniquely wedded to a textbook:

> Mathematics curriculum materials, particularly textbooks are central to the work of beginning teachers; they are used in most classrooms and address the central activities of students and teachers, making them a "concrete and daily" part of the classroom with a "uniquely intimate connection to teaching." (Christou, Menon & Philippou, 2009, p. 226)

## Method

*Survey development.* Items in an online, anonymous, structured survey were used to gather demographic data and information on materials and instructional strategies used by mathematics student teachers in 2016. Fowler's (2014) *Survey Research Methods* guided item development.

In Fall 2015, a first draft of the survey was field tested at one university with five mathematics student teachers who answered the items and wrote comments about confusing wording and the feasibility of a student teacher being able to answer the items. The following February, a focus group of six middle and high school practicing mathematics teachers in one district completed the revised survey individually and supplied written and oral feedback that resulted in the elimination of some items and wording changes in statements and responses. The final version of the 32-item survey included items with Likert-scale responses, items asking for rank order, and items that requested open-ended responses.

The field test with student teachers and the focus group with practicing teachers, both viewed as subject matter experts, were two steps taken to establish content validity of the survey. In addition, from the beginning, descriptions of possibly unfamiliar phrases were included to raise the probability that each respondent understood the statement. The descriptions of Digital and eTextbooks were taken from published research conducted by others (e.g., Rockinson-Szapkiw, Courduff, Carter & Bennet, 2013). Cronbach's alpha reliability statistic was .727 for the Likert-scale survey items.

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From the longer survey, items about type(s) of textbook used, other types of print material used, and instructional strategies related to literacy were selected for analysis and reported in this article. Four items addressed type(s) of textbook available, used, or preferred, two items addressed use of guided notes or worksheets, and three items addressed expectations about reading, writing, and vocabulary in mathematics classrooms.

***Participants.*** Initially, informal email or telephone contact was made with the mathematics teacher educators nationwide. If the teacher educators were working with student teachers and showed interest in the study, a formal recruitment letter was sent. Across the country, 29 mathematics educators in 16 states were contacted. The recruitment letter explained the overall study, gave them access to the survey, and asked them to distribute the Information Statement/Letter of Consent to their student teachers.

Ninety student teachers located in 16 different states (East, Midwest, and West) participated by clicking on the online survey link. Eighty answered all or most of the survey items. Participants taught a wide range of mathematics courses in middle school and high school (grades 5-12). They taught in urban (30%), suburban (53%), and rural (17%) public schools. Respondents identified themselves as primarily White (89%) and female (76%); 4% self-described themselves as Asian, 4% as Hispanic, 2% as Black and 1% as Other.

## Findings

***Preferences for text formats.*** A survey item asked, "If you had the opportunity to choose a type of text for your students, which type of text would you choose? If you select more than one, rank order the choices with 1 as your top choice and 5 as the last choice." The five options below were provided. Respondents were then asked to explain the reason for their #1 choice using two to three sentences.

Sixty-seven participants chose to identify their text preferences. Most of those (91%) indicated that they preferred to use some form of a textbook to guide their instruction. Text formats ranked as number 1 by respondents are presented in Table 1.

**Table 1**

*Student Teachers' Top Ranked Preference of Text*

| Text Format | Count | % |
|---|---|---|
| Digital-Text with interactive components and multimedia content like video clips or animation | 35 | 52% |
| Print-Traditional printed math textbook | 24 | 36% |
| eText-Image of a print text on a digital device without interactive components | 2 | 3% |
| No text | 4 | 6% |
| Other | 2 | 3% |

Based on their responses, the majority of student teachers preferred to use a digital mathematics text. However, digital texts were not necessarily available in their classrooms. When asked in another survey item about types of math texts available to their students, traditional printed texts appeared most frequently (65%) and electronic texts appeared in second place (37%). When asked about the math texts they expected their students to use, again, traditional printed texts (47%) and electronic texts (30%) were the top two responses.

When asked to explain the reason for their number one choice of text format, comments about digital texts were effusive. Respondents described the digital text as the embodiment of technology and noted that technology in the classroom was inherently good: “With the world changing to a technology driven society this [digital text] is the best option for students at this time.” Respondents believed a digital text would allow students to “learn to use technology,” and “prepare students to be college and career ready in the 21st century.” Since “students these days love to use technology” that factor would make the text “positive,” “interesting,” “relatable,” “relevant,” and “engaging.” “Interactive” was a descriptor that appeared 27 times in reasons for choosing a digital textbook. Respondents stated that “interactive components were more engaging,” even when, “I’ve never used a digital textbook, but it sounds neat and interactive.”

Interestingly, some respondents described themselves as the teacher when using a print book, but the textbook as the teacher when a digital text was used: “instead of reading [the digital text] and then talking to me or the class, students are able to interact with the material directly.” “With a print book, the only resource for teaching is myself…With a digital book, students who want to work at a faster pace have resources to study on their own and students who have trouble understanding my instruction could watch videos.” Respondents noted that a digital text “gives students the guided support when I am not there to help them.” Several wrote that the digital text would “allow students to work at their own pace,” “give immediate feedback,” and provide “deeper understanding” and “clarification of concepts through visuals.” One said she preferred digital because “I would like students to be able to have a reliable source for more information…if they want more help.” “The digital textbook allows students to…get other teachers to explain the material in different ways,” help to “correct misconceptions,” and would “hopefully stop them [students] from practicing the wrong thing.”

A smaller group of respondents (36%) who preferred a traditional print math textbook noted the accessibility of print texts. About one-fourth of those who justified the print textbook as their #1 choice said they worried about the reliability of and access to technology. Repeatedly, student teachers said that either at home or at school, their students did not have access to computers or internet or when they got online there were connectivity problems, or problems getting the equipment fully charged. One said,

> I prefer to use a print textbook because they are available to all of the students. The library checks out textbooks to the students for each of their classes. When textbooks are only provided online, students are required to have access to computers and/or internet, which is not always possible.

Another wrote, “I would have chosen the Digital Textbook as my number one choice because of the interactive and multimedia components, but would be nervous that the technology wouldn’t always work and then we could be stuck without the textbook.” Additional representative comments included, “Most of my students do not have access to a computer,” “are not equipped with laptops for class,” and “There is not the technology at the school…to accommodate online textbooks.”

A second reason for preferring a print textbook addressed the problem of distractibility with digital texts: “I do not like the students to have access to YouTube on

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the same device they have the book on." Another representative comment in this line of concern was, "My students would not be able to stay on task given technology to view the textbook."

A third common explanation for the desirability of a printed textbook was the physicality of the book: "Students tend to like concrete texts because they can see more of the page;" "There is something to be said about having a tangible book in front of you;" "Having a physical textbook is beneficial for many kinesthetic students;" "I love having a hands-on book to look at. It is much easier for me and I believe for my students to have something they can physically look at;" and "They get to feel the book."

***Use of supplemental print materials and literacy strategies.*** Student teachers' responses about their use of supplemental print materials and incorporations of reading, writing, and vocabulary activities are presented in Table 2. Fewer open-ended comments addressed these instructional and literacy components.

**Table 2**

*Frequency of Student Teachers' Use of Supplemental Print Materials and Literacy Strategies*

| Instructional Activity | Always | Mostly | Half time | Sometimes | Never |
|---|---|---|---|---|---|
| I teach math by distributing printed notes, guided notes, Cornell notes with key facts, concepts or examples. | 13% | 38% | 13% | 24% | 14% |
| I teach math by giving students worksheets (single sheets or bound workbook. | 18% | 29% | 25% | 28% | 1% |
| I require students to read the text or other math materials. | 3% | 4% | 11% | 45% | 37% |
| I have students use writing to explain their thinking processes and answers. | 4% | 20% | 33% | 37% | 5% |
| I teach math vocabulary. | 47% | 34% | 16% | 3% | 0% |

Responses about the use of guided notes or Cornell notes indicated a wide range of implementation. In the open-ended responses, four student teachers described posting guided notes on a website for student access. Another described "hand written notes kept in a chronologically ordered composition book that remained in the class" and students "take a picture of their notes daily" with their individual iPads so they will have access to their notes at home. One respondent mentioned using a composition notebook that had all notes and examples for the year and that this was used instead of a traditional textbook.

All but one of the student teachers used worksheets (bound as a workbook or as single sheets), with varying amounts of frequency. Comments indicated a variety of uses for worksheets: "homework worksheets that the textbook company provided rather than assigning book work;" worksheets that presented discovery tasks; involved collaborative instruction; incorporated group work and cooperative learning strategies. About 70% of those who chose digital texts also used worksheets at least half of the time, apparently in conjunction with the digital textbook.

All of the survey participants responded that they taught math vocabulary and 81% of them did so always or most of the time. Few comments offered any additional insights, though one student teacher mentioned that in a class of "very low reading levels and comprehension abilities" most vocabulary and work with the text were completed in class.

In stark contrast to vocabulary instruction, the majority (82%) seldom required students to read from the text or other math-related materials. Based on comments, reading appeared to be connected to print text, whereas visual learning was connected to digital textbooks. Respondents explained, "Students do not open and read printed textbooks very often. If there was a great digital textbook, I would take advantage of that;" "students would be able to use the [digital] textbook to learn and not just through reading on their own." Another who advocated for a digital text said, "They will also be able to get a deeper understanding of the concept through the visuals."

There was more diversity in responses about having students use writing to explain their thinking process and answers, but limited comments. One student teacher cited the use of "Think-Write-Pair-Share." Another respondent seemed to infer that a digital text would circumvent the need to teach writing in the form of note taking. She elaborated, "I would use something interactive and digital as students are not great note takers at my school and that is hard to overcome."

## Discussion

As in previous National Survey of Science and Mathematics Education studies, most (91%) respondents in the present study, preferred to use a textbook to structure their mathematics instruction. Only 4% of student teachers preferred "no text" and 2% preferred use of "Other" instructional materials, like a notebook with notes and examples. Although the majority preferred a digital math text, most did not have access to digital texts so did not expect their students to use them. Perhaps the idea of teaching with this text format was more attractive than the reality.

***Digital text: technology and interaction.*** From the perspective of many respondents, the digital textbook served as a sort of instructional panacea. Their comments described roles for the digital text that included teacher, motivator, and key to technology skills for the future. The draw of technology was, indeed significant. An organization for instructional technology professionals, CompTIA, conducted a study in 2014 that affirmed that enthusiasm; among 1000 middle and high school students, more than 90% reported that technology made learning "more fun," and "more interesting." Of course, the enthusiasm should be harnessed and used to foster interactive discussions, problem solving and learning.

The "interactive" quality of the digital text was frequently mentioned as a factor in text choice but the interaction that was described involved a text or laptop, not the teacher or other students: "The digital textbook allows for students to have the opportunity to learn the material at home. They are able to watch videos and interact with the content;" "An interactive component will teach students different ways of understanding the material."

Thomas (2013) found this same lack of human interaction when she compared two Algebra classes. In one class students used a print textbook and in the other a digital format of the same material. She noted, "Students in the class using print textbooks tended to engage with the teacher and peers while using their textbooks, while the class using the digital format remained mostly silent as students used their textbooks" (p. xii).

This also happened to a group of high school teachers when their district mandated a one-to-one initiative (i.e., one digital device for every student). An English teacher said she found herself "looking across a landscape that is wall-to-wall laptops where every head is poised downward, silver screens acting as barricades, no eye contact occurring" (Lopez-Boren, 2016, p. 59). She saw her position shift from being part of the group, a facilitator and companion, to being outside of the group, serving as police for students distracted with all the online options at their fingertips. She noticed that students' rich conversations were lost with the infusion of technology. When Lopez-Boren talked with other teachers in her school regarding the district's one-to-one initiative, they also noted that when using laptops in their classrooms their roles shifted from teacher to monitor, to prevent students from instant messaging and watching Netflix during class. Elaine, a veteran teacher of 23 years, told Lopez-Boren that she saw her students as "compliant," rather than "engaged" when laptops were used.

A situation in which students interact with the text or the technology rather than the teacher is a concern. This could be problematic for the student because the teacher is critical to student success (e.g., Darling-Hammond, 2008; Deacon, 2011). It can be a problem for the teacher because the teacher may feel marginalized as Lopez-Boren found.

Given the student teachers' responses, it is relevant to reflect on Brown's (2009) conceptualization, drawn from sociocultural theory, of curriculum materials as artifacts that mediate human activity. This teacher-tool relationship is rooted in the notion that all teaching involves a process in which teachers use curriculum materials in unique ways, depending on their abilities, experiences, and goals, as they design or craft their instruction. Brown argued that teachers' interactions with instructional tools or materials could be viewed in terms of degree of "artifact appropriation." Of most relevance to this study, "Curricular offloads are instances where teachers rely significantly on the curriculum materials to support instruction, contributing little of their own pedagogical design" (p. 6). *Offloads* may occur when a teacher is unfamiliar or uncomfortable with the subject matter or pedagogical strategies and the resources provide enough structure to support the activity. When *offloading* occurs, the tool may actually become the teacher. This may well be the case with student teachers in this study. This situation is understandable based on research such as that of Choy, Wong and Gao (2009/2010) who noted that novice teachers can become overwhelmed by the numerous factors associated with teaching and may therefore feel more secure by relying heavily on the curriculum materials to structure instruction.

***Print text: accessibility and attention.*** Some student teachers who chose a print text did so because of the reliability and tactile attributes of a "concrete" object that could be accessed both in and out of school. Also concerned about access, Horrigan (2015) discussed the Pew Research Center's conclusion that approximately "5 million households with school-age children do not have high-speed internet at home" (p. 2). These numbers are more alarming because lack of internet in the home appears to be disproportionate in Black and Hispanic households. However, as Horrigan noted, there has been a concerted effort by the FCC to expand a program that would include broadband access for low-income families.

Other student teachers who advocated for a print text focused on the problem of distractibility when online materials were used. Distractibility, including neurological and physiological aspects, is a multi-layered issue.

University of California Los Angeles (UCLA) professors of psychiatry, Small, Moody, Siddarth, and Bookheimer (2009) examined the neurological and physiological effects of digital media use and concluded that an individual's brain actually changes as a result of Internet use. Using functional magnetic resonance imaging, they and others, examined the differences that took place in the brain when reading on the Internet and when reading a print book. "Book readers have a lot of activity in regions associated with language, memory, and visual processing," synthesized Carr (2010, pp. 121-122). Those reading on the Internet activated these plus prefrontal regions of the brain associated with decision making and problem solving because, as one comes to a link, the reader pauses to allow the prefrontal cortex to evaluate the link and decide whether to click on it. When this shift from reading words to making judgments is repeated multiple times across a page of text (read…judge…read…judge), comprehension and retention are affected. Even if the reader tried to ignore the links, some neuroscientists (e.g., Pynte, 2004) claimed that the different-colored and clickable text interrupted the saccadic eye movements, therefore inhibiting comprehension. Thus the fluency that makes deep reading possible is sacrificed (Wolf, 2007). The Internet is, by design, an "interruption system." On the other hand, when reading shorter pieces of text, the links could provide such benefits as online definitions and examples, which could support readers at all levels.

Other effects of digital media on the brain take place in working memory. Working memory is a critical form of short-term memory with a very limited capacity. The information that moves into working memory is referred to as an individual's cognitive load. When that load goes beyond the mind's ability to store and process information, it cannot be retained or connected to schemas in long-term memory. "Compared to linear text," explained Rouet and Levonen (1996), "hypertext [links connecting networks of information] imposes a higher cognitive load on the reader: The reader must remember her location in the network, make decisions about where to go next and keep track of pages previously visited" (p. 17). A high cognitive load reduces one's ability to comprehend and retain what is read.

***Reading, writing, vocabulary.*** "Just because we are in the digital age does not mean we need to give up on teaching kids to read and use books," proclaimed one mathematics student teacher. It is a concern that 82% of student teachers in this study "Never" or only "Sometimes" required their students to "read from the text or other math-related materials." "Worksheets," on the other hand, possibly another *offloading tool*, were used to some degree by all student teachers to "teach math."

Student teachers reported that they did "teach math vocabulary" regularly (81% do so always or most of the time), but apparently not by reading about it in their texts. Instead, they made moderate use of "printed notes" or "guided notes" that "include key facts, concepts or examples" to teach math. As similarly noted by Siebert and Draper (2008), the connection was not made between reading those notes and literacy. "Writing," to have students "explain their thinking processes and answers" would have produced another seemingly logical opportunity to incorporate literacy, but was used infrequently.

This issue of actually reading math text is complex and the associated problems appear pervasive. For example, even though the two math teachers in Doerr and Temple's (2016) study had both been trained to teach reading and had taught reading, they did not initially help their students read the math textbook. "Their available designs for learning mathematics did not include learning to read mathematics texts" (p. 16). One teacher's solution was to "bypass the reading altogether and tell students what they needed to know" (p. 16). The other teacher often read the problems aloud and broke them down for her students. These reading teachers saw the process of reading math text as an obstacle rather than a support. An encouraging fact was that by the end of the study in which they participated, these teachers affirmed that reading the text was important to learning math. Additionally, in order to help students read their math texts educators did not need to invent new reading strategies. "Rather it consisted primarily of the teachers selecting strategies already in their repertoire as reading teachers, and recontextualizing them to match mathematics texts" (p. 28). They concluded that rereading and close reading were probably the most important literacy strategies for comprehending math text.

Another key was that the teachers actively worked with the students, modeling strategy use, thinking aloud, guiding, and scaffolding as they moved through the text. This, student-to-student and student-to teacher interaction, rather than an interaction with a textbook, was what was necessary for learning math. While this process seems intuitive, it took a four-year study to bring about the "evolution of the teachers' perspective on mathematics instruction from one that did not include reading to one in which reading was viewed as integral to students' mathematics learning" (p. 5).

## Final Thoughts

It is currently in vogue to use digital texts as school districts purchase iPads, flip classrooms, and embrace one-to-one initiatives. Of course, technology cannot be ignored. It has revolutionized lives. A Pew Research Center Survey showed that 92% of the thousand teens surveyed were online daily and 24% online "constantly" (Lenhart, 2015). In order to participate and compete in current cultural and economic life, students must be proficient in technology. Schools play a central role in facilitating this proficiency and helping students become critical consumers of electronic media. Administrators have been instrumental with their pocketbooks. In 2014, schools in the United States spent more than $8 billion in software, digital content and training (Murphy, 2015). However, it is essential that administrators not engage in 'drive-by' education—distributing technology, then walking away "leaving students to fend for themselves under the guise of student empowerment" (Sousa, 2014, p. 114).

Attempting to draw a conclusion about text use—digital versus print—is messy. Mathematics student teachers in the present study and the literature, cited advantages (e.g., technology as motivating, some increase in interactivity, more resources via links) and raised disadvantages (little access to technology, some loss of interactivity, disruption caused by links). Comparisons of the overall strengths and weaknesses (e.g., ProCon.org, n.d.) and classroom instruction with print versus digital formats (e.g., Thomas, 2013) should be discussion topics in university literacy classes and district study groups, so student teachers and veteran teachers alike can make reasoned choices.

Considering the expectations (e.g., *offloading*) placed on digital texts by novice educators, the issues in reading digital texts, and problems with accessibility and distractibility, educators cannot jump blindly on the digital bandwagon. As McMahon (2013) pointed out, “scant research has been conducted to determine if the advantages [of digital learning] are real or simply promotional promises” (p. 1).

Even though student teachers in this study did not incorporate reading in their math classrooms, all teachers could be guided to do so. The basic techniques already taught in content literacy courses, like converting visual and verbal into symbolic representations; discussing tables, graphs and definitions; using graphic organizers like T-charts, can be recontextualized for math texts. Collaborative assignments could be used to ensure interactions with peers and teachers.

Finally, it is important to remember that the impact on an individual’s learning is the result of a complex interaction of good teachers, methods, instructional content, and the technology that work together to deliver the instruction.

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