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The Importance of, and the Need for, Research on How Students Read and Use their Mathematics Textbook

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The Importance of, and the Need for, Research on How Students Read and Use their Mathematics Textbooks

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Abstract: In this article, we argue that: (1) there has been little research on how students read their mathematics textbooks; (2) there has been research on opportunities to learn from textbooks, on how teachers use textbooks, and on how textbooks are selected; (3) reading comprehension research, while valuable in general, does not sufficiently inform one about good reading strategies for mathematical text; (3) *text relevance* research on the kinds of goals students have when reading their mathematics textbooks may be a useful direction; and (4) more generally, that research on what parts of their mathematics textbooks students read and use, and why, would greatly inform both research and practice.

In the reform known as the "New Math," Begle (1973, p. 209) wrote, "If a mathematical topic is in the text[book], then students do learn it. If the topic is not in the text[book], then, on average, students do not learn it." More recently, it has been argued that textbooks play an important role in university students' mathematics courses (Weinberg, Wiesner, Benesh, & Boester, 2012), and specifically in regard to calculus textbooks, that they are "together perhaps with the teacher, the students' main source of reference" (Poisson, 2011). Thus, it would seem that gaining mathematical knowledge from reading, and using, one's mathematics textbook is an essential component of learning mathematics both at school and university. But how much do we really know about how students read, and use, their mathematics textbooks?

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Prior research on mathematics textbooks

Prior research has often focused on mathematics textbooks themselves, such as on opportunities to learn from them, on how teachers use them, and on how they are selected. For example, researchers have examined textbooks for opportunities to learn such important skills as reasoning and proving (Stylianides, 2009; Thompson, Senk, & Johnson, 2012). Researchers have considered the readability of mathematical textbooks, trying to discover "characteristics of a text that facilitate or inhibit the ability of a reader to comprehend the text." (Horney, 2012). Textbooks have been examined in an attempt to correlate opportunities to learn from them with student outcomes (Törnroos, 2005). Researchers have examined how teachers use their mathematics textbooks (e.g., Haggerty & Pepin, 2002; Remillard, 2005; Woodward & Elliott, 1990). There has also been research on what influences K-12 textbook selection (Zeringue, Spencer, Mark, & Schwinden, 2010), though little is known about how community college or university instructors select textbooks for multi-section mathematics courses.

More importantly, however, only a little research seems to have been done on how students actually read, and use, their mathematics textbooks. Osterholm (2008) surveyed 199 articles having to do with the reading of word problems, but found little about reading comprehension of more general mathematical text. He has conducted several studies on secondary and university students' reading of mathematical text (Osterholm, 2005, 2008) using passages written especially for that research. But research on how students actually read, and use, their own mathematics textbooks is still quite limited (Shepherd, Selden, & Selden, 2012; Rezat, 2009; Weinberg, Wiesner, Benesh, & Boester, 2012). This lack of research into students' reading of, and use of, their mathematics textbooks is especially noteworthy because textbook authors regard students as their main readers (Kang & Kilpatrick, 1992). And it is often mathematics textbook authors who provide advice to students on how to read, and use, their textbooks.

Advice on reading from mathematics textbook authors

Advice on how students should read, and use, their mathematics textbooks is not hard to find on the web or in print. For example, on the Swarthmore College website there is a short paper titled, "How to Read a Math Textbook", with eight elaborated steps. These include: (a) skimming the assigned material; (b) circling any new words: (c) highlighting the important material; (d) going through each step of worked examples and writing down any skipped steps; (e) marking concepts you do not know; (f) rereading misunderstood passages several times; and finally, (g) reflecting on what you have read .

Somewhat similar advice can be found in the precalculus textbook that we used in our study of beginning undergraduates' reading of their textbooks (Shepherd, Selden, & Selden, 2012). The textbook authors suggested that students work lots of problems with a graphing utility or paper-and-pencil at hand and follow this five-step approach: (a) read the mathematical development; (b) work through the illustrative examples; (c) work the matched problem; (d) review the main ideas in the section; and (e) work the assigned exercises at the end of the section. (Barnett, Ziegler, & Byleen, 2000, p. xxxi). These are just two examples of mathematics textbook authors' advice to students.

While the above suggestions appear to be reasonable and are probably based on the textbook authors' own experiences while learning mathematics, it is far from clear that they are effective. We do not know of any research on this. In addition, one might ask: Can students implement mathematics textbook authors' advice without further instruction? Also, if students attempt to do so, how effective is the advice for doing their homework, passing their tests, or for gaining genuine mathematical understanding?

Special features of mathematical and science texts that make reading hard

It seems apparent, from all the advice that has been written to help students with reading their mathematics textbooks, that it is a nontrivial task to read such texts and obtain knowledge and understanding from doing so. If this is true, that alone would provide sufficient reason to investigate how students read, and use, their mathematics textbooks. But why is reading one's mathematics textbook hard?

There are many conjectures about this, including some special features of mathematical text that are not found in narrative text. These include: (a) the need to read from right to left, top to bottom, bottom to top, or diagonally; (b) that there are more concepts per sentence and per paragraph than in other writing; (c) that concepts are often abstract and difficult to visualize; (d) that mathematical writing is terse and compact; (e) that words have precise meanings which students often do not fully understand; (f) that formal logic connects sentences so that the ability to understand logical implications is essential; (g) that, in addition to words, mathematics textbooks contain numeric and non-numeric symbols that students do not know how to vocalize; (h) that the layout can make it easy to find and read worked examples while skipping explanatory passages: and (i) that sentences are often complex, and hence, difficult to parse (Barton & Heidema, 2002; Shuard & Rothery, 1998). Again, one might ask: To what extent do these features give students difficulty? Are any of these features especially difficult for students to learn? Provided that these special features of mathematical text are indeed difficult, what kind, and how much, instruction is needed for students to obtain reasonable fluency in mathematical reading? Indeed, mathematics textbooks are not alone in having special features.

In 2010, a special section of *Science*, the journal of the American Association for the Advancement of Science (AAAS), was devoted to research on, and to the challenges of, reading the academic language of science. It was noted that, while school students have mastered the reading of various kinds of English text (mostly narratives), this does not suffice for science texts that are precise and concise, avoid redundancy, use sophisticated words and complex grammatical constructions, and have a high density of information-bearing words (Snow, 2010, p. 450). These are some of the same features of mathematical text that seem to make reading such text hard for students.

This special section of *Science* also indicated that collaborations "between designers of science curricula and literacy scholars are needed to develop and evaluate methods for helping students master the language of science at the undergraduate and high-school levels as well as at the middle-school level." (p. 452).

Reading comprehension research

Shouldn't reading comprehension research give us information on how students read, and use, their mathematics textbooks? Not necessarily. For example, such research has produced formulas on the readability of textbooks by students; however, "The large majority of these formulas are inapplicable to mathematical text because they have no ability to evaluate symbolic notation, much less graphical information." (Horney, 2012). Indeed, while such research can inform us about whether textbooks are written at a level that students should be able to comprehend, it cannot inform us on how students actually read, and use, their mathematics textbooks.

It turns out that neither mathematics education researchers nor reading comprehension researchers seem to have much investigated how individuals read and comprehend mathematical text. Indeed, the most recent *Handbook on Reading Research* has only one chapter (Moje, Stockdill, Kim,& Kim, 2011) on the role of text in any kind of disciplinary reading, and it only gives specific examples of research for the disciplines of history and mathematics. Indeed, most of the information given on students' reading of mathematical text is concerned with the nature, and content of, middle school and high school algebra textbooks and their uses in classrooms, rather than with how individual students read, and use, their mathematics textbooks. For example, in this chapter of the *Handbook*, one finds mention of the work of Nathan, Long, and Alibali (2002), who analyzed ten popular pre-algebra and algebra textbooks to determine how those texts seemed to scaffold algebra learning, in particular, whether those textbooks give precedence to more symbolic or to more narrative language. Again, this research is about the nature of the textbooks themselves, without consideration of how students actually read, and use, them.

Reading comprehension researchers appear to have concentrated largely on narrative texts (e.g., Pressley & Afflerbach, 1995; Shanahan & Shanahan, 2008), but reading academic text, in particular mathematical text, is not like reading other text. "Mathematicians appear to prize brevity, conciseness, and precision of meaning in mathematical writing. Further, there is often little room for an interpretation of a mathematical passage that is different from the one intended by the author." (Shepherd, Selden, & Selden, 2012)

Not only do reading comprehension researchers *not* seem to investigate the reading of academic text very much, but they also seems to implicitly define good reading as what good readers *do*, where good student readers are often those who perform better academically. For example, in their meta-analysis of the reading comprehension research literature, Pressley and Afflerbach (1995) examined 38 studies whose readers included 6^{th} graders, high school students, undergraduates, graduate students, PhDs, professors and other professionals. All were good readers in that they had no decoding difficulties and many read texts with which they had a great deal of experience. Pressley and Afflerbach found a great number of activities that good readers do before, during, and after reading. They reduced these to a "Thumbnail Sketch" of 15 Constructively Responsive Reading (CRR) activities, including: (a) preview text before reading to gain an overview: (b) look for and pay attention to important material; (c) activate and use prior knowledge to interpret text; (d) make inferences about information not explicitly stated; (e) determine meanings of new or unfamiliar words; (f) change reading strategies when comprehension is not occurring; and (g) reflect on text after reading. (For details, see Pressley and Afflerbach, 1995, Table 4.1, p. 105)

A recent study of undergraduates reading their first-year mathematics textbooks

In our recent study (Shepherd, Selden, & Selden, 2012) of undergraduate students' reading of their first-year university mathematics textbooks, we found that good readers, who were also good at mathematics, as measured by their entering ACT scores, were not effective readers of their own mathematics textbooks. By *effective reading*, we meant that the students should have been able to work straightforward textbook tasks after having read how to work them.

In their reading, our students exhibited three kinds of difficulties: (a) insufficient sensitivity to, or inappropriate response to their own confusion or error; (b) inadequate or incorrect prior knowledge; and (c) insufficient attention to the detailed content of the textbook. Also, perhaps somewhat puzzling, we also observed that, in addition to being good readers as measured by the ACT reading comprehension test, our students used many of the CRR strategies of good readers mentioned above. Based on these observed difficulties and the psychology literature on mind wandering during reading (e.g., Schooler, Reichle, & Halpern, 2004), we posited that the students had experienced *cognitive gaps* during their reading, that is, periods of lapsed or diminished focus, and hence, may have missed important points.

For example, after having read the introductory trigonometry section on the Wrapping Function, *W*, that included sample calculations, one student, Christie, in attempting to *Find the coordinates of* $W(-\pi)$, not only started wrapping at the wrong point, (0, 1), but she also did not appear to know that the measure of a quarter circle is $\pi/2$. These points had been explained earlier in the passage she had just read aloud, but she must somehow have missed them (Shepherd, Selden, & Selden, 2012).

Since publishing our study, we have discovered other researchers (McCrudden, Magliano, & Schraw, 2011) who, while perhaps not in the mainstream of reading comprehension research, use the concept of *text relevance* when studying reading. Since those ideas seem to hold promise for investigating students' reading of their mathematics textbooks, we discuss them briefly.

Ideas from text relevance research

Text relevance researchers focus on reading "as a goal-directed activity in which the reader uses text to accomplish some task" and applies to many kinds of reading from office memos to letters to textbooks. They assert "that successful reading comprehension is contingent upon a readers' ability to identify *text relevance*," where text relevance refers to "the instrumental value of text information for enabling a reader to meet a reading goal." (McCrudden, Magliano, & Schraw, 2011, p. 2).

Text relevance researchers have considered a number of related concepts: the role of reading goals, working memory capacity, and standards of coherence. We will consider these, in turn, to see how they might apply to students' reading and use (i.e., comprehension) of their mathematics textbooks.

The Role of Goals

Reading in instructional settings is often task-induced, and readers' goals may affect one's inferential processes while reading. Tasks can impact "how people judge information's relevance to their goals and the strategies that they enact to meet their goals." (McCrudden, Magliano, & Schraw, 2011, pp. 3-4). In addition, reading goals are the outcome of a complex interaction between external and personal intentions. "Specific relevance instructions [can] prompt readers to focus on discrete text segments … whereas general relevance instructions [can] prompt readers to read for a general purpose (e.g., to read for study). (Kendeou, Bohn-Gettler, & Fulton, 2011, pp. 378-379).

Skilled readers "can achieve *optimal cognitive efficiency* [emphasis ours] by formulating reading goals and developing criteria for determining information's relevance to those goals. For instance, if a reader receives a list of focusing questions before reading a text, [he or] she may allocate more resources toward information that enables [him or] her to answer the questions and fewer resources towards information that does not." (McCrudden, Magliano, & Schraw, 2011, p. 4).

The above ideas rather naturally bring up the following potential research questions: When mathematics teachers assign end-of-section homework exercises, what message(s) do they send to their students? Do students (implicitly) assume that the exposition at the beginning of a mathematics textbook section, that often provides conceptual underpinnings for working the end-of-section exercises, is unimportant? Do students achieve *optimal cognitive efficiency* by looking for sample worked problems to mimic, rather than by first reading the entire section? We do not have answers to these questions, but some of our students' proffered comments (Shepherd, Selden, & Selden, 2012) are suggestive:

Winnie: I learn by example [perhaps meaning that's what's important].

Zoe: Sometimes it's just jibberish, but stuff that they mean to attempt to stand out, then I read that, but usually, at the beginning of the chapter I try not to read. I just read the definition because otherwise it's just confusing.

Yates: It takes quite a while to read through [the section] like that, too, maybe an hour, hour and a half [perhaps implying that's not a worthwhile use of his time].

The above comments seem to indicate that our students did not consider it worthwhile to read all of a textbook section, especially the exposition at the beginning. If completing the exercises correctly is the instructor's goal (as perceived by the students) and students want to complete their homework assignments correctly and completely in order to get good grades, then it may seem reasonable to them to skip large sections of the textbook.

Working Memory Capacity

It has been shown that "a reader's working memory capacity (WMC) affects online processing when they read for different purposes…. Furthermore, working memory resources are important because they also allow the reader to integrate ideas across sentences." (Linderholm, Kwon, & Wang, 2011, p. 201). In addition, low WMC readers engage in less effective strategies when reading for study purposes (rather than entertainment purposes), as compared to their high WMC counterparts, and that they also recall less text information (as judged by multiple choice tests), but are overconfident in their performance -- they believe "they are engaging in strategies to meet their goals, but fall short." (Linderholm, Kwon, & Wang, 2011, p. 207).

Although we had information on our students' ACT reading comprehension and mathematics scores (Shepherd, Selden, & Selden, 2012), we did not have information on their working memory capacities,[3] so it is possible that, in future studies, knowledge of students' working memory capacities might give additional insights into their reading. Future research studies might consider administering a test for WMC to investigate whether, and how, this affects students' reading of their mathematics textbooks.

Standards of coherence

Standards of coherence refer to the types and strength of coherence that an individual reader aims to maintain during reading. These can be implicit or explicit and reflect that individual's desired level of understanding for a particular reading situation. Standards of

[3] One common test for WMC is the reading span task (RST) invented by Daneman and Carpenter (1980). The original RST required participants to read series of unconnected sentences aloud and to remember the final word of each sentence of a series. The number of sentences of a series was incrementally increased until a participant's reading span, or the maximum number of final words correctly recalled, was found.

coherence are influenced not only by characteristics of the reader, but also by the characteristics of the text.

Characteristics of the text include the "specific content of the text, the order in which the content is presented, gaps in the semantic flow, layout, [and] the presence of text signals such as titles and italics." (Bock, et al., 2011, p.125). It would be useful to investigate which special features of mathematical text give students' difficulties and how one might help students overcome such difficulties.

The *characteristics of the reader* include working memory capacity, mentioned above, and inadequate or insufficient prior knowledge. "A reader's standards of coherence when reading a particular text are influenced by situation-specific factors such as goals and task instructions, text properties, and reader characteristics." (Bock, et al., 2011, p.130). Readers can adopt standards of coherence that are incomplete, but adequate (in the eyes of the reader). Such considerations prompt us to ask: What standards of coherence did our students (Shepherd, Selden, &Selden, 2012) adopt when reading aloud for the interviews? Clearly, because they were asked to do so, they read parts of the textbook, such as a section's introductory exposition, that they would not normally have read (they said so). What else was different? We asked in the final debrief how their reading for the interview differed from their normal reading of their mathematics textbooks.

Tara: I don't usually get the reading done before class.

Zoe: Usually I will read in between if it looks like it's important, but if it just looks like it's fluff or explaining it, and I already understood it. … so maybe I wouldn't have read in between …

Darcy: I'll like look through the section …then I'll go and start doing the

> problems [homework exercises], and I'll come across something I don't understand, and I'll go back to the section … and try to find what they're saying ...

Additional studies are needed to gain more insight into students' standards of coherence when reading their beginning university mathematics textbooks. But, what about students at other levels? In a study (Shepherd, 2012) of mathematics graduate students' and mathematicians' reading of unfamiliar mathematical text, it was observed that, when a portion of the text was unclear to them, they sometimes read ahead in the hopes that further reading would clarify things. For example, one mathematics graduate student, when reading about a homeomorphism, being defined between two open sets, said, "Although I don't completely understand, I'm going to see later on where it's used and how it's useful. And if I need to come back to this, then I will."

One can see from the above, that using the concepts of text relevance could be useful for designing studies on, and analyzing data collected on, what, how, and why students' read their mathematics textbooks the way they do.

What students do when reading their mathematics textbooks.

In addition to our own study (Shepherd, Selden, & Selden, 2012), described above, we know of two other recent studies that have either looked at, or have asked students about, their reading of their mathematics textbooks. Rezat (2010) looked at the actual reading of high achieving German 6th grade and 12th grade students. Instead of using an interview setting and having the students read aloud, he asked students to highlight every part of the textbook that they used, both in and out of class, and to explain in a small booklet why they had used the highlighted parts. In addition, he observed the classroom mathematics lessons and took field note for a period of three weeks. That way he was able to tell whether students only used the textbook when told to by the teacher or whether they also used it of their own accord. They did both.

Rezat found students used their textbooks for solving tasks, for consolidating of mathematical knowledge and skills, for acquiring new mathematical content, and for pursuing their own mathematical interests. However, Rezat also commented that “Hardly ever does it seem like students want to understand the mathematics first and then apply it to the task.” This seems to agree with our undergraduates (Shepherd, Selden, & Selden, 2012) who stated, in the debrief, that they normally did not read the exposition at the beginning of a section and had only done so during the interview because they were asked to. Rezat indicated the need for more research, stating that “a better understanding of student’s [sic] utilizations of mathematics textbooks is a prerequisite for effective implementation of mathematics textbooks into teaching.”

Weinberg, Wiesner, Benesh, and Boester (2012) surveyed 1146 undergraduate students in introductory mathematics classes, such as college algebra, precalculus, discrete mathematics, calculus, and introductory statistics, about what parts of their textbook they used, when they used the textbook, and for what purpose. In addition they recruited nine undergraduates to keep “textbook-use journals” and an additional 18 students to participate in structured interviews.

Students reported using worked example more than any other part of their mathematics textbooks, and a large percentage reported not reading the chapter introduction or the chapter text. However, “These are the portions of the text in which the author attempts to develop a deeper understanding of the mathematical concepts.” (Weinberg, Wiesner, Benesh, and Boester , 2012). The authors conjectured that the way the students used their textbooks “may be the result of the textbook structure itself, as well as students’ beliefs about reading and the nature of mathematics.” But these conjectures need further research.

DISCUSSION

It has been noted by Lithner (2004), in his study of the kinds of reasoning required to work calculus textbook tasks, that "it is possible in about 70% of the exercises to base the solution not only on searching for similar situations, but on searching only the solved examples." This, together with some of our students’ proffered comments on reading the textbook exposition (Shepherd, Selden, & Selden, 2012) and the findings of Weinberg, Wiesner, Benesh, and Boester (2012), suggests that an optimally efficient reading strategy for beginning university mathematics students, who are primarily interested in completing their end-of-section homework assignments in order to get good grades, is to look for similar worked examples. Furthermore, for this goal, such students may correctly see it as a waste of time to read the entirety of the preceding textbook section before attempting their homework. Perhaps university instructors and school teachers need to ask more conceptual and integrative questions on assignments and tests in order to encourage students to read the exposition. But this also needs more research.

The ineffective reading we observed in our students (Shepherd, Selden, & Selden, 2012) had to do with not being able to consistently correctly work straightforward tasks, immediately after reading how to work them. It could be that our students were simply not accustomed to reading their textbooks in order to find out how to work tasks, but rather depended greatly on their instructor to illustrate such methods during class. Since the instructor of these students had provided instruction on reading their textbooks

(Shepherd, 2005), one might ask: Was the instruction of the right kind? Was the instruction they received sufficient?

We wondered why our students, unlike mathematicians, did not go back and reread portions of their textbooks upon discovering that they had worked a task incorrectly. For this, we have a few conjectures. Perhaps this was because they did not believe they could do so. Perhaps they also did not know where to look in the passage or elsewhere in the textbook. Indeed, in the case of one calculus student who had a problem with negative exponents when taking a derivative, there was nowhere in the calculus textbook that would have helped with that particular incorrect prior knowledge. Finally, sometimes it seemed to the interviewer that the students did not know what was important or where to focus their attention (Shepherd, Selden, & Selden, 2012). These conjectures could use additional research.

CONCLUSION

More research is clearly needed on whether advice on how to read one's mathematics textbook, given in the non-research literature, is indeed useful and in what ways. That is, can such advice, or some of it, be implemented by students, with or without, special instruction? Is it merely descriptive, without being proscriptive? It seems to us that even with considerable instruction (Shepherd, 2005), students while able to improve their ability to read their mathematical textbooks, probably need additional help in order to decipher and understand mathematics textbooks on their own, with the ultimate goal being that they become independent learners. Indeed, given the current interest in the "flipped classroom" model of teaching, in which students do much textbook reading or watching of videoed lectures outside of, and prior to, class so there can be more in inquiry-based learning in class, research on students' reading could be very useful.

In addition, it would be informative to investigate how various kinds of individuals (e.g., school students, undergraduate students, mathematics graduate students, mathematicians) attempt to learn and to use mathematics by reading mathematical text. One of us has recently completed such a study (Shepherd, 2012). In that study, Shepherd, based on her own and on our joint reading research data (Shepherd, Selden, & Selden, 2012), posited a framework for how reading mathematical text progresses from novice to intermediate to expert, where novices were beginning undergraduates, intermediates were mathematics graduate students, and experts were mathematicians all reading unfamiliar (level appropriate) mathematical text. But much more research is needed. This sort of information could be especially informative for teachers, who could then know what could be expected from students at various levels of school and university mathematics without special instruction.

While research on opportunities to learn found in textbooks, on the readability of textbooks, on the relation between the choice of textbook and student academic performance, on teachers' use of mathematics textbooks, and on how K-12 mathematics textbooks are selected all provide valuable information, it seems to us that crucially missing is substantial research on how students actually read, and use, their mathematics textbooks, in particular, on what parts of their mathematics textbooks they read, and why. Such research on students' reading would greatly inform both research and practice.

REFERENCES

Barton, M. L., & Heidema, C. (2002). *Teaching reading in mathematics* (2nd Ed.). Aurora, CO: Mid-continent Research for Education and Learning.

Begle, E. (1973). Some lessons learned by SMSG. *The Mathematics Teacher 66*(3), 207-214.

Bock, van den, P., Bohn-Goettler, C. M., Kenedou, P., Carlson S., & White, M. J. (2011). When a reader meets a text: The role of standards of coherence in reading comprehension. In M. T. McCrudden, J. P. Magliano, & G. Schraw (Eds.), *Text relevance and learning from text* (pp. 123-139). Charlotte, NC: Information Age Publishing, Inc.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, *19*(4), 450-466.

Horney, M. (2012). How can the readability of a mathematical text be measured? Mathematics eText Research Center. Retrieved May 26, 2013, from http://metrc.uoregon.edu/index.php/related-questions/125-readability.html.

Kang, W., & Kilpatrick, J. (1992). Didactic transposition in mathematics textbooks. *For the Learning of Mathematics*, *12*(1), 2-7.

Kendeou, P., Bohn-Goettler, C., & Fulton, S. (2011). What we have been missing: The role of goals in reading comprehension. In M. T. McCrudden, J. P. Magliano, & G. Schraw (Eds.), *Text relevance and learning from text* (pp. 375-394). Charlotte, NC: Information Age Publishing, Inc.

Lithner, J. (2004). Mathematical reasoning in calculus textbook exdercises. *Journal of Mathematical Behavior, 23* (4), 405-427.

Linderholm, T., Kwon, H., & Wang, X. (2011). The effects of reading purpose on advanced readers. In M. T. McCrudden, J. P. Magliano, & G. Schraw (Eds.), *Text relevance and learning from text* (pp. 197-222). Charlotte, NC: Information Age Publishing, Inc.

McCrudden, M. T., Magliano, J. P., & Schraw, G. (2011). *Text relevance and learning from text.* Charlotte, NC: Information Age Publishing, Inc.

Moje, E. B., Stockdill, D., Kim, K., & Kim H.-J. (2011). The role of text in disciplinary learning. In M. L. Kamil, , P. D. Pearson, E. B. Moje, & P. P. Afflerbach, (Eds.), *Handbook of reading research, Volume IV* (pp. 453-486) New York, NY: Routledge.

Nathan, M. J., Long, S. D., & Alibali, M. W. (2002). The symbol precedence view of mathematical development: A corpus analysis of the rhetorical structure of textbooks. *Discourse Processes*, *33,* 1-22.

Osterholm, M. (2005). Characterizing reading comprehension of mathematical texts. *Educational Studies in Mathematics, 63,* 325-346.

Osterholm, M. (2008). Do students need to learn how to use their mathematics textbooks? The case of reading comprehension. *Nordic Studies in Mathematics,13*(3), 7-27.

Poisson, C. (2011). Mathematical and didactic organization of calculus textbooks. Masters' thesis. Concordia University, Montreal, Canada.

Pressley, M., & Afflerbach, P. (1995). *Verbal protocols of reading: The nature of constructively responsive reading*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Rezat, S. (2010). The utilization of mathematics textbooks as instruments of learning. In V. Durand-Guerrier, S. Soury-Lavergne, & F. Arzarello (Eds.), *Proceedings of CERME 6*, Working Group 7 (pp. 1260-1269) Lyon, France: Institut National De Recherche Pédagogique.

Schooler, J. W., Reichle, E. D., & Halpern, D. V. (2004) Zoning out while reading: Evidence for dissociations between experience and metaconsciousness. In D. T. Levin (Ed.), *Thinking and seeing: Visual metacognition in adults and children* (pp. 203-226). Cambridge, MA: MIT Press.

Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literature to adolescents: Rethinking content area literacy. *Harvard Educational Review*, *78*(1), 40-59.

Shepherd, M.D. (2012). A first look at how mathematicians read for understanding. In S. Brown, S. Larsen, K. Marrongelle, & M. Oehrtman (Eds.), *Proceedings of the 14th Annual Conference on Reearch in Undergraduate Mathematics Education,* Vol. 1 (pp. 417-432). Available online: http://sigmaa.maa.org/rume/RUME_XIV_Proceedings_Table_Of_Contents.pdf

Shepherd, M. D. (2005). Encouraging students to read mathematics. *PRIMUS*, 15, 124-144

Shepherd, M. D., Selden, A., & Selden, J. (2012). University Students' Reading of their First-Year Mathematics Textbooks. *Mathematical Thinking and Learning*, *14*, 226-256.

Shuard, H., & Rothery, A. (Eds.) (1988). *Children reading mathematics*, London: John Murray. (Original work published 1984).

Snow, C. E. (2010). Academic language and the challenge of reading for learning about science. *Science*, *328*, 450-452.

Stylianides, G. J. (2009). Reasoning-and-proving in school mathematics textbooks. *Mathematical Thinking and Learning, 11*, 258-288.

Thompson, D. R., Senk, S. L., and Johnson, G. J. (2012). Opportunities to learn reasoning and proof in high school mathematics textbooks. *Journal for Research in Mathematics Education*, *45*(3), 253-295.

Törnroos, J. (2005). *Mathematics textbooks, opportunity to learn and student achievement.* University of Jyväskylä, Finland: Institute for Educational Research.

Weinberg, A., Wiesner, E., Benesh, B., & Boester, T. (2012). Undergraduate students' self-reported use of mathematics textbooks. *PRIMUS*, *22*(2), 152-175.

Zeringue, J. K., Spencer, D., Mark, J., & Schwinden, K. (2010). Influences on mathematics textbook selection: What really matters? Paper presented at the NCTM Research Pre-session, April 2010, San Diego, CA.