Promoting Reading Strategies for Developmental Mathematics Textbooks,

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Abstract. This article presents three reading and study strategies designed to facilitate student comprehension of and learning from developmental mathematics textbooks. It also includes a review of pertinent research and briefly describes our experiences teaching these strategies to students.

The National Council of Teachers of Mathematics has recommended that "students have an opportunity to read, write, and discuss ideas in which the use of the language of mathematics becomes natural" (1989, p. 6). Many developmental mathematics students, however, continue to lack strategies for academic reading (McIntosh & Draper, 1995). The purpose of this article is to discuss three strategies selected from a methodology designed to teach developmental students to read mathematics textbooks. The methodology reflects research in reading (Nist & Diehl, 1994), mathematics (Borasi & Siegel, 1990; Polya, 1957), and cognitive psychology (Janvier, 1987). The discussion includes a preview, predict, read, and review reading strategy; concept cards; and a Question Answer Relationship technique. These strategies were designed to enable students to read and study effectively mathematics textbooks and concepts. In 1996, they were introduced in one math-specific and two general developmental reading classes. All three classes consisted of 90 to 100% minority students who were concurrently enrolled in developmental mathematics courses.

How to Study a Mathematics Textbook: Preview, Predict, Read, and Review

This process used to facilitate students' ability to read and study a mathematics textbook was initially developed by Dr. Ann Schlumberger with Dr. Jill Keller. Keller's research (1992) indicated that instructors tend to play into students' learned helplessness in reading quantitative texts. Schlumberger and Keller analyzed mathematics textbooks and found that authors intend for students to engage in a continuous process: read, practice, and review. Students can reinforce this

process in their study routine.

Prereading

Before they read, students are instructed to preview the assignment using the following steps: (a) read and highlight the readings; (b) highlight words that are emphasized in italics or bold print; and (c) ask themselves questions such as "What is the main topic? What does the author hope to accomplish in this section? What am I supposed to learn and be able to do after I finish this?" Students also keep a notebook or study journal in which they write brief answers to these questions. After they preview the assignment, students make a three-column list, in their journal or on a separate sheet of paper, with these headings: things I already know, things I have studied before but need to review, and things I have never heard of.

During Reading

Students are made aware that mathematics textbooks follow this expository pattern: statement, example, and explanation/summary. This pattern is repeated over and over in the chapter and even within a single section.

Statement. To identify and study the statement, students are instructed to cover up the page, exposing only the first title or subtitle, and to predict what will come next. They then read the first paragraph and write a short summary phrase in the margin of the textbook. They also highlight or underline key words. These steps are repeated if there is more than one paragraph of text.

Example. To study the examples, students are instructed to begin by looking at the first line of the sample problem. They cover the rest up with a sheet of paper, or, if the problem is on one line, they cover up the answer. Second, they are asked to predict the next line of the problem or the answer, which they write down or answer silently. Third, they check their predictions. If these are different from what is written, students examine and learn from the differences. Students are encouraged to see mistakes as excellent teachers and are encouraged to take the risk of making mistakes in order to learn from them.

Explanation or Summary. Often the sample problem will be explained in the paragraph following it. If a sample problem is explained, students work the problem on a piece of paper, following the explanation given in the textbook. If a summary rather than an explanation of the sample problem is given, students annotate the summary in the margin of the textbook.

Practice

Before going on to read the rest of the assignment, students work a couple of problems that follow the rules and examples they have just studied. They then move to the next section, read and work the problems. During this stage of the process, students are asked to write down every step when working each problem. Students then check their answers using the key in the textbook or with a study partner. If the answers are incorrect, they go over the steps, carefully comparing theirs to the sample in the book. By using these steps, students learn that practice problems are like the sample

problems discussed in each section. They learn to recognize similar patterns between the sample problems explained in the text and the practice problems after each section and in the chapter reviews.

Review

Students work review into their mathematics reading routine in two important ways. First, after working a couple of problems that illustrate each section in the reading assignment, they can go back and finish working homework problems pertaining to that section. Second, before class, they can look over their annotations in the textbook, as well as their mathematics journal or study notebook, and put a question mark (?) beside any section that still is giving them difficulty. Students are then encouraged to ask their instructor for help with that section. Once students are comfortable using the process, they are encouraged to practice it and keep a journal over several weeks. Journal entries and work are shared and discussed in class, and questions about applying the steps are discussed in class. In small groups, students in the same mathematics class share annotations and problems and learn how other students are applying the process.

Concept Cards

Concept cards are note cards students make while they are reading their mathematics textbook. To develop cards that will aid in studying, as well as test review, students need to learn to read, to reflect on what was read, and to put the information in their own words. The ability to restate what was read is important because it demonstrates comprehension of the text. Once students restate what was read, they make a card. One advantage of concept cards is that they can be reconfigured and organized by related concepts.

Concepts cards in general can include definitions, characteristics, examples, and nonexamples. The following are common kinds of concept cards in mathematics: (a) strategy cards for solving problems; (b) fact cards that include rules, laws, or theorems; and (c) cards for symbols and specialized vocabulary. An excellent discussion with examples of mathematics concepts cards is in Wood (1996).

QAR: Question Answer Relationships

Students in a Summer Bridge course were also taught a method for reading word problems based on strategies recommended by Polya (1957). These students ranked instruction in reading word problems second in importance of the six strategies they were taught. They indicated that they wanted more strategies and instruction for reading word problems. In response, Lou Ann Pate refined and further developed Question Answer Relationship Activities based on strategies developed by Polya (1957), Raphael and Gavelek (1988), as well as McIntosh and Draper (1995).

The QAR strategy was designed to enable students to understand where basic mathematical concepts apply to the real world and how they connect to more sophisticated mathematical concepts. This strategy begins with "Right There Questions" which are based on information that is right there in the problem. "Think and Search Questions" require students to identify relationships

among the givens and the unknowns and require students to perform calculations using them. "Author and You Questions" provide an extension of basic concepts used in "Think and Search." The three types of questions all require students to become aware of the different kinds of information provided in the story problem that they can use to answer the different kinds of questions. Finally, students learn to answer "On Your Own Questions." They are taught how to identify prior knowledge or additional information needed to solve the problem.

In the early parts of the course, the instructor works with students to identify the information needed to answer the "Right There Questions." Students are given guided practice and learn to generate or create their own questions. The instructor also models the responses to the "Author and You" and the "On Your Own" questions. By the end of the course, students are able to come up with their own questions for these categories.

Conclusions

Students introduced to the three strategies for reading developmental mathematics textbooks gave the preview, predict, read, and review strategy and the concept cards strategy the highest ratings for perceived usefulness. They stated that concept cards enabled them to isolate what they needed to focus on and extract from the text. They also learned to separate general concepts from specific examples through use of the cards. Students saw the cards as references they could use when solving problems. They associated the idea of flash cards with the act of reviewing and memorizing, and the cards became a physical prompt reminding them to review. Students indicated the QAR strategy helped them gain a sense of where they were in their development of mathematical understanding, as well as a sense of where they were going.

References

- Borasi, R., & Siegel, M. (1990). Reading to learn mathematics: New connections, new questions, new challenges. For the Learning of Mathematics, 10, 9-16.
- Keller, J. L. (1992). Conversational implicature in higher order thinking in instructional conversations. Unpublished doctoral dissertation, University of Arizona, Tucson.
- Janvier, C. (Ed.). (1987). Problems of representation in the teaching and learning of mathematics. Hillsdale, NJ: Earlbaum.
- McIntosh, M., & Draper, R. (1995). Applying the question-answer relationship strategy in mathematics. Journal of Adolescent & Adult Literacy, 39, 120-131.
- National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: Author.
- Nist, S., & Diehl, W. (1994). Developing textbook thinking (3rd ed.). Lexington, MA: D.C. Heath.
- Polya, G. (1957). How to solve it (2nd ed.). Princeton, NJ: Princeton University Press.
- Raphael, T. E., & Gavelek, J. R., (1988). Question-related activities and their relationship to reading comprehension: Some instructional implications. In G. Duffy & L. Roehler (Eds.), Comprehension instruction: Perspectives and suggestions (pp. 234-250). New York: Longman.
- Wood, N. (1996). College reading and study skills (5th ed.). New York: Harcourt.