TEACHING TIP

CONNECTING READING AND MATHEMATICAL STRATEGIES

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Recently, there has been a growing push toward interdisciplinary teaching and learning in elementary classrooms. Teachers are increasingly looking for integrated approaches that enhance student learning both within and across the different content areas. The practices of teaching comprehension strategies in reading and problem solving in mathematics offer one such example of similarities across content areas.

In both reading and mathematics, we want students to make predictions, monitor understanding, determine importance, and make connections. Beyond these similarities in individual strategies, reading and mathematics also place a common priority on flexible strategy use. We want students to use strategies flexibly, coordinating and adjusting them in response to specific tasks (National Council of Teachers of Mathematics [NCTM], 2000; National Reading Panel [NRP], 2000).

In this article, we highlight some of the similarities between strategies used for reading comprehension and for solving mathematical problems, provide examples of common language that teachers can use to promote learning across subject areas, and emphasize the benefits of forging pedagogical connections between reading and mathematics. Again, we hope to draw attention to a central, common need for flexible strategy use. By taking advantage of some natural parallels between reading and mathematics, teachers can enhance students' learning of individual content areas and their ability to make generalizations across them.

Making Predictions

To build reading comprehension skills, teachers often teach students to make and justify predictions about a text (Paris, Wasik, & Turner, 1991; Pressley, 2006). For example, when reading a fiction text, a teacher may ask students what they think will happen next. Students' predictions are based on existing knowledge about the story and its characters, in addition to personal background knowledge and knowledge of story structure and genre features. To guide students in this strategic process, a teacher might ask questions such as, "What do you think will happen

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next?" and "What made you think that would happen?" As students continue to read, a teacher may follow up by asking, "Does this event match what you predicted would happen?" This process of making—and later checking, and possibly even revising—predictions helps students engage closely and iteratively with texts (Pressley, 2002).

Just as they teach predicting as a comprehension strategy, teachers can use similar language to help students think about mathematics. Whether students are engaging with word problems or with mathematical concepts in other contexts, teachers can ask students to make predictions when solving problems. For example, teachers might ask, "If you had to estimate, what do you think 65 × 33 will equal? On what ideas are you basing your prediction?" In responding to these questions, students think more deeply about the mathematics they are doing; they have to justify why they made that prediction rather than just guessing a random number.

By listening to students' explanations, teachers learn how students are using their requisite knowledge of multiplication concepts (Mewborn & Huberty, 1999) and using multiplication facts to estimate. Are they making 60 groups of 30, or are they using different groupings and multiplication facts?

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When teachers ask students to make and justify mathematical predictions based on prior knowledge, they are using the same pedagogical approach in mathematics as they do in reading.

Monitoring Comprehension

Another effective strategy in improving reading comprehension is comprehension monitoring (NRP, 2000). To use this strategy successfully, students need to know how to assess their level of comprehension and use a repertoire of strategies for repairing errors and filling gaps. They also need to understand that comprehension problems may be related to difficulties in multiple areas, including word recognition, vocabulary knowledge, and inference making.

Teachers can model this strategy during read-aloud lessons. For example, when a teacher read aloud that a character was "beating himself up," one student asked why the character would do that. The teacher commented, "So, it doesn't make sense that he would actually beat himself up, does it? Are we reading all of the words correctly? Maybe some of the words have another meaning." When students are reading silently to themselves, teachers can encourage them to periodically ask themselves, "Does that make sense?" or "Do I understand what is happening?"

Teachers may also guide students to identify the source of the problem—issues such as word recognition errors, gaps in background knowledge, or confusion with figurative language. To clear up misunderstandings, a teacher may encourage students to reread or take other steps to repair comprehension. Monitoring strategies help students focus on constructing meaning as they read and reflect on comprehension after they read. Students who monitor their comprehension successfully can identify and repair gaps in their understanding of a text (Palincsar & Brown, 1984).

In mathematics, when teachers ask similar monitoring questions, students need to understand the strategy they are using to solve the problem. A question you might hear in an elementary mathematics lesson is, "Does this answer make sense?" Many times, in solving computational problems, students end up with incorrect answers because they do not have the mathematical monitoring skills to determine whether their solution looks reasonable. For example, students often provide 106 as a solution to the problem 1203 – 1197. Teachers can prompt students by saying, "You took away 1197 from 1203; tell me how you got an answer of 106."

During the resulting conversation, the student may recognize the mistake or the teacher may identify a gap in the student's understanding. If the student struggles to see the error in his or her thinking, the teacher can model self-monitoring behaviors: "Let's see if we get the same answer using a different strategy." And afterwards, "Now let's compare answers from your two strategies. Do the answers match? Why?" Although the ultimate goal is for students to monitor their own problem solving, teachers can use guiding questions to model this valuable

Pause and Ponder

- How can teachers help their students understand connections between reading comprehension strategies and mathematical problem-solving strategies?
- What can teachers do to help their students use comprehension and problem-solving strategies flexibly and independently?

habit of mind. Mathematics teaching that enables children to articulate their thinking when solving problems helps comprehension (Kazemi, 1998). Monitoring problem solving, like monitoring reading comprehension, can help students identify mistakes and repair misunderstandings.

Determining Importance

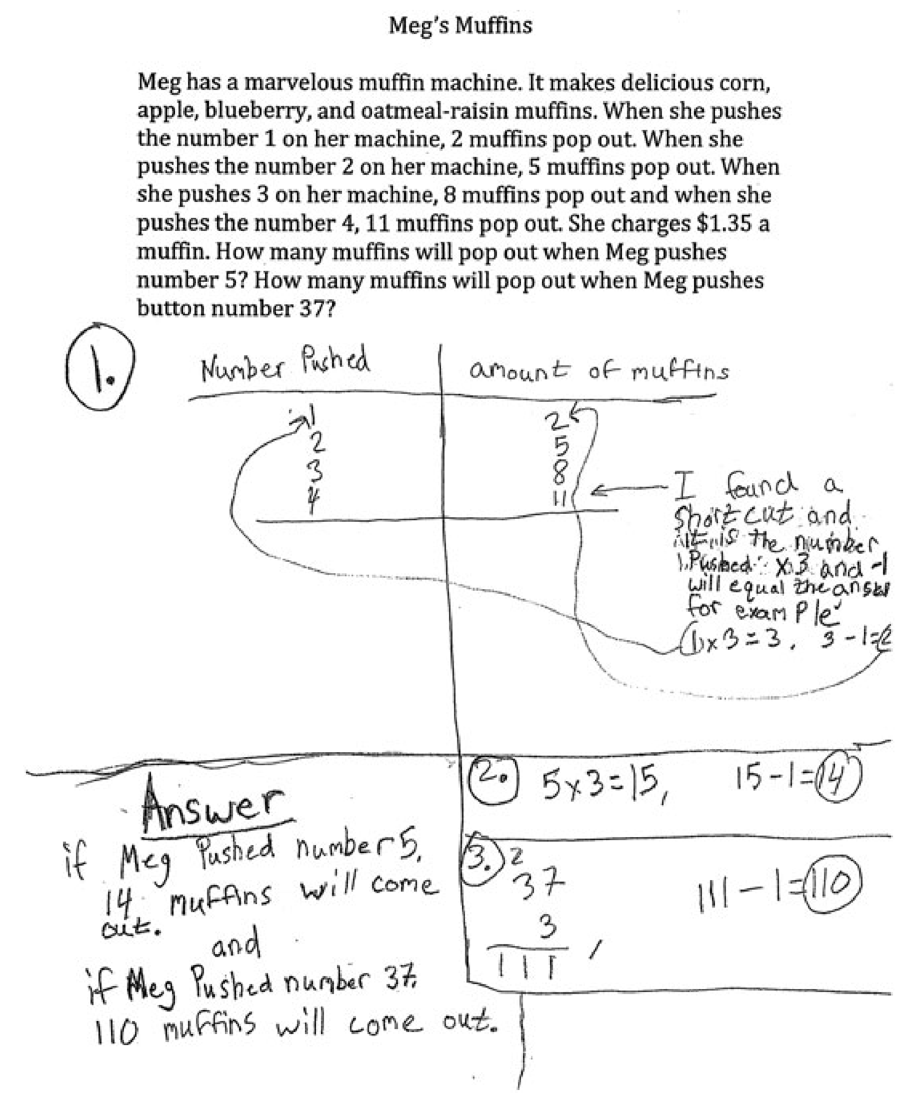
Another strategy for comprehending both narrative and expository texts is the process of determining what parts of a text are most important. To guide students' use of this strategy, a teacher might use prompts such as, "Tell me the most important parts of what you just read" or "Think about the main idea of this paragraph." To determine importance, students need to have a good understanding of genre-specific text structures and features. Teachers can help students develop this understanding through explicit, scaffolded instruction.

For example, a lesson about expository texts with a "compare and contrast" structure might focus on common organizational patterns and key words and phrases (e.g., similar, likewise, however, on the other hand). A teacher might then have students use graphic organizers to support them in identifying important points and details as they read texts with that structure (NRP, 2000). This kind of instruction can help students differentiate between essential information (e.g., "environmental hazards are affecting frog populations worldwide") and appealing but extraneous details (e.g., "goliath frogs are nearly 12 inches long"). By determining the importance of information in a text, young readers focus on essential ideas and build a mental structure of the text.

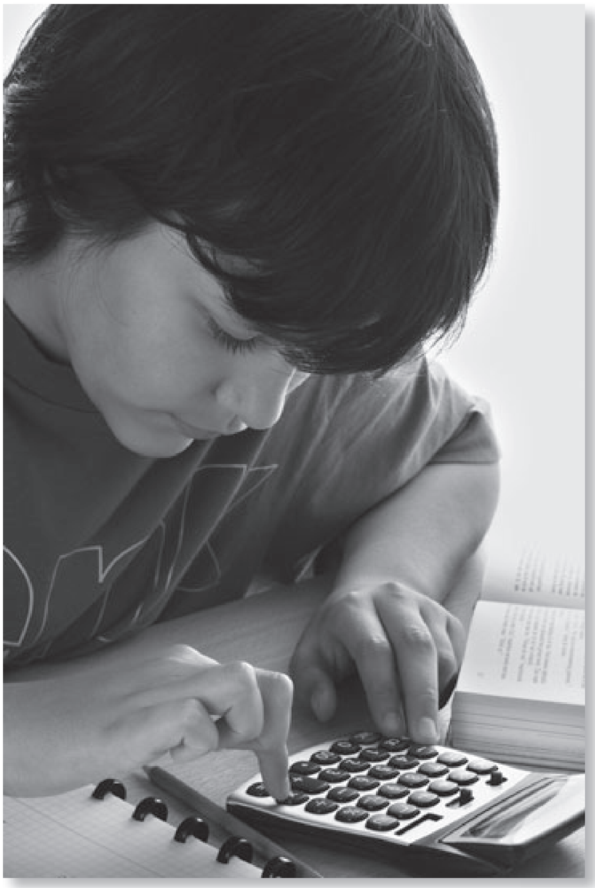
Similar processes are at work in mathematics. To solve the mathematical problems they encounter, students need to have strategies for determining what information is important to the problem and what information is extraneous (Carpenter, Fennema, Franke, Levi, & Empson, 1999). As with reading other types of texts, teachers can help students determine importance in mathematical problems by focusing on structures, using graphic organizers, and identifying key words common to different problem types.

The Figure shows an algebraic patterning problem that includes a combination of essential and extraneous information. In problems such as these, real-life connections can distract students with "seductive details" and can hinder their problem-solving efforts. For example, a student's interest in the types of muffins produced or the cost of the muffins could divert him or her from

Figure Problem-Solving Sample


Meg's Muffins

Meg has a marvelous muffin machine. It makes delicious corn, apple, blueberry, and oatmeal-raisin muffins. When she pushes the number 1 on her machine, 2 muffins pop out. When she pushes the number 2 on her machine, 5 muffins pop out. When she pushes 3 on her machine, 8 muffins pop out and when she pushes the number 4, 11 muffins pop out. She charges $1.35 a muffin. How many muffins will pop out when Meg pushes number 5? How many muffins will pop out when Meg pushes button number 37?



addressing the key point of the question, which is to compute the amount of muffins made with each push of the button.

To help students apply appropriate mathematics strategies, such as graphic organization (a table) and pattern recognition (adding 3 to the previous amount with each step), the teacher had students organize the information for the buttons pushed and the muffins that were produced. She then had students explain their problem-solving strategies. Because real-world mathematical problems are often complex, with extraneous information, it is important for students to distinguish between essential and irrelevant information.

Making Connections

Perhaps the strongest similarity between reading and mathematics strategies is in making connections. By guiding students to think about how a text relates to other texts, to themselves, and to the world around them, teachers support students' comprehension. To use this strategy effectively, students must be aware that connections strengthen comprehension by allowing them to relate new ideas to existing knowledge (Pressley, 2000). To prompt such strategy use, a teacher might ask, "Does that remind you of any other things we've read?" or "Can you think of a time you've felt like that?"

Students also need to understand that not all connections will be helpful ones. When a student responds to a story about a hot air balloon flight with a connection about a water balloon fight, a teacher could guide the student by asking, "What part of the text led you to that connection? How does that connection help you understand the story?" By using probing questions like this, teachers can find out more about students' thinking and can guide students toward more productive strategy use. In this example, the teacher might discover some word-level misunderstandings and use the conversation as an opportunity to help the student see the link between word recognition and comprehension. Conversations like this encourage students to make connections that enhance their comprehension.

The idea of students making connections in reading corresponds to having students make problem-to-problem, problem-to-self, and problem-to-world connections in mathematics. Based on similar concepts about how students learn, teachers can ask students to make parallel connections in mathematics. When teachers ask children to find similarities in problems they have done earlier, they enable students to draw on the methods used previously.

For example, a teacher could prompt students to make such a connection by asking, "How can our solution to 203 – 197 help us solve this new problem of 1203 – 1197?" When teachers ask children, "How is the problem connected to your life?" or "How is the mathematics problem connected to the real world?" they help students build connections to how the mathematics is used in their students' lives and in the world around them. In doing so, the mathematics becomes tangible and real to students. In both reading and mathematics, making connections

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between new information and existing knowledge strengthens understanding (NCTM, 2000).

Using Strategies Flexibly and Independently

Although each of the individual reading comprehension strategies discussed so far is useful in certain situations, it is important to note that using individual strategies when prompted is not enough; students must learn to use a variety of strategies flexibly and as needed (Pressley, 2002). Teachers can help students understand this overarching principle of flexible strategy use by modeling their own strategy use as they read and think aloud. For example, after reading a chapter aloud from *Charlie and the Chocolate Factory*, a teacher might say, "I want to be sure I remember all of the important things that happened in this chapter, so I'm going to take a minute to flip back through it and summarize it for myself. Charlie found a dollar on the sidewalk, which made me wonder what he might do with it. I predicted that he would buy some candy." This explicit description of flexible, purposeful strategy use can serve as a model for students.

A teacher can also promote independent strategy use by encouraging students to be metacognitive and by giving them feedback on their strategy use. For example, when one student made an unsolicited prediction during a read-aloud lesson, a teacher commented, "You just made a prediction. You saw the picture and guessed what might happen next. Did anyone else make a prediction based on this picture? Predictions can help us think about what might come next." This kind of teacher talk draws students' attention to strategy use through explicit labeling and reminders about how a strategy works. These open conversations about strategy use send the message that strategies should be used both flexibly and independently to help make sense of text.

In mathematics, discussing why different strategies were helpful for solving a problem enables students to become flexible mathematical thinkers who can make choices about using a strategy that is most efficient for them (Russell, 2000). For many students, subtracting 201 from 747 is a straightforward problem that they can solve using a variety of strategies. However, solving 747 – 199 can be difficult for students who are limited to the traditional algorithm of a borrowing procedure; more efficient strategies exist for solving this problem. For example, (747 – 200) + 1 is a far more efficient strategy. Helping students use strategies flexibly, in different problem-solving situations, promotes deeper understanding of and comfort with mathematical concepts (Caldwell, Karp, & Bay-Williams, 2011).

Promoting Common Language and Strategic Thinking

Because there are many natural connections between comprehension and problem-solving strategies, students can use similar patterns of thinking in reading and mathematics. Teachers can help students understand these connections by using common language to promote strategic thinking. By applying parallel pedagogical approaches, teachers can strengthen their students' comprehension and conceptual understanding both within and across the subject areas.

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TAKE ACTION!

1. When listening to students' thinking, find opportunities to identify and label their strategy use.
2. During guided instruction, make explicit connections between reading and mathematics strategies.
3. Look at math curriculum to find opportunities to apply reading comprehension techniques to mathematical problem-solving situations.
4. Work with students to create an anchor chart showing reading–math connections.

MORE TO EXPLORE

ReadWriteThink.org Lesson Plans

- "Giant Story Problems: Reading Comprehension Through Math Problem-Solving" by Renee Goularte
- "What If We Changed the Book? Problem-Posing with *Sixteen Cows*" by David Whitin and Phyllis Whitin

IRA Book

- *Literacy + Math = Creative Connections in the Elementary Classroom* by Jennifer Altieri

IRA Journal Article

- "Using Children's Literature to Inspire K–8 Preservice Teachers' Future Mathematics Pedagogy" by Robin A. Ward, *The Reading Teacher*, October 2005

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