

MATHEMATIZING READ-ALOUDS IN THREE EASY STEPS

Allison Hintz ■ Antony Smith

Tamara Mak (all names are pseudonyms) and her first-grade students have just finished reading aloud *The Very Hungry Caterpillar* (Carle, 1969). The students are gathered on the carpet, each holding a clipboard for keeping track of how many things the caterpillar ate on his weeklong adventure. The students are sharing their strategies in a lively mathematical discussion.

Ms. Mak: How many things *did* The Very Hungry Caterpillar eat?

Students: 26! 25!

Ms. Mak: Sounds like we have different answers. Let's share some of the ways you kept track and see if we can agree. Eva, I see you used tally marks, can you tell us what you did and why?

Eva: Every time he ate another food, I made a mark in his belly. At the end of the story I went back and counted up all the marks. I did it like this because I could just make a little line each time he ate something and that helped me keep track... 'cuz he ate A LOT!

The Very Hungry Caterpillar, like many children's books, is rich in opportunities to engage in discussion and connect concepts to students' lives. Ms. Mak often uses a mathematical lens to discuss read-aloud books with her students. In the episode just described, they discussed different recording strategies and shared how and why they represented items in particular ways. Prompting children to notice mathematics within a text offers opportunities to learn new concepts and establish literacy-math connections.

In this article we outline a three-step process for *mathematizing* books; that is, weaving together read-alouds, mathematics, and discussion to deepen student learning.

Allison Hintz is an assistant professor at the University of Washington, Bothell, USA; e-mail University of Washington, Bothell, USA; ahintz@uwb.edu.

Antony T. Smith is an associate professor at the University of Washington, Bothell, USA; e-mail ansmith@uwb.edu.

Why Mathematize?

Mathematizing is a process of inquiring about, organizing, and constructing meaning with a mathematical lens (Fosnot & Dolk, 2001). By mathematizing books commonly available in classroom collections and reading them aloud, teachers provide students with opportunities to explore ideas, discuss mathematical concepts, and make connections to their own lives.

Read-alouds are a significant component of literacy instruction (Fisher, Flood, Lapp, & Frey, 2004) and a powerful way to promote language and literacy development through interactive discussion and response (Hoffman, 2011; Sipe, 2002). Reading aloud allows teachers to model sense making and strategy use while also providing engaging literacy experiences that increase student motivation and foster a love of reading (Hoffman, Roser, & Battle, 1993).

Mathematizing a read-aloud provides students with opportunities to learn mathematical concepts in meaningful contexts (Raymond, 1995). Using literature to connect concepts with students' experiences helps foster understanding and motivates students to learn (Bintz, Moore, Wright, & Dempsey, 2011; Shatzer, 2008). These connections are essential to making mathematics accessible and for helping students use literature and mathematics to make sense of their lives (Lo Cicero, Fuson, & Alleksaht-Snider, 1999).

The process of mathematizing aligns with the Common Core State Standards (CCSS; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Ms. Mak's discussion with her students addresses several English Language Arts and Literacy

CCSS, including asking and answering questions about key details (CCSS RL.K.1), retelling stories and details (CCSS RL.K.2), and describing connections between illustrations and the text in which they appear (CCSS RL.K.7).

Ms. Mak's discussion also addresses Mathematical CCSS, including representing a number of objects, counting forward by ones, using

cardinality, and knowing number names and the counting sequence (K.CC).

Additionally, students were using pictures to help conceptualize the story, which is important for making sense of problems and persevering in solving them. By mathematizing *The Very Hungry Caterpillar* read-aloud, Ms. Mak was able to help her students explore both the story and important reading and mathematical concepts.

Figure 1 Planning Sheet for Mathematizing Books in Three Easy Steps

1. Selecting a Text

Title: _____

- ☐ Text dependent
- ☐ Story enhancing
- ☐ Illustration exploring

2. Exploring the Text

Reading: Plot, theme, central idea: _____

Mathematics: Key concept(s): _____

Stopping points and key questions (copy onto sticky notes to place on book pages):

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____

3. Extending the Text

Prompts for discussion, writing, drawing:

- 1) _____
- 2) _____

Mathematizing: Three Steps

Working with teachers in local elementary schools, we have developed a three-step process for mathematizing a variety of texts that can be read aloud in a way that engages students, highlights mathematical concepts, and facilitates understanding. Figure 1 provides a planning template for working through this process. By following these three steps, teachers can use available materials to make the

most of read-alouds while also exploring mathematical concepts.

Step 1: Choosing a Text

The first step is to choose a book to read aloud. The mathematizing process can be applied to a range of literary and informational texts. Picture books, for example, may be used to investigate mathematically interesting illustrations, whereas chapter books may be used to discuss story events

“Prompting children to notice mathematics within a text offers opportunities to learn new concepts.”

Table Mathematizing Books

Book type and title	Grades	Mathematical concepts
Text-dependent		
<i>Double Those Wheels</i> , Nancy Raines Day	K–2	Doubling, counting by groups
<i>Equal Shmequal</i> , Virginia Kroll	3–5	Equal and fair
<i>Mummy Math: An Adventure in Geometry</i> , Cindy Neuschwander	2–4	Geometry
<i>Pete the Cat and His Four Groovy Buttons</i> , James Dean and Eric Litwin	K–1	Number recognition, counting back
<i>Tiger Math: Learning to Graph From a Baby Tiger</i> , Ann Whitehead Nagda and Cindy Bickel	3–5	Data and statistics
Idea-enhancing		
<i>Actual Size</i> , Steve Jenkins	1–3	Estimation, measurement
<i>The Doorbell Rang</i> , Pat Hutchins	2–4	Adding on, counting up
<i>Move Over Rover</i> , Karen Beaumont	K–2	Adding on, counting back
<i>The Phantom Tollbooth</i> , Norton Juster	4–6	Number sense, geometry
<i>Ten Flashing Fireflies</i> , Philemon Sturges	K–2	Fact fluency, combinations of ten
Illustration-exploring		
<i>Ancient Greece</i> , Anne Pearson	3–5	Geometry, estimation, counting
<i>Anno's Counting Book</i> , Mitsumasa Anno	K–2	Counting by ones, groups
<i>I Spy a Dinosaur's Eye</i> , Jean Marzollo	K–2	Counting and cardinality
<i>Lonely Planet Not for Parents Extreme Planet</i> , Lonely Planet	4–6	Representing and interpreting data
<i>Shintaro's Umbrellas</i> , Marjorie Jackson	K–1	Shapes and patterns
<i>There Is a Bird on Your Head</i> , Mo Willems	K–2	Addition and grouping

from a mathematical perspective. Across the range of texts typically available to teachers, we have identified three book types: text-dependent, idea-enhancing, and illustration-exploring. Please see the Table for a list of literary and informational texts that fit these three types.

Text-dependent books feature mathematical concepts to the degree that the plot or ideas in them cannot be understood without also understanding the math. *Two of Everything* (Hong, 1993), for example, explores the concept of doubling. In this story, a magical pot has the power to double anything put in it. Comprehending this story is dependent on understanding the mathematical idea of doubling. The counting book, *Each Orange Had 8 Slices* (Giganti, 1999), focuses on multiplying; understanding multiplication, or counting in groups, is essential to making sense of the illustrations and text on each page.

Idea-enhancing books do not depend on mathematical understanding the way that text-dependent books do, but they offer opportunities to deepen students' understanding by highlighting mathematical ideas. *The Rainbow Fish* (Pfister, 1995) is a story about a fish that does not want to share its dazzling scales with friends but learns that generosity is better than selfishness.

Although understanding this story does not require mathematical thinking, having students record how many scales the fish gives away (subtraction) helps them explore the generosity theme more deeply.

Chapter books may also be idea-enhancing. In *My Father's Dragon* (Gannett, 1948), Elmer Elevator encounters a large number of creatures on his visit to Wild Island. Inviting students to gather and analyze data about the animals Elmer meets adds a mathematical perspective to this adventure.

Illustration-exploring books contain pictures, drawings, or diagrams that lend themselves to exploring mathematical concepts, regardless of whether the text highlights or even mentions them. The classic story *The Snowy Day* (Keats, 1962) features illustrations showing sets of footprints in the snow—a perfect opportunity to practice counting by twos, or subitizing (Fosnot & Dolk, 2001). Similarly, *Jungle* (Greenaway, 2000) contains photographs of life in the rainforest and opportunities to notice how animals use camouflage (patterns, shapes, changing colors) to disguise themselves.

Many books found in classroom collections or school libraries fit into one of these three types of text. Once a book has been selected and its type identified, the next mathematizing step is to explore the book through a read-aloud.

Step 2: Exploring the Text

Exploring the text involves reading aloud and engaging students in lively discussion before, during, and after reading. This step draws on elements of an interactive read-aloud (Fisher et al., 2004) as a way to explore mathematical concepts. Key elements include

establishing a clear purpose for reading, reading with fluency and expression, and stopping occasionally to ask sense-making questions.

Central ideas and key concepts are best identified early in the mathematizing process. At the same time, it's important to remember that engaging in the read-aloud should not be diminished by integrating math into the experience. Revisiting a text or reading it multiple times, for example, is one way to explore concepts without distracting students from the story or main ideas. There must be a balance between asking questions for discussion and preserving the read-aloud's momentum.

We recommend discussing a book before, during, and after reading. These interactive discussions help teachers scaffold interpretive meaning-making skills such as identifying important information, synthesizing concepts with background knowledge, and analyzing ideas from multiple perspectives (Hoffman, 2011). Before-reading discussion activates background knowledge, establishes purposes for reading, and explores students' predictions of what the text might

be about. During-reading discussion occurs at specific stopping points, focusing briefly on concepts in response to questions asked by the teacher. Listing questions on the planning sheet (Figure 1) and jotting them on sticky notes placed within the book is one way to keep things organized during read-aloud experiences.

Ms. Mak, for example, stopped after each page to ask questions such as “How many plums did the caterpillar eat?” “Does your recording match the picture on this page?” “What would an equation look like for the number of items the caterpillar has eaten so far?” These questions provided opportunities to practice counting, discuss strategies for recording and organizing information, and write and solve equations.

After-reading discussion provides an opportunity to more deeply examine ideas and mathematical concepts in the book. These activities help students connect ideas to their own knowledge and experiences. Ms. Mak, after reading, had her students discuss the various ways in which they kept track of what the caterpillar had eaten (see Figures 2, 3, and 4).

Figure 2 Eva's Strategy for Tracking How Much the Hungry Caterpillar Ate

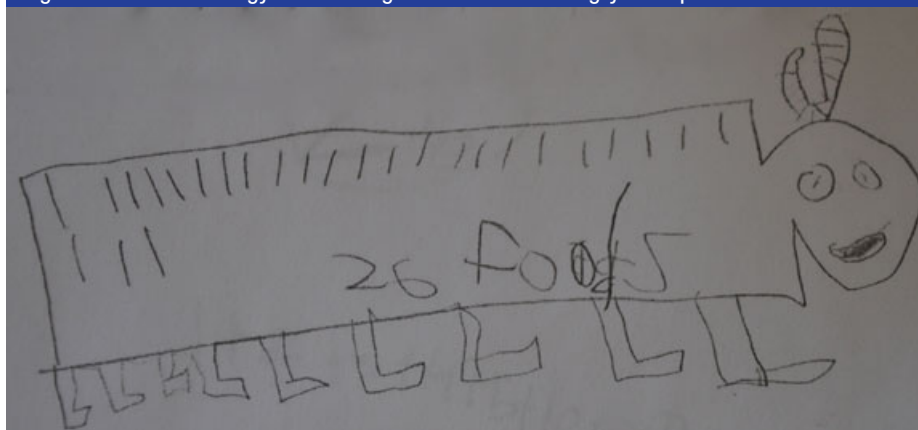


Figure 3 Isaiah's Strategy for Tracking How Much the Hungry Caterpillar Ate

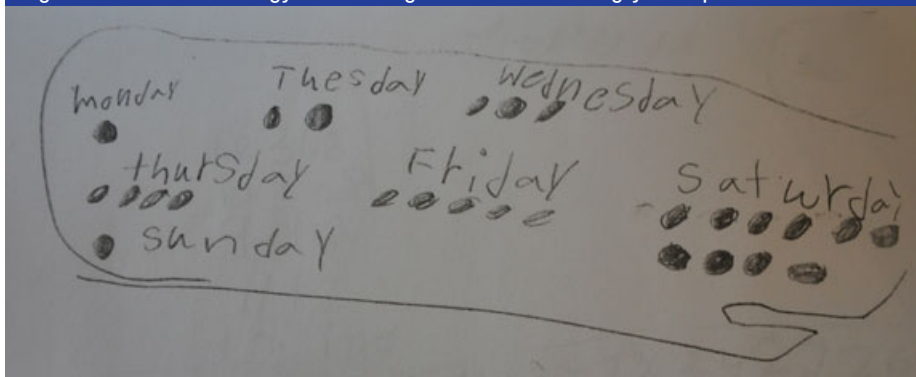
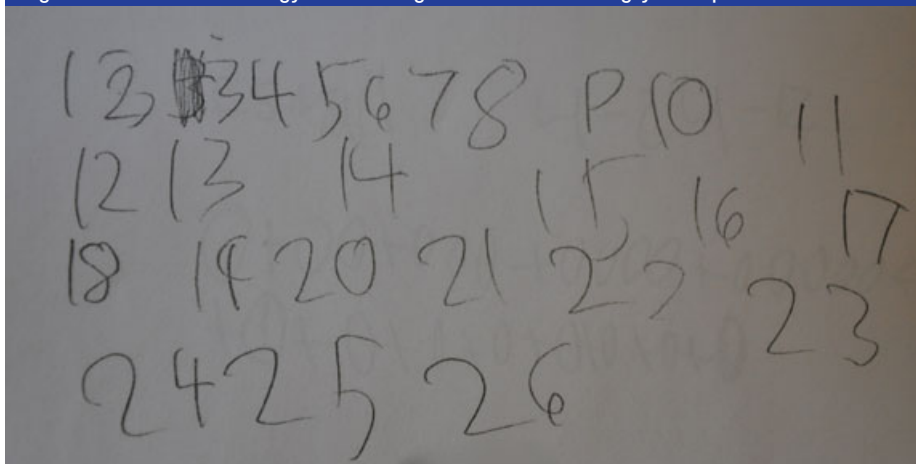


Figure 4 Halima's Strategy for Tracking How Much the Hungry Caterpillar Ate



Eva talked about using tally marks. Isaiah showed how he used days of the week and dots, and Halima demonstrated how she had counted on, recording the numbers 1 through 26. Each strategy represented an important understanding in children's development of counting and provided an opportunity for Ms. Mak to help students develop efficient counting strategies (Carpenter, Fennema, Franke, Levi, & Empson, 1999).

Step 3: Extending the Text

The third step, extending the text, helps students continue to explore ideas

after the read-aloud is finished. One way to extend the text is to delve more deeply into discussion of key ideas, emphasizing mathematical applications or connections between concepts and personal experience. Ms. Mak, for example, might have extended the text by discussing with her students what they might have eaten had they been the caterpillar and how they might have kept track of what they consumed.

Another way to extend the text is to have students write or draw in response to a prompt (Fisher et al., 2004). Ms. Mak might have chosen to prompt her students to write and illustrate their own eating adventure,

label the quantities of items eaten, and count all of the items at the end of their story. Extending the text encourages students to share their thoughts with others and to think more deeply about mathematical concepts. Text-extending activities also provide teachers with assessment information on students' understanding of the literacy and mathematical concepts targeted in the read-aloud.

We have found that mathematizing books by selecting, exploring, and extending texts helps teachers facilitate lively read-aloud discussions focused on key concepts. These three steps make it easy for teachers to sketch a plan using readily available books and to facilitate read-aloud discussions exploring literacy and mathematics in an integrated way.

Final Thoughts

We have seen teachers transform read-alouds into engaging experiences that are also mathematically powerful for students. As one teacher said after mathematizing a book for her students, "I read that book all the time and I never thought of doing that with my students! They loved pausing to discuss the math in the story and I could see they were developing important mathematical concepts!" We encourage teachers to grab a book, jot down some mathematizing notes, and jump into a lively read-aloud experience with students. We are amazed by the wonder and joy of mathematics that literature cultivates, and we hope that you will be, too.

Note

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