



How Big is Humongous?

Mathematics Conversations

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Abstract

Questioning strategies, while reading selected storybooks, promote young children to express measurement concepts using descriptive language.

How big is humongous? “As big as a giant’s teeth.” Why, in real-life, do you need to measure accurately? “Because the giant needs the right size of glasses.” Using questioning strategies during an interactive reading of *Jim and the Beanstalk* (Briggs, 1997), a pre-kindergarten child describes the size of a giant’s teeth using rich vocabulary and makes authentic connections to the purpose of measuring precisely. Implementing questioning strategies, during interactive storybook reading, encourages young children to express mathematics concepts in their conversations.

Benefits of Storybooks to Promote Mathematics Conversations. Children’s literature enhances mathematical learning in classrooms by providing an alternative for communicating about mathematics. Through purposeful book selection, interactive reading and hands-on activities, students become engaged in “math-talk” to further develop an understanding of measurement concepts. Math-talk is an instructional conversation directed by the teacher, teacher-aide, or parent and includes student-to-student talk (Fuson, Atler, Roedel, & Zaccariello, 2009). Reading aloud and engaging

children interactively with the book fits naturally with the established routines in the classroom and encourages math-talk. Stories that focus on concept development can bring life to seemingly isolated and abstract mathematical ideas for many students. Questioning strategies, which can be implemented quickly and easily, promote conversations to express measurement concepts.

A standards-based mathematics classroom exists when teachers *and* students contribute to the mathematics conversations. Math-talk challenges students to express and justify their mathematical thinking, thereby constructing and exchanging knowledge. Talking about mathematics encourages children to increase their vocabulary and compels them to really consider what words mean and how they are used. Storybooks are the springboard to enhance mathematical concepts by introducing precise vocabulary. In language-rich classrooms, the meaning of mathematical terms and their connections to the real-world objects or pictures become the emphasis. When language objectives are integrated in teaching mathematics concepts, English language learners can concurrently develop their English language skills while they are learning mathematics (Furner, Yahya & Duffy, 2005).

Research Support. The NCTM *Standards* advocates the use of children's books as a vehicle for communicating mathematical ideas (2000). Shared storybook reading has proven to be an effective context in which to embed specific strategies to increase the language and early literacy skills of young children (Mol, Bus, de Jong, & Smeets, 2008; Whitehurst et al., 1988). Other work suggests how teachers can integrate children's

literature to enhance mathematics learning in classrooms (Whitin & Wilde, 1992; Columba, Kim, & Moe, 2009). To implement the Core Curriculum State Standards in Mathematics (CCSSM) (2010) in primary classrooms: “The classroom library would have mathematics-concept literature books and manipulatives alongside toys and games to challenge growth and learning” (White & Dauksas, 2012, p. 443).

Seeley (2009) recommends developing imaginative thinking and creativity to stimulate students’ interest in mathematics. Storybooks can provide a unique alternative to formulaic approaches and facilitate math-talk. The National Institute for Literacy (2009) concludes that the more teachers intentionally make time for talking and sharing experiences, such as reading books with rich concepts, the more support there is for children’s language development and later reading comprehension success.

Research Design. Over a three-year period, my co-authors and I provided professional development for parents, teachers and teacher-aides to increase math-talk with pre-kindergarten children. We adapted and modified strategies to promote mathematical conversations, which are used for successful reading and language development and are presented in this manuscript. We provided storybooks selected to provide specific mathematics content, such as, measurement concepts and hands-on materials. In addition, we provided reader’s guides (see Figure 2), which have been developed by the authors, to provide suggestions and structure when implementing an interactive math-talk approach in the classroom. A reader’s guide, similar to a lesson plan, includes a summary of the book, objectives, key concepts and recommended

questions to focus on the mathematics content and to engage students in the mathematics process. Recommended questions to encourage dialog was in bold font on the reader's guide to facilitate meaningful mathematics discussions of pre-kindergarten children.

In the earliest study, we examined systematically the effect of instructing parents to focus on mathematical concepts and vocabulary during shared storybook reading. Specific research questions were as follows (a) did parents increase their use of math talk during shared storybook reading following training? (b) did parents generalize intervention strategies? and (c) did children increase their use of math-talk during shared storybook reading? Parent and child utterances were recorded and transcribed and then coded for mathematics content and process. Results from a yoked multiple baseline design with six dyads, indicated variability across the dyads with two general patterns. For three of the dyads, there was an increase in math-talk following training whereas verbal mathematical behavior did not show consistent change for the other three dyads. The mean frequency of mathematics utterances during reading sessions increased from baseline to intervention for all child participants.

During the next phase of our research, for ten weeks, five preschool teachers in the intervention condition were instructed in interactive reading strategies with the emphasis on using storybook reading as a means of engaging in "math-talk." One of the authors served as a literacy coach. Professional development involved modeling, rehearsal, feedback, and weekly consultation. Five preschool teachers in the control condition were instructed in using interactive reading strategies with no emphasis placed

on the use of “math-talk.” Professional development involved modeling, rehearsal, and feedback, as well as, weekly consultation. Teachers were provided with storybooks with reader’s guides that focus solely on interactive reading procedures. The children’s mathematics growth was measured through pre- and post-test data. Initial analyses indicate growth across both groups of students.

Questioning Strategies to Promote Mathematics Conversations. How we read to young learners is as important as how often we read to them. Reading children’s books provides nourishment for language-rich classrooms and provides a real-life context for the development of mathematical terms and measurement concepts. Children learn most from books when they are actively involved in the story.

The first two strategies were developed by Whitehurst et al. (1998). Presented as an acronym each letter may not be used on every page of the book, in this order, or in every conversation with the child(ren). They are a guide that is easily implemented to engage the child(ren) in talking, measuring, comparing, estimating, representing, and using descriptive language.

The first strategy to encourage “math-talk” is PEER.

Prompts the student to say something about the book;

Evaluates the child’s response;

Expands the student’s response by rephrasing and adding information to it; and,

Repeats the prompt to make sure the student has learned from the expansion.

An example from our research demonstrates math-talk between a parent (A) and a child (C) using the PEER strategy while reading *How Big is a Foot?* (Myller, 1991). The child is prompted to point to the length and width of the bed and to count the number of feet for each in the drawing. Instantly, the child is evaluated and guided to repeat the counting for accuracy and receives confirmation.

Text: *He counted that the bed must be three feet wide and six feet long to be big enough to fit the queen. (Including the crown which the queen sometimes liked to wear to sleep).*

A: How many feet this way? (Prompt)

C: Three!

A: Three, three feet wide. And how many feet this way? (Evaluate)

C: One, two, three, four, five, six.

Text: *One, two, three, four, five, six.* (beside drawings of feet.)

C: So, one, two, three, so three equals six, it makes, one, two, three, four, five, six, seven, eight.

A: Count them again. (Expand)

C: One, two, three, four, five, six, seven, eight, nine.

A: Nine. (Repeat)

A second strategy to encourage mathematics conversations is CROWD.

Completion prompts—Fill in the blank. Provides child with information on the structure of language;

Recall prompts—Can you tell me? Helps child to identify plot and sequence;

Open-ended prompts—Tell me what’s happening. Helps the child to increase expressive fluency;

Wh-prompts—What, where, when, why, how? Encourages the child to develop new vocabulary; and,

Distancing prompts—Relate pictures or words outside the book. Allows the child to make connections between the book and the real world.

An example of a conversation about measurement from our research using CROWD, while reading *Inch by Inch* (Lionni, 1960), illustrates how to develop measurement concepts recommended in the *Measurement and Data* domain in the CCSSM (2010). The standard states “to directly compare two objects with a measurable attribute in common, to which object has “more of”/“less of” the attribute, and describe the difference” (p. 12). Pictures in the storybook present a learning opportunity for young mathematicians to compare and describe the difference between two objects. Additionally, opportunities are presented for the adult (A) to probe further to discover how the child (C) worked out the answer.

Text: *He measured the toucan's beak...*

A: Do you think the toucan's beak is longer than the flamingo's neck?

C: Um, longer than it, the flamingo's neck?

A: You think the flamingo's neck is longer? (Recall)

C: Yeah.

A: So, how many inches do you think the flamingo's neck is? (Completion)

C: One, two, three, four, five, six, seven.

A: Only seven?

C: Yeah.

A: Okay, and so if the flamingo's neck is longer, then how long do you think the toucan's beak is? (Open-ended)

C: One two, three, four, five, six, seven, eight, nine, ten, eleven.

A: Is eleven longer than seven?

C: Yeah.

A: It is? Well how can the toucan's beak be 11 and the flamingo's neck be 7 if the flamingo's neck is longer? (Distancing-connecting to real-life; guiding to immediately correct a misconception)

C: Oh, I know what it is.

A: What? (Wh-Prompts)

C: It's 20!

A: 20? (Wh-Prompts-How? An opportunity to probe deeper)

C: Yeah!

The third is strategically asking open-ended questions. Asking questions, such as “Tell me about this” and “What’s this?” at key points in the book encourages oral responses and active participation from the children. Explaining “why” requires reflective thinking and diminishes guesses or responses based on rote memorization. Teacher questioning promotes thinking and understanding of ideas and allows the teacher to probe deeper after an answer is given.

An example from our research, while reading *Inch by Inch* (Lionni, 1960), illustrates how an adult (A) guides a child (C) to use the nonstandard measurements, an inch-worm cutout and fingers, to measure the toucan’s beak. The child enthusiastically measures the toucan’s beak.

Text: *He measured the toucan’s beak...*

A: That’s a long beak, isn’t it? (Tell me about this...)

C: Let’s count. One, two... (using an inchworm cutout).

A: Oh you know what, I’ll show you something. See these two fingers here? (modeling first two fingers) (Actively engaging the child)

C: Mm-hmm.

A: These together make about an inch! So you can go like this.

One, two three, four, five six, seven, eight, nine, ten eleven, twelve! You can pretend you're like the inch worm! What do you think about that? (What is this? Guiding the child to clarify the meaning)

C: Yeah!

Selecting Measurement Storybooks. Children's literature presents mathematics content in different ways. Mathematics concept books can provide *explicit* content, such as measurement concepts. In *Measuring Penny* (Leedy, 1997), Lisa, the main character, learns about measurement by measuring her dog, using standard and nonstandard units.

In some storybooks, mathematical concepts are *implicit* because they present mathematical concepts subtly. In *How Big is a Foot?* (Myller, 1991), students discover the usefulness of standardized measuring tools when the king decides to have a bed built for the queen and everyone has difficulty determining the size of a bed. Measurement is indirectly part of the plot. For lesson ideas related to *How Big is a Foot?* see illuminations.nctm.org/LessonDetail.aspx?id=L635.

When mathematics content is *invisible*, creative teachers construct meaningful connections to the mathematics concepts. Or the book can serve as an invitation to introduce other books and resources about the topic in order to construct a fuller, more complete understanding of the concepts. Teachers accomplish these types of connections

by organizing learning experiences around topics of high interest to students, allowing connections to occur across curriculum areas. *The Mitten* (Brett, 1989) illustrates a content invisible book. Shared reading integrates measurement concepts by engaging the students in estimating the length of real mittens.

However, all of these features—purpose, audience, genre, text structure, and content—are necessary to judge the appropriateness of a book’s selection. Other selection criteria for quality children’s books to guide teachers’ selections are provided by a set of questions, which are:

1. Is the book engaging to the reader?
2. Is the book age appropriate?
3. Does the book contribute to the balance of the classroom collection?
4. Does the book include meaningful and relevant mathematics concepts?

(Columba, Kim, & Moe, 2009, p. 31) These overarching principles provide a justification for each storybook selection. See Figure 1 for other storybook selections at the primary level that foster the teaching of measurement concepts.

So whether students are measuring humongous teeth or long beaks, these math-talk examples demonstrate how incorporating questioning strategies into interactive storybook reading promotes mathematical conversations and increase the awareness of measurement concepts. For young children, language plays an essential role in learning how to express themselves, which often results in new understandings of measurement concepts.



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