Making informed choices: Selecting children's trade books for mathematics instruction

Hellwig, Stacey J; Eula Ewing Monroe; Jacobs, James S . Teaching Children Mathematics ; Reston Vol. 7, Iss. 3, (Nov 2000): 138.

FULL TEXT

Headnote

Traditionally, mathematics has been taught as a series of isolated subskills, with the emphasis on the product rather than on the problem-solving process. Many students have emerged from such instruction with memorized formulas in their minds but not at their fingertips. Real mathematics, however, is not so cut-and-dried. The practice of mathematics is not merely plugging numbers into an algorithm or a calculator to find a solution, nor is it just a subject in school or a set of rules to memorize. Mathematics is thinking and reasoning, solving problems, making connections, and being able to communicate ideas mathematically.

With the current emphasis on teaching processes and developing mathematical thinking, many teachers are seeking approaches that do not rely solely on traditional textbook methods and materials. One practice that is gaining popularity is to include trade books, that is, books other than textbooks, in mathematics instruction. Trade books allow students to interact with mathematics in context, helping them draw meaningful connections between experiences in the classroom and life outside the classroom.

Trade books can contribute significantly to mathematics education in a number of ways. First, they provide appealing settings that show students how mathematics exists in our world. As Leitze explains, "This mathematics-literature connection is a natural way for teachers to allow students to see mathematics in everyday society, to give meaning to mathematics, and to make it come alive" (Leitze 1997, p. 398). Many authors agree that these contexts help students frame problems to solve and build a bridge between the concrete and the abstract (Harsh 1987; Gailey 1993; Harris 1997). In addition, trade books give students the opportunity to develop language skills as they develop mathematical skills. As Gailey states, "Mathematics and language skills develop together as students listen, read, write, and talk about mathematical ideas" (Gailey 1993, p. 158). Students must develop language skills as tools to construct, articulate, and reflect on ideas. Indeed, language skills are as essential in mathematics as they are in any other content area. Many researchers assert the value of using trade books to encourage students to reason and communicate mathematically (e.g., Lewis, Long, and Mackay [1993]; Whitin [1992]).

In response to the increasing use of trade books, many publishers have rushed to fill the need for mathematics literature, offering the classroom teacher many titles from which to choose. Some books that have appeared on the market present meaningful, engaging experiences for students; others closely resemble glorified textbooks. Although many books can be used to create mathematical situations and promote discussions about problem solving, some books are written specifically for mathematics content. Gailey (1993) established four distinct categories of trade books used in mathematics instruction: (1) counting books, which are "used to develop and reinforce counting and number concepts" (p. 258); (2) number books, "in which a specific number is emphasized" (p. 258); (3) miscellaneous storybooks, which include trade books that are not specifically written with mathematics in mind but happen to "touch on a mathematics concept" (p. 258); and (4) concept books, which

include those that "explore specific mathematical concepts" (p. 259), such as multiplication.
Our goal in writing this article was not to delineate how a teacher can find mathematics in a trade book but to provide a scale to evaluate the trade books that are distinctly oriented toward mathematics, including those defined as counting books, number books, and concept books. To assist the classroom teacher in selecting highquality mathematics trade books, we designed an evaluation instrument (see fig. 1). This instrument does not absolve the classroom teacher from exercising judgment-each teacher must decide which books will best meet his or her students' needs. Additionally, a good trade book does not eliminate the need for effective classroom discourse and instruction; neither does it offer a single approach to developing good problem-solving skills. However, a good trade book, appropriately selected, can enhance instruction and build positive and meaningful connections that enable students to visualize and engage in mathematics. We identified the following key evaluation criteria: accuracy, visual and verbal appeal, connections, audience, and the "wow" factor. These criteria are the focus of the remainder of this article.
Accuracy Accuracy refers to the integrity of the concepts presented in the book. Where appropriate, are the facts presented accurately and soundly? Are the mathematics concepts represented and labeled correctly? Are the basic concepts presented in a way that might promote deeper thinking, or are they depicted in a way that might be distracting or superficial? Does the book promote one single way of approaching a problem, or does it interweave a variety of layers and ideas? Integrity is important, both in the mathematics depicted and in all other concepts presented. Concepts should be labeled and portrayed correctly and accurately. Illustrations should correspond with the text, not interrupt the flow of reading. Farr (1979) states that "the explanation of terms must be precise and understandable... [and] illustrations must be impeccably accurate" (p. 101).
In selecting books for mathematics instruction, the teacher must discover inaccuracies before presenting the book and identify the inaccuracies when exploring the book with students. As students become familiar with the mathematical principles that they are studying, they too will be able to spot inaccurate terms or conditions and correct errors. For example, if a trade book labels a shape incorrectly, teachers could use this discrepancy as an investigative problem; students could be assigned to find the appropriate term and use the correct terminology to create their own versions of the book or page.
The selection One Grain of Rice (Demi 1997) (see fig. 2) tells the story of a young village girl who outsmarts the raja of India by using a simple mathematical concept. The concept of doubling is shown accurately in a skillfully woven story. The book even introduces proportionality in that the animals needed to deliver the rice increase in numbers and size according to the amount of rice required. This story is appealing and maintains mathematical integrity.
Another selection, Triangles and Pyramids (Morgan 1995), is an example of a book that depicts mathematical concepts vaguely or incorrectly. Although this selection illustrates a variety of connections and is visually appealing, two concepts are particularly misleading in the text. First, a pyramid is inaccurately defined as "a solid triangle" (p. 10). Further, the author states that two types of pyramids exist, a square pyramid and a triangular pyramid. In actuality, pyramids can be formed with any polygon as a base. Teachers might use these inaccuracies creatively as puzzles or discovery lessons for students to spot the mistakes, or simply point out and correct the mistakes when they are discovered beforehand.
Visual and Verbal Appeal
We are often advised not to judge a book by its cover, but an inviting cover frequently lures a reader into the book. If the pictures are appealing and inviting, we sometimes want to keep reading, regardless of content! Pictures must enhance the text, however, not distract from it. If pictures do not follow the text, they may frustrate the plot development, interrupting the flow of the story.
Verbal appeal is significant in book selection, as well. If the book is redundant or overly predictable, the mystery is gone and with it, the reader's enjoyment. Content should be both clear and engaging; it should make the reader want to turn the page, promoting further interest in the topic. Trade books should present concepts in fresh and interesting ways. Usually, literature is more exciting when the reader is surprised in some way.

A counting book that rates high in visual appeal is I Spy Two Eyes: Numbers in Art. This book, by Micklethwait (1993), directs readers to count specific objects found in photographs of well-known works of art. Readers trip down a pathway of pleasing artwork while counting up to 20.

A book that we would not rate as high on the evaluation scale for visual and verbal appeal would be Every Buddy Counts, written by Murphy (1997) and illustrated by Fiona Dunbar. To us, the pictures are flat and not especially rich, and the text appears more intent on rhyming than appealing to students' interests and fostering new ideas and connections.

Connections

Some of the main reasons for using literature in the mathematics classroom are to build meaningful relationships between mathematics and the "real" world, connect mathematics and other content areas, show connections among different ideas in mathematics, and build on the premise that mathematics can be linked with children's interests. These connections must be authentic, not contrived; they should help children learn to think about mathematical ideas as ways of expressing relationships rather than as discrete bits of information to be memorized and retrieved.

In many traditional classrooms, the notion of drawing connections between "classroom mathematics" and "real life" has not been pursued. Trade books provide the motivational setting that promotes students' interest in a topic and encourages further study. Once students connect with a book, the mathematics emerges naturally from the text and infuses the school subject with life skills.

In the Next Three Seconds, a concept book compiled by Morgan (1997), is rich in mathematical connections with time. The data presented and illustrated demonstrate time in a meaningful way for students, and the book presents helpful statistics and comparisons that students can use as a springboard to make their own connections and benchmarks to understand-time relationships. This book uses statistics that would interest and appeal to many different cultures and races and to readers of both genders and many ages. We would rate this selection high in most of the criteria on the evaluation scale.

The "M&M's " Brand Chocolate Candies Counting Book (McGrath 1994) (see fig. 3) has been used successfully by many teachers to engage students in mathematical activities. Although the M&M's capture students' interest and several mathematical concepts are explored using these enticing "manipulatives," the book offers few connections, aside from the candy, that tie in with mathematics and encourage further study.

Audience

Lewis declared, "It certainly is my opinion that a book worth reading only in childhood is not worth reading even then" (Lewis 1975, p. 38). Various people "enter" a book at different times and for different reasons. Perhaps the pictures in a particular selection are enticing and interesting to a primarygrade student, whereas the relationships in the book may stimulate an older reader to make connections with it. An adult studying the concept presented in the same book might peruse it for further information that is presented in a simple way. The field of children's literature is changing and growing, and picture books that in the past were labeled for use in the primary grades have been found to be useful for, and enjoyable to, children at a variety of ages.

A young child does not need to see all the relationships immediately on encountering a book. Students can see and enjoy the pictures and text, perhaps building on some of the mathematics presented. They can enjoy the book and be exposed to the concepts without explicit identification of the mathematics. Although some students may be ready for a specific concept the first time that it is encountered in a trade book, others may simply enjoy the story, building connections that will be developed with future readings.

The term foreshadowing, as used in writing, suggests a hint of more to come. We define foreshadowing in a mathematical context as a tantalizing introduction to what is yet to come. If a student does not address all the mathematical content of a book on the first reading, that student may still enjoy and benefit from the foreshadowing. Future interactions build and heighten the student's connections with the mathematical content. Farr (1979) reiterates, "An introductory treatment of a topic should never leave a reader with the belief that there is nothing more to learn" (p. 101).

Another aspect of audience that must be considered is a book's appeal to a variety of cultures and both genders. To be used effectively to build a common experience among students, a trade book should appeal to different interests and accommodate all the children in the classroom, both male and female and with diverse backgrounds.

Good literature can be used in a number of ways and be respectful of various audiences. Sea Squares (Hulme 1993) is a good example of the concept of foreshadowing. Although it would seem to be a simple counting book and could be used strictly for that purpose, it also presents other concepts, such as multiplication and square numbers. Our definition of foreshadowing is seen as the author and illustrator connect ocean life with numbers and with their readers. When a book meets several audiences on many levels in many ways, foreshadowing can kindle further interest, motivating that audience to learn more.

The Crayon Counting Book (Ryan and Pallotta 1996) uses crayons or parts of crayons and rhyme to teach counting by twos. The book demonstrates skip counting by even numbers, then odd numbers. The connection of colorful crayon illustrations with the skill of counting appeals to children, but the concept and pictures are targeted specifically at a younger audience and do not offer connections that might attract a wide range of students.

The "Wow" Factor

In the process of reviewing many trade books, we found that the "wow" factor evolved as its own category. Several books resurfaced with a quality that was more than the first four evaluation criteria could define. These selections bring an unexpected freshness and appeal to the content. These books draw the reader to new heights, stir new ideas, and add rich, multilayered connections to existing knowledge. They remind the reader that mathematics is not a "closed" subject, that it does not fit neatly into formulas or boxes as pedagogical subskills. These books send the reader on a crusade to discover that mathematics is "messy," multifaceted, and entrenched in our existence in every way. The "wow" factor is evident in good literature that sparks something new in the reader. Because the walls of a classroom hold so many different people with many divergent interests, "wow" can be a very subjective characterization. For example, although the selection How Much Is a Million? (Schwartz 1985) engenders enthusiasm in some students, the book My Little Sister Ate One Hare (Grossman 1996) may appeal to others, evoking a "wow" reaction in different, yet equally effective, ways.

The selection Walter Wick's Optical Tricks (see fig. 4) examines some interesting mathematical concepts in an engaging, stimulating manner. Wick (1998) presents several mysterious puzzles for students to solve, exploring and presenting the idea that problem solving involves looking at situations from a number of perspectives and in different ways. This book uses unique ideas in mathematics in a way that wows audiences and encourages further investigation of the ideas.

The majority of books do not have the "wow" factor but may still be appropriate to use. In fact, most books will not meet every criterion in every category. One favorite found in many references on how to use literature in the classroom is The Doorbell Rang (Hutchins 1983). In this selection, two children divide a dozen cookies in different ways to accommodate the number of friends who arrive at the door. This book has been used successfully by many teachers to demonstrate several mathematical ideas. Even though we do not consider the pictures especially rich or the text particularly engaging-so that the book does not cause us to step back and say, "Wow!"-it makes a connection with students' lives. Most of them have been in a situation in which they have had to share and divide things evenly, and they make the connection that this activity is mathematics! Such books can still be good selections and can be used successfully in the mathematics classroom.

A rare mathematics trade book would excel in all five criteria; many books will be noteworthy in one or more aspects but weak in another dimension. Most mathematics trade books are potential resources for instruction if the teacher devises ways to use them to help children learn concepts meaningfully. Our scale for evaluating mathematics trade books was developed as a guide-and nothing more-to help teachers make decisions about which mathematics trade books they will choose for instruction.

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DETAILS

Publication title:	Teaching Children Mathematics; Reston

Volume:	7
Issue:	3
Pages:	138
Publication year:	2000
Publication date:	Nov 2000
Publisher:	National Council of Teachers of Mathematics
Place of publication:	Reston
Country of publication:	United States, Reston
Publication subject:	Education--Teaching Methods And Curriculum, Mathematics
ISSN:	10735836
e-ISSN:	23270780
Source type:	Scholarly Journal
Language of publication:	English
Document type:	PERIODICAL
ProQuest document ID:	214139493
Document URL:	https://login.libproxy.uregina.ca:8443/login?url=https://www.proquest.com/scholarly-journals/making-informed-choices-selecting-childrens-trade/docview/214139493/se-2?accountid=13480
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Last updated:	2014-05-20
Database:	Education Database

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