

Using Children's Literature to Teach Mathematics

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William James, a prominent psychologist and philosopher at the turn of the 20th century, and brother of esteemed novelist Henry James, is quoted as saying, "The union of the mathematician with the poet, fervor with measure, passion with correctness, this surely is the ideal." For centuries, there has been a perceived connection between mathematics and the arts, including literature. This connection now is being introduced to children as part of an effective curriculum that includes subject integration. Over the past two decades, educators have turned more attention toward integrated curricula, particularly the introduction of literature into mathematics instruction.

Much of the reasoning behind such integration is intuitive—there is evidence that children have more success learning and understanding material when it is presented in a way that is meaningful to them. The variety in literature provides countless opportunities for students to become engaged in a mathematics concept being taught, thereby creating a meaningful context for the student. David Whitin asserts, "Through [these] varied opportunities for investigation, [these] books support readers in developing healthy attitudes and dispositions about mathematical activity" (Whitin, 2004). With the benefits of bringing literature into the mathematics classroom understood, the task then becomes how to do this effectively.

Not every book will be appropriate for enhancing a mathematics lesson, and literature should not be manipulated to suit the purposes of the lesson. There should be an organic relationship between the book chosen to enhance the lesson and the lesson itself. Researchers and educators have developed criteria for selecting literature that can be integrated effectively into mathematics instruction. Ideally, children's literature books should have authentic context that includes life experiences, personal or cultural episodes, and enjoyable plots that unite mathematics and literacy (Worley, 2002).

How to Select Appropriate Literature to Enhance Mathematics Instruction

In the article, "Making Informed Choices: Selecting Children's Trade Books for Mathematics Instruction," Hellwig, Monroe and Jacobs assert that, "The practice of mathematics is not merely plugging numbers into an algorithm or 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" (2000). They include the scale in Figure 1 (on the next page) for determining the efficacy of trade books being used as part of mathematics lessons. The scale addresses the following components of the mathematical content: accuracy and integrity; visual and verbal appeal in the language and illustrations; context of the book, which should provide meaningful connections and relationships in mathematics with refreshing appeal; appeal to a variety of audiences and the ability to offer multiple and, possibly, unexpected connections to mathematics topics; and, finally, the "wow" factor in terms of the richness, plurality and pedagogical implications in the story, language and illustrations.

Figure 1. Scale for evaluating mathematics trade books

Represents factual information inaccurately; uses incorrect terminology or principles, or both.	Accuracy	Represents mathematics and other information accurately; depicts relationships correctly.
Format and presentation are pedestrian; book is overpowered by mathematics—a modified "textbook."	Visual and Verbal Appeal	Both format and presentation are visually and verbally appealing.
Depicts mathematics as isolated or neutral; connections are hard to find.	Connections	Provides a context for learners to make meaningful connections between mathematics and their own experiences.
Targets a specific audience with no range for age or ability.	Audience	Presents concepts in a way that appeals to a range of audiences and abilities.
Contains little or nothing beyond the expected; has no surprises.	"Wow" Factor	Offers layers of richness beyond the predictable or expected; presents exciting new views or ideas.

Additionally, in their book, "New Visions for Linking Literature and Mathematics" (2004), Phyllis and David Whitin describe criteria that should be considered when selecting literature for mathematics instruction, including:

- *Mathematical integrity*: The mathematical components of the book are accurate. In fiction, the mathematics reflects functional use in believable contexts. The ideas and concepts in all genres are accessible to the reader. The tone of the book promotes healthy mathematical attitudes and dispositions.
- *Potential for varied response*: The tone of the book is invitational rather than didactic.
- *An aesthetic dimension*: The book heightens the reader's awareness and appreciation of form and design. The language and/or the illustrations appeal to the reader's senses and emotions. The design and format of informational graphics (e.g., charts, tables and graphs) are visually pleasing and pique young readers' interest. Visual material complements and extends the text.
- *Ethnic, gender and cultural inclusiveness*: The content, language and illustrations promote racial, cultural and gender equity. There are no instances of stereotyping or tokenism. Cultural representations are authentic.

Ultimately, it will be the cooperative effort of the teacher or parent and students to select and utilize literature to enhance mathematical skills and understanding. Different books will be more appropriate for certain lessons and children. Literature shared in the mathematics classroom taps into the natural process of communication, not only improving students' language skills but adding dimension and understanding to their mathematics skills. With so much literature available to incorporate into mathematics lessons, criteria for selecting the right books are invaluable tools. Once the right books have been selected, there are many ways in which this union of literature and mathematics benefit students.

Using Literature in the Classroom to Improve Mathematics Engagement

In her book, "How to Use Children's Literature to Teach Mathematics" (1992), Rosamond Welchman-Tischler suggests ways to use literature in the mathematics classroom to enhance students' learning experiences.

- To provide a context or model for an activity with mathematical content.
- To introduce manipulatives that will be used in varied ways (not necessarily as in the story).
- To inspire a creative mathematics experience for children.
- To pose an interesting problem.
- To prepare for a mathematics concept or skill.
- To develop or explain a mathematics concept or skill.
- To review a mathematics concept or skill.

These ways suggest the promise of improved performance and demonstration of skills in the classroom. If the child can make a connection to mathematics content in a story, the literature can make mathematics more interesting, engaging and applicable to real-life situations.

Communication is one of the NCTM process skills emphasized in mathematics education (2000). Literature naturally brings a more complex mode of communication to mathematics instruction because it presents mathematical concepts in words rather than in numbers. After incorporating literature into mathematics lessons, many teachers report that their students show increased comfort levels in talking about their understanding of mathematics concepts. In addition, teachers are able to identify many misunderstandings during the course of this dialogue.

Making connections is another process skill identified by NCTM (2000). Children who find the relevance of mathematics after reading (or listening to) a book are learning to recognize mathematics used in the world around them. After exposure to numerous books incorporated into mathematics lessons, students often connect the concept from one book to similar mathematics concepts in other books that they have discussed.

A teacher can ask students to use art, charts or patterns to demonstrate some of the topics in the story. This is an excellent method of implementing the NCTM process skill of representation (2000). Children can make their own models that demonstrate the value of a fraction, or the meaning of multiplication using art. The motivator for such an activity is often a fun and entertaining story. In many instances, the students will make observations that are quite unexpected but have mathematical integrity. When a teacher applauds such observations, the student's thought processes and conclusions are validated. The student is able to communicate his or her thoughts and make connections in mathematics from his or her personal experience and interaction with the literature.

The Quantile® Framework for Mathematics supports efforts to incorporate literature into the mathematics classroom by providing references to children's literature and other books, as well as literature guides for selected books. For mathematics teachers, there are many ways to access book titles that align to state curricula, grade level, course pacing guide or simply a keyword on the Quantile website (www.Quantiles.com).

The Quantile website offers the *Search the Math Skill Database* and *Quantile Teacher Assistant* utilities. These enable a teacher to do a keyword search alone or specify his or her state and grade in the *Advanced Search* to access the relevant objectives in that state curriculum.

The search results identify one or more specific skills that are associated with the keyword or are included in the state objectives. Within the Quantile Framework, these are called "QTaxons." A teacher can click on the QTaxon that is applicable to a particular lesson. At the bottom of the page is a list of available resources, including websites, worksheets and book titles. Some of the book titles also might have a companion Quantile Literature Guide. The literature guides provide specific topics to discuss in the books and supplemental activities to enhance understanding of the mathematical concept.

Using Literature in the Home to Improve Mathematics Skills

Parents are easily able to support their child and the classroom teacher by incorporating mathematics into daily activities, such as measuring, counting, shopping, scheduling, estimating and comparing. Daily activities at home and on the job can provide opportunities to explain and demonstrate to a child the ways in which mathematics is used to carry out seemingly simple tasks. When parents share with a child the activities of counting money, measuring for recipes, or estimating travel time to work, the child becomes more aware that mathematics is applicable to many activities in life.

Literature can add to that dimension in an entertaining way when parents share the participation and enjoyment of the literature. Many children's books have plots that include solving problems with probability, comparing numerical amounts or telling time. Parents who share in these literature opportunities at home can feel more empowered by their ability to help their child learn mathematics in a supportive and fun environment. After reading together regularly and discussing the relevant mathematics concepts, the parent and child can discover new connections and observe mathematical applications around them on a daily basis.

On the Quantile website, there is a *Families & Students* section where parents can learn more about Quantile measures. In order to find books at the appropriate Quantile level for their child, parents can go to the *Tools* section of the *Families & Students* page. By selecting the *QTaxon Search*, parents can find resources, such as book titles, that are relevant to what their child currently is learning in the classroom. In the *keyword* field, a parent can enter a topic that the child is studying or a topic that the child's teacher believes needs more practice.

The literature guides were designed with parents in mind, and suggest fun mathematics activities that can be done in the home or outdoors. They offer discussion topics and activities that complement the book and address mathematics skills. The material is meant for the parent to use as a guide when sharing the book topic as it relates to the identified mathematics skill(s). In some cases, there are manipulatives, such as charts, cut-outs or clock faces, that accompany the literature guide. These will help the parent engage the child in the mathematics concept of the story and bring it out into "real life."

Summary

Incorporating literature into mathematics instruction—either in the classroom or at home—enables students at all achievement levels to benefit from a richer and more complex understanding of mathematics. Students who struggle with concepts can benefit from an approach that often is less intimidating and more entertaining. Students who excel can add

to their understanding of mathematical concepts by more fully understanding the real-world applications of those concepts. Most often, the prevailing notion is that literature is useful for the development of language skills or to find information about a topic in history, science, geography or current events. In fact, there are many books in school and public libraries that also effectively and creatively educate in the field of mathematics.

When parents and teachers offer children opportunities to share and discuss the books they read, children are motivated to read even more and, therefore, learn more (Gambrell, 2009). When this process is undertaken with a mind toward enhancing mathematics education and understanding, the integration of curriculum, and education itself, comes full circle. Mathematics simply is not a series of rules and formulas that should be memorized, tested and contained within the boundaries of the mathematics classroom. Mathematics is real and part of everyday life. Mathematics is alive in books that children, teachers and parents enjoy reading. Such a shared delight as that of a good book makes mathematics a little less scary and more enjoyably real.

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