Integrating Children’s Literature into the Mathematics Classroom

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May 2012

**Abstract**

 Learning mathematics can sometimes be mundane and limited when it is taught solely through a textbook. In order to engage and reach more students, mathematics in the K-5 classroom can be supplemented with an approach through the use of children’s literature. This has been proven to be quite beneficial for both learners and the learning context. Benefits can be seen in student motivation and engagement in mathematics, student sense-making, and student dispositions towards mathematics. To be effective, appropriate literature must be chosen after considering both the literary and mathematical aspects of the book. Implementing children’s literature into the classroom can vary in its approach. It can be used in whole group or small group instruction and the mathematics can be both explored and enhanced by the students. The books can create hands-on, realistic situations for students to engage in. There are multiple resources available for teachers to begin this implementation and some of these resources will be explored through this review. While these resources do exist, it is also needed that schools and administrators begin to take note of this approach and offer professional development for interested personnel.

**Integrating Children’s Literature into the Mathematics Classroom**

When thinking back on my mathematics instruction in school, I can remember the teacher simply presenting concepts using textbooks and lecture, and then just expecting us to learn the concepts. The concepts were related to purely mathematics, and we seldom thought about mathematics in other subjects. Surprisingly, though, when I remember my reading instruction, there were all kinds of tools that my teacher used: a basal reading series, picture books, short stories, poems, and we read about all different kinds of things. Why cannot some of these tools be used when teaching mathematics as well, especially in the K-5 classroom? Children’s literature, picture books and poems are perfect tools to augment teaching math concepts. In today’s world there is a magnitude of children’s literature. Incorporating literature with either explicit mathematical content or literature where the story allows mathematics is a good place to start. In this paper I plan to identify the benefits that the incorporation of literature can have for students, how one can effectively choose and implement appropriate literature, and then explore books in the whole number computation genre to pinpoint specific ways that such literature can be integrated.

In this new age of teaching, concepts are heavily related to standards, and educators are constantly being held accountable to addressing such things. Using children’s literature can be a useful and helpful tool when addressing some of these standards. According to the *Principles and Standards for School Mathematics* (NCTM, 2000), children should be engaged in more reading, writing, and discussing of ideas so that they learn mathematical ideas in real-world contexts. When the numbers and operations are embedded in meaningful real-world contexts, children are given the opportunity to make sense of the mathematics and gain “mathematical power” (National Council of Teachers of Mathematics, 2000 as cited in Moyer, 2000, p. 248). Using children’s literature as a context to explore mathematics enables children to engage in solving problems that are relatable to reality. NCTM (2000) recommends that children learn to communicate their mathematical thinking to their peers and teachers and that problem solving be an integral part of the mathematics curriculum. Using literature allows children to discuss such ideas while solving problems that are embedded within the stories they read (Forbringer, 2004).

**Benefits of Incorporating Children’s Literature for Both the Learner in Your Classroom and the Environment**

Using children’s literature in the mathematics classroom not only aligns with standards that are common to education, but also aids the advancement of students’ learning of mathematical concepts. Both the learner and the learning context can benefit from this incorporation of literature.

Motivation and Engagement

In this section I will explore the benefits that including children’s literature has on the motivation and engagement of students in the mathematics classroom. Incorporating literature into the mathematics classrooms allows students to see mathematics in a different light. “Cognitive scientists have argued that the story is the most natural package of organized knowledge in the cognitive system, and that information can be learned and retained more effectively when it is learned within a story context, rather than in a de-contextualized format” (Casey et al., 2008, p. 31). Using story books as a way to present or enhance mathematical concepts allows students to be free from the mundane nature of classical textbooks for a time period. Mathematics is then shown as an important part of everyday life (Moyer, 2000). Children’s literature can provide a meaningful context for math; it motivates students to learn, celebrates math as a language, demonstrates that math develops out of human experiences, fosters the development of number sense, and integrates math into other curriculum areas (Whitin and Wilde, 1992, 1995). The “literature places mathematics in a familiar setting that children can identify with and which feels relevant and interesting to them” (Schiro, 1997, p. 10). The characters on the pages become real and relatable. Their problems can be compared to problems that the students themselves are having. Lawrence, Hope, Small, & Martin (as cited in Shatzer 2008, p. 652) suggest that “when mathematics is presented in the literature form, it is humanized, its relationship to the arts is emphasized, and the picture books and extension activities stimulate positive reactions, interest, enjoyment, and confidence in children.”

It is quite common for many students to see the subject of mathematics as too complicated and difficult, and therefore many students suffer from “math anxiety.” Marilyn Burns (2005) has found that when visiting classrooms, connecting mathematics and literature helps boost the confidence of students who love books, but are “math-wary.” Learning mathematics through a story brings children into a more relaxed mathematical environment. They are given the chance to learn in playful atmospheres and develop positive attitudes (Whitin & Wilde, 1992). Learning communities where social interactions are supported and encouraged helps provide personal support for students (Ball, 1996). Talking through the mathematics using a story provides just this situation for learners in a classroom.

Sense-making

In this section I will discuss that benefits that incorporating children’s literature has on developing sense-making in mathematics. Literature can take students away from a dry textbook approach to mathematics. They can relate to characters, act out the storyline, and engage in hands-on activities related specifically to the plot of the story. Acting out these stories and using hands-on manipulatives supports Piaget’s theory that children learn by interacting physically and socially with their environment (Piaget, 1952 as cited in Jennings et al., 1992). Mathematical language is also presented to students through the literature and providing this mathematical thought-to-language link supports the need for children to communicate and talk about mathematics while also extending oral language by communicating with others (Vygotsky, 1962 as cited in Jennings et al., 1992). The stories provide productive thinking and children can be engaged in problem solving situations. The organized use of numbers and language enables students to employ these problem solving strategies in the real world (Moyer, 2000).

Students learn in a variety of ways and presenting opportunities for this to happen is important. Howard Gardiner has created a theory of multiple intelligences that include: linguistic, logical, spatial, musical, bodily, kinesthetic, interpersonal, and intrapersonal (Bransford et al., 2000). The combination of literature in mathematics can address a multitude of such intelligences, to include:

* Kinesthetic, or acting out storylines.
* Spatial, or visualizing the plot of the stories.
* Logical, or using mathematics within the stories.
* Linguistic, or talking about the stories.

Using literature also allows children to visually see mathematical concepts being presented (Murphy, 1999). Just as students learn in a variety of ways, their levels of learning all vary as well. Sometimes these levels of understanding can vary greatly even within one classroom. Being an effective teacher requires meeting the needs of all these levels and presenting different instruction methods to enable all students to reach success (Dewey, 1963, 1964, as cited in Forbringer, 2004). The wealth of children’s literature that is currently available allows teachers to have mathematical investigations at a variety of instructional levels in an enjoyable, versatile manner (Forbringer, 2004).

 Presenting mathematics in an assortment of situations allows students to learn in a variety of different contexts. Using literature would make the mathematics environment versatile and provide students with an opportunity to learn in these different environments. According to Bransford et al. (2000), there are four learning environments that teachers should be aware of and attempt to cater to. These are: learner-centered, knowledge-centered, assessment-centered, and community-centered. In a learner-centered environment, a learner’s knowledge and prior experiences are taken into account and teachers attempt to accommodate the learners’ strengths and interests. This type of environment can be implemented when the literature is geared towards student interests and their strengths and weaknesses have been taken into consideration. A knowledge-centered environment is one in which activities are developed to help students develop a deeper understanding. When literature in integrated, the students are given the chance to learn the mathematics in a different light, enabling them the chance to deeper their understanding of mathematics. In an assessment-centered environment students are given multiple opportunities to express their thinking and understanding. Using literature provides students opportunities to verbally discuss mathematics allowing teachers to assess their understanding through discussion, and also provides activities for students to show their understanding. A community-centered environment encompasses the previous three learning environment. In such an environment it is important for students to feel safe and that they can take chances (Bransford et al., 2000). Approaching mathematics through literature can help alleviate the fear that some students have.

Attitudes and Mathematical Disposition

In this section I will explore the benefits that literature in the mathematics classroom can have on students’ mathematical disposition and attitude. Various studies have taken place that illuminate the effects that integrating these books can have on a child’s learning. It has been found that teaching mathematics through children’s literature can improve a child’s disposition toward mathematics. Allowing children to continue to use the literature and focusing mathematical centers around the stories showed that children would prefer to use and spend more time in such places (Hong, 1996). The literature “provides opportunities for children to express mathematical thoughts and to practice using mathematical language related to the situations in the story (Hong, 1996, p. 490). Jennings et al. (1992) concluded that incorporating literature can improve both children’s math achievement scores and their use of mathematics vocabulary with peers, and it encouraged them to use the mathematics language and skills in other content areas. Comments from teachers and parents hinted that children’s genuine interest of mathematics was increased after having been taught lessons using literature (Jennings et al., 1992).

**Effectively Choosing Literature to Incorporate in the Classroom**

Given the understanding of the benefits of using children’s literature in the mathematics classroom, how does a teacher effectively choose and implement appropriate literature? In the world of children’s literature there are literally thousands of books to choose from. How do we, as teachers, make sure we choose a worthwhile piece of literature? “Children’s books need to be not only mathematically sound, but also “good books” from a literary perspective” (Schiro, 1997, p. 76). Choosing just any book to help children explore mathematics can have its own negative effects. If the mathematics is presented incorrectly, students can be lead to having misconceptions about mathematics. Incorporating poor literature can “create situations whereby children’s mathematical beliefs and abilities may actually be diminished and their mathematical understandings may be misconceived to the point of inaccuracy” (Nesmith & Cooper, 2010, p. 281).

When assimilating literature into the classroom, the literature temporarily takes the place of the textbook and succumbs to the role of the curriculum. In this case, it is the role of the teacher to purposefully select appropriate material. The literature needs to be of sound quality while also being appealing to students. “Any book that has some intriguing mathematical possibilities must be judged, first and foremost, as a worthy piece of literature. It must be marked by an engaging story line, beautiful language and a sense of wonder about the world” (Whitin & Whitin, 2001 as cited in Von Drasek, 2006, p. 62).

To ensure the literature being used is worthwhile, Michael Schiro (1997) has suggested using both a mathematical and literary set of standards to use when selecting literature. Patricia Hunsader has since adopted Schiro’s evaluation tool to make it more concise and added a point scale rating.

In terms of the mathematics of a book, Schiro (1997) has suggested that it should reflect the following:

* be correct and accurate,
* be effectively presented,
* be worthy of being learned,
* be visible to the reader,
* present an appropriate view of mathematics,
* be intellectually and developmentally appropriate for the audience,
* involve the reader in the mathematics,
* provide the information needed to do the mathematics,
* facilitate the readers’ use of the mathematics,

After reviewing the criteria and tool that Schiro (1997) had created, Hunsader came to the conclusion that this was too time consuming and cumbersome for classroom teachers to use. She then adapted this to focus on six specific areas (Hunsader, 2004 as cited in Nesmith & Cooper, 2010 p. 282):

1. Content accuracy
2. Content visibility
3. Developmental appropriateness
4. Facilitation of the reader’s involvement in, use of, and transfer of the content
5. Complement between the story and the mathematics, and
6. The resources required to obtain the maximum benefits are accessible.

When looking through and completing these critiques of books to use in the classroom, it is important to get more than one opinion of a book. Several people examining one book can have positive effects because a more thorough and insightful investigation is completed and the evaluators are able to “see more” and “judge better” in future evaluations of books. Evaluating multiple books at the same time can also be effective because it enables the evaluators to see how they compare to each other and to the standards (Schiro, 1997). One way to achieve this multiple view perspective would be to review the books with a committee of other classroom teachers or the mathematics coach.

**Effectively Implementing Integration: Making the Literature Become Your Curriculum**

When mixing children’s literature into a mathematics lesson, it is important for students to be able to experience the literature itself, enjoy the illustrations, and revisit mathematical concepts afterwards. Just as when performing a read-aloud in a reading class, the same strategies should be employed when reading in mathematics. Utilizing such strategies as making connections, visualizing, asking questions, inferring, predicting, and synthesizing will help expand the mathematics for the students (Hyde, 2006 as cited in Shatzer, 2008). Incorporating extension activities such as mathematical centers and projects can be applied to literature pieces to provide a hands-on connection and exploration of mathematics (Shatzer, 2008). These mathematical centers also allow students to experience the mathematics at an individual achievement level (Forbringer, 2004).

Enhancing the mathematics of a piece of literature is one way in which using books in the mathematics classroom can be utilized. Schiro (1997) refers to this as having “mathematical literary criticism.” Learning involves being an active part of the environment and being a mathematical literary critic involves the student ~~to~~ by making them really work through the book. The first step is to experience the literature from a literary perspective, allowing students to become familiar with the text. Next, have the students identify and analyze the mathematics within the text. Identify the problem, if there is one, with the way the mathematics is presented and work through the book, rewriting the text, redrawing the illustrations, and/or adding elements to the literature (Schiro, 1997). This process helps clarify the underlying mathematics to both the students themselves and their peers. Working in smaller groups to examine the mathematical aspects of the books can prove beneficial for the students, or learners, in the classroom. This small setting “allows more children to be involved in discussions in which they can express their own ideas and question others’ thoughts” (Schiro, 1997, p. 21). Expressing and challenging others on their ideas enables students to learn from each other. When doing this in classrooms, teachers have said, “The opportunity to knowledgeably critique and actually alter books to make them more vital pieces of literature was empowering” (Schiro, 1997, p. 7). Using wordless books allows students to create their own literary story to describe situations appearing in the illustrations. Students can construct the story along with the mathematics.

An excellent way to implement literature into the classroom is to use the selected literature as an introduction or enhancement to a specific mathematical topic. The stories can act as a springboard for further teaching (Burns, 1992). When exploring the subject of multiplication or division, using manipulatives is beneficial for students. The stories themselves can be a hands-on approach to learning about mathematics and typically students can act out the stories, acting as manipulatives themselves. After having read the story, students should still be allowed to have access to the story and the mathematics that were presented. Simply having read a story does not necessarily imply that all the mathematics must be exhausted in one sitting. Revisit the story multiple times to expand on the mathematics that has been previously observed, while still allowing students the chance to explore the mathematics working in centers.

**Books and Resources to Use**

The idea of incorporating literature into the mathematics classroom has been gaining popularity, and with this popularity new resources for teachers have been emerging. Marilyn Burns, David Whitin, and Sandra Wilde, have written numerous books that include lesson ideas for incorporating such literature. Marilyn Burns has published a series of books that are related to integrating pieces of literature for grades K-3 and also 4-6. Another great resource that has an abundance of ideas is John Van De Walle’s *Elementary & Middle School Mathematics Teaching Developmentally* (2008). This book contains a list of literature pieces that can be used with certain topics within mathematics and is also a great mathematical resource for teachers.

The first book that I would like to explore is *The Doorbell Rang* by Pat Hutchins. This is a story about two children whose mother baked 12 cookies. She instructs them to share the cookies evenly between themselves. Before they can begin to eat however, the doorbell rings and people come to visit. This phenomenon keeps happening and the final person to arrive is Grandma who has baked some cookies as well. As discussed earlier, one of the benefits of incorporating literature is that is allows students to see mathematics in an everyday situation (Schiro, 1997).

This story can be used in many different ways within the classroom and at various age levels. It can implemented when exploring division in older grades or subtraction in lower grades. Throughout the story, the two children have to solve how to share the cookies equally, first among two people, then four people, six people, and finally twelve people. One way that this book can be used in the classroom is to have students act out the story and create their own sharing problems. Students can begin sharing the twelve cookies between two people just like the children in the story. After having done this, students should be encouraged to create new problems by changing the amount of cookies being shared, or the amount of children sharing them. For example, how should two children share nine cookies? Older students may come up with more complex problems such as, “There are 14 people. Each person gets 7 ½ cookies. Grandma baked 65. How many did a stranger bring?” (Griffiths & Clyne, 1988, p. 26).

Another way that this same book can be used is to have students act as mathematical literary critics like Schiro (1997) has suggested. Approaching the story in this way allows the students to expand on the story and use a combination of literature skills and mathematical skills. After reading the story a second time, children themselves should be allowed to identify where mathematics is being used in the story and if it relates to the story itself. Next students work with their own copy of the book in small groups and analyze the mathematics at a closer level. They can draw and write on post-it notes to make corrections or adaptations to the text. Finally after having recreated or adapted the story, students can share their new creations with their classmates or younger students in the school (Schiro, 1997). This newly adapted version of the story can be used as a performance assessment of the students’ understanding. Through this activity a plethora of informal assessment can be used, such as the post-it notes the students create, the list of mathematical aspects of the book, and teacher observations while the students are working.

*Quack and Count* by Keith Baker (1999) can be used when learning addition. *Quack and Count* is a story about seven ducklings and their adventures. As you read through the story, the ducklings are engaged in a variety of activities and through the illustrations the ducklings are pictured in different groups, all adding up to seven. Through reading and engaging with this story students benefit from seeing mathematics visually (Murphy, 1999). Number sentences making seven are visually displayed through the illustration of ducklings. This is the type of story that would be suitable for a first grade classroom and can be visited more than once. Marilyn Burns (2005) suggests using this book to provide a lesson on ways to break apart numbers into different addends. Reading this book more than once can provide students the opportunity to expand on the mathematics in the book. On the first reading of the book, have students count the ducklings along with you. When the book displays the same number of ducks marching in different amounts, ask the children about whether they think there is still the same number of ducks altogether. After hearing from a few students, count them altogether as a class. Continue reading the story in this same fashion and talk about the things the ducklings are doing.

During the second reading of *Quack and Count,* the focus can be shifted to recording equations that will represent the addition in the story. As the story is read aloud equations can be recorded on the board or on chart paper. For example, six ducklings on the left and one on the right would be recorded as: 6 + 1 = 7. As the story continues, the students can help create the number sentences. After completing the story, the students can be given the opportunity to engage with the mathematics of the story in a hands-on manner using unifix cubes. Through the use of these unifix cubes students are able to explore mathematics in a kinesthetic way. Students can represent each addend with the appropriate “train” of cubes. Finally, after having been given the opportunity to model the addends, students can independently illustrate a number sentence of their own using any kind of object they choose. Creating their own number sentences allows for students to put into practice the skill they learned through reading the story. For students who are at a higher level and may require more of a challenge, have them write or illustrate their own equations with combinations of more than two numbers that add up to seven (Burns, 2005). The benefits of exploring this story allows students to learn about addition through the multiple intelligences expressed previously.

A third book that I have as a recommendation to use is *Multiplying Menace: The Revenge of Rumpelstiltskin* (2006). This is a mathematical adventure story that helps to explain the phenomenon of multiplying both whole numbers and fractions. After Rumpelstiltskin comes to the kingdom to make a visit strange things begins to happen. Mice and other pests begin to multiply in great numbers while the cows and other farm animals begin disappearing. With the help of Peter the kingdom is soon back to normal. This story would be very useful when beginning to discuss multiplying fractions. A very common misconception among students is that you always get a larger number when multiplying two numbers together. Through this story, it is exposed that when multiplying by a fraction numbers actually get smaller. The benefit of such a story like this is that students see fractions being multiplied in a concrete example. They see the outcome that multiplying by fraction leaves a smaller amount. This provides students with an introduction to multiplying fractions in a non-traditional manner. Since this book would be most helpful when used as an introduction to multiplying fractions, it would be most suited for a whole group setting rather than a small group setting. When referring back to the standards for evaluating books set forth by Hunsader (2004 as cited in Nesmith & Cooper, 2010), *Multiplying Menace* (2006) proves to be a worthwhile book to use. The mathematics presented in the book is both accurate and visible to the students. Looking at the developmental appropriateness, both the mathematics level and the reading level are about the same; making this book most suitable for 4th grade students. In this story the mathematics is very closely related to the storyline. Each mathematical computation is directly related to an event that is occurring in the story. The last criterion from Hunsader (2004 as cited in Nesmith & Cooper, 2010) is that the resources required be accessible. To be able to effectively use this story in the classroom, the only resource needed is the book itself!

**Looking to the Future**

In conclusion, one can see that using children’s literature in the mathematics classroom can have a multitude of benefits. Students can learn mathematics in a meaningful context and engage in problem solving with real-world examples. Using literature can address a variety of levels within students and allows for differentiation. The mathematics can be presented in a non-threatening and enjoyable way allowing students to develop a happier attitude when learning mathematics.

The way in which teachers approach this implementation of literature in mathematics can vary, and to be effective they need to keep in mind standards when choosing literature. Not just any book can be chosen. It needs to have been looked at from both a literary and mathematical perspective. After a book has been chosen, it can be used to supplement a topic, introduce a topic or even review a topic. Students can work through a piece of literature identifying mathematics and striving to improve the way that it is presented. They can recreate the book while acting as mathematical critics. Using literature not only allows students to learn mathematics in a different approach than the typical textbook, it allows them to be assessed in an alternate way as well. Teachers can use informal and formal assessments to assess students’ understanding. The whole class discussions stemming from the literature can be a way for students’ oral communication of mathematics to be assessed. Instructional activities related to the literature can also provide a form of assessment for teachers.

Overall, the implementation of using children’s literature has proven to be beneficial for students in the subject of mathematics. It provides an alternative to the traditional textbook curriculum and with the outside support of realistic situations and a hands-on experience to mathematics children are able to increase their mathematical disposition and achievement.

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