

USING CHILDREN'S LITERATURE TO TEACH MEASUREMENT

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Mathematics is often seen by elementary school teachers as a difficult subject to teach and by many children as a hard subject to learn. Perhaps the main reason for this perception is the abstractness of mathematical concepts. The purpose of this paper is to examine the use of children's literature in teaching mathematics and its impact on the teaching and learning of mathematical concepts in early childhood education.

Introduction

Several studies have examined the use of children's literature in teaching math for different purposes. Evidence clearly shows that using children's literature to teach math is a very effective method of instruction.

Rainy Cotti and Michael Schiro (2004) conducted a study where they found that teachers' purposes in the ways they used children's literature to teach mathematical concepts were directly linked to their own curriculum ideologies. They cited four ideologies that influenced teachers in their study in the way they used children's literature in their math classrooms, which included the Scholar Academic, Social Efficiency, Child Study, and Social Reconstruction positions. Teachers who believe that children should learn mathematics because it is one of the academic disciplines and who believe that teachers should have a profound understanding of mathematics and the ability to teach that understanding to children, are Scholar Academics. They often use direct instruction or guided inquiry as their teaching method and may use children's books as a context to illustrate a mathematical concept. Teachers who believe that children should learn

mathematics in order to be able to use math skills in the home and at work in order to be productive members of society are taking the Social Efficiency position. They may use children's books in their math classrooms as a springboard for teaching math skills, rather than an understanding of the concepts. Teachers who believe that children should learn mathematics through developmentally appropriate practices, constructing their own mathematical concept meanings in a child-centered classroom are among the Child Study advocates. They often use children's books to provide a rich context to motivate children and provide concrete manipulatives for the children to handle in order to construct their own meaning of mathematical concepts. They also use children's books to show children how math in school relates to their daily lives. Teachers who believe that children should learn mathematics in order to understand social injustices and improve society are exhibiting characteristics of the Social Reconstruction position. They may use children's books in their math classrooms that show members of an at-risk population being successful in math activities, or to emphasize environmental issues, pover-

ty, and community problems to help children learn to solve these types of problems and to illustrate how they can use math to improve society. Teachers should have a clear understanding of their own ideological orientation in order to prepare purposeful instruction and be able to communicate more effectively with colleagues whose ideological orientation may be different. The authors of this study also expressed the fact that a teacher's ideological orientation may change as they grow as a teacher and therefore, knowing one's own ideological position and the way it influences their math instruction is important (Cotti & Schiro, 2004).

Leigh Ann Beard (2003) conducted a study in which she examined the effects of an integrated math and children's literature instruction on mathematical achievement and mathematical anxiety compared with students who received mathematics instruction without the contexts provided through children's literature. The author cited several studies that promoted the use of children's literature in mathematics instruction as helping children learn to value mathematics, showing real world contexts in math, and developing communication skills in the language of mathematics. Many children do not value mathematics because they do not understand how it relates to their daily lives. To them, it is just counting, numbers, memorization of facts, and computations without meaning. When teachers use children's literature to teach math concepts, children see how people use math on a daily basis for many purposes, and can then transfer those math

concepts to their own lives. Quality children's books are appealing, non-threatening, and related to children's lives. Many mathematical concept books or informational books can provide an interesting, risk-free context for children to explore mathematical concepts. Good children's literature can help children relate math to their personal lives, extend their understanding to other contexts, and provide an opportunity to explore mathematics concepts further. When teachers use children's literature to teach mathematics concepts, they help children connect their informal ideas with the abstract language and symbols of mathematics, which also reduces math anxiety and negative attitudes toward math.

Measurement

According to the *Curriculum and Evaluation Standards for School Mathematics*, measurement is of utmost importance in the mathematics curriculum because it is through measurement that children see the usefulness of mathematics in their daily lives; connect and learn other mathematical concepts such as numbers, fractions, and decimals; understand what it means to measure; and appreciate estimation. Children should have many opportunities to measure real objects, both with standard and nonstandard units, and to estimate the measurement of an object.

According to the NCTM (1989) Standard 10: Measurement, states:

In grades K – 4, the mathematics curriculum should include measurement so that students can---

- understand the attributes of length,

capacity, weight, mass, area, volume, time, temperature, and angle;

- develop the process of measuring and concepts related to units of measurement;
- make and use estimates of measurement;
- make and use measurements in problems and everyday situations.

The *Curriculum and Evaluation Standards for School Mathematics* also has set forth five general goals for K – 12 students:

- (1) that they learn to value mathematics,
- (2) that they become confident in their ability to do mathematics,
- (3) that they become mathematical problem solvers,
- (4) that they learn to communicate mathematically, and
- (5) that they learn to reason mathematically (NCTM, 1989).

The Importance of Enhancing Math With Children's Literature

Traditional teaching of math involves teaching numbers, sets, counting, addition, subtraction, multiplication, and division through rote memorization, drawing circles around objects, counting forward and backward, and repeated addition, to name a few strategies. Some children can learn to do these things, but they do not make a connection to their own lives, therefore, the value is small. However, many children have trouble learning mathematics through traditional methods. "Some children are visual learners and find it difficult to grasp math concepts when they are presented verbally or numerically" (Murphy,

2000). Often, children develop an anxiety about math because they must learn it, but they do not understand it. Teachers and researchers have found that using storybooks about math concepts can help because they present the abstract concept through a story to which children can relate and explain the concept in terms the child understands. Most storybooks also have vivid illustrations and even diagrams to help explain the concept. As children begin to understand these abstract concepts, they should be encouraged to create their own visual representations to illustrate and communicate their understanding.

The goals and standards of the NCTM, NCTE, and IRA promote the importance of integrating children's literature with mathematics instruction. The NCTM recommends that to help children develop and retain measurement concepts and skills, teachers need to integrate them into other curriculum areas. They also encourage more reading, writing, and discussing of mathematical concepts, which is where children's books take a place of prominence. Children's literature can foster the five general goals of the standards. The first goal, to value mathematics, is nurtured through stories in which children see others using math for many reasons in their daily lives. Children can transfer these math usages to their own lives. The second goal, to help students build confidence in their own math abilities, is developed by providing opportunities for a non-threatening, relaxed time to explore math concepts through stories. Children can achieve the third goal, to become mathematical problem solvers by reading stories

that contain fun, interesting, or exciting mathematical problems. They should also be encouraged to create and solve their own mathematical story problems (Whitin, 1992). To achieve the fourth goal, to communicate mathematically, children need to read books that illustrate mathematical concepts through words and pictures, and then follow the actions of the characters by creating their own related projects that communicate the concept. To learn to reason mathematically, the fifth goal, children might act out parts of a book in order to use deductive reasoning to solve problems or they may use manipulatives to explain their reasoning.

When a group of primary school teachers from Mountain Gate Primary School in Victoria, Australia participated in the *Early Numeracy Research Project*, they all shared the same children's book, *Alexander's Outing* by Pamela Allen, with their classes and taught a measurement lesson based on it. They generated many different ideas about how to approach the lesson. Most focused on capacity and created their own hands-on learning activities that included predicting and estimating as well as using nonstandard units. After using the storybook technique with their students for two years, they described how using storybooks to teach math changed their teaching. The changes included having more of a focus on their teaching, using open-ended questions more, allowing more time for children to explore the problem and possible solutions, and having a greater emphasis on ending the lesson with closure that pulls the information together. Reflecting on their children's growth while using

children's books to teach math, the teachers indicated they had observed that the children were able to explain their reasoning better, that they enjoyed math more and enjoyed being challenged, that the children reflected more on what they had learned, and that all children were having more success in math (Clarke, 2002).

Word problems seem to bring their own hardships and sufferings to students. Many students find word problems especially hard to understand. They are often unrelated in any way to the child's interests or experiences; they are dull, listing only the facts and asking a closed question. Teachers can avoid this problem by turning word problems into exciting stories with characters, problems, and plots; they may even integrate other curriculum areas to enhance the learning experience. Students really feel a part of the story problem when teachers ask for their help in creating it. When teachers use good stories to teach math, or create good stories from dull word problems, students tend to learn math in a natural progression "from reading the story to thinking about math and working out math activities in the story" (Martinez, 2000).

Measurement in Early Childhood Classrooms

Measurement concepts taught in primary classrooms include time, temperature, weight, length, money, volume, and area. They also include standard and nonstandard units of measure. Estimation follows an understanding that the measurements are not usually exact. Children are often first introduced to

measurement of time through the daily calendar, including days, weeks, months, and years, which may be followed with a general understanding of time for school, time to eat lunch, time for bed, and then clock hours and minutes. Temperature usually begins with adjectives describing the temperature of the day before moving into temperature as degrees Fahrenheit. The concept of weight often starts with comparisons of an object's weight, such as lighter or heavier. The concept of length may begin with comparisons, but can quickly move into nonstandard measurements of lengths of objects in the classroom, which is then followed by measurement with standard units of measure. The concept of money is often familiar to children in that they know that money is required in order to purchase something. However, they usually do not have a grasp of the value of each type of coin or paper money. Therefore, instruction in money usually begins with an identification of the coins and their monetary value. Adding and subtracting money comes later, after children have a firm grasp on the value of each coin and bill. Volume, introduced through stories and visuals, illustrate the amount of something an empty cup or other vessel can hold. The concept of area is introduced late in the primary grades, after children have a good understanding of length. Textbooks hold little promise for helping children understand these concepts. Teachers and researchers have found that using children's literature to address these concepts to teach math make the learning much easier and more fun.

Measurement and Children's Literature Connections

Children's literature is an important tool for teaching mathematical concepts about measurement. Author Marilyn Burns stated, "I believe that we can't teach what we don't understand, and we can't teach well what we don't enjoy. I think that children's literature offers a wonderful vehicle for helping teachers teach math well" (Bafile, 2001). There are many good quality children's books available for introducing measurement concepts and for enhancing children's understanding of those concepts. For example, *Inch by Inch*, by Leo Lionni is an excellent book for teaching the concept of measuring length in nonstandard units as well as for introducing measuring in inches. Other great books for teaching length measurement include *Measuring Penny* by Loreen Leedy, *How Big is a Foot* by Rolf Myller, and *Twelve Snails to One Lizard, A Tale of Measurement and Mischief* by Susan Hightower.

All in a Day, by Mitsumasa Anno demonstrates how time affects daylight, seasons, and weather all around the world. *The Berenstain Bears and Too Much Pressure* by Stan and Jan Berenstain is a book for children who are beginning to understand the concept of time in a day. For teaching children to understand the concept of one minute, Teddy Slater's *Just a Minute* is a great choice. *The Grouchy Ladybug* by Eric Carle is one of the best-loved books to teach time concepts.

For teaching concepts about money, *Alexander, Who used to be Rich Last Sunday* by Judith Viorst is an excellent choice, as well as *If You Made a Million* by David

Schwartz. Some other great choices are *Pigs Will be Pigs: Fun with Math and Money* by Amy Axelrod and *Jelly Beans for Sale* by Bruce McMillan.

Teaching the concept of weight may seem easy, since all children can weigh themselves, but understanding the variances of weight may be a different story. *How to Weigh an Elephant* by Bob Barner explores the basic underlying skills of measurement. *The 100-Pound Problem* by Jennifer Dussling offers stories with problems and activities to do.

Some children's books lend themselves to a variety of concepts. *Who Sank the Boat?* by Pamela Allen provides a story through which children may reason mathematically about weight, balance, and capacity while estimating and predicting outcomes. *Counting on Frank* by Rod Clement leads children to discover volume through a study of the length and weight of humpback whales. Volume is also the math concept to be studied with the reading of *The Black Snowman* by Phil Mendez, by using cups and jars of different sizes to fill with shaved ice and determine the differences in volume. *The Village of Round and Square Houses* by Ann Grifalconi provides a backdrop for exploring area and perimeter.

Conclusion

Using children's literature in the teaching of mathematics in the primary grades can make teaching and learning fun, relevant, and lively. Children experience measurement concepts personally, through stories that relate the use of measurement to their daily lives and through hands-on

activities. They can introduce the concept and skill with a fun story and follow through with hands-on activities that are sure to enthrall their students, while enhancing their understanding of the concept. When teachers ground their measurement lessons in good quality children's literature that leads to appropriate math activities, both teachers and students benefit.

Activity Sample

The following is an activity that can be used to teach measurement with literature.

We Measure Our World

Unit Lesson

Grade Levels 1 - 2

Literature connection: *Inch by Inch* by Leo Lionni

Objective: TLW create a one-inch collage to demonstrate an understanding of measuring items in terms of inches.

Bloom's Taxonomy Level: Application, Synthesis

Mississippi Mathematics Frameworks:

1st grade: 4. Identify and apply measurable attributes. a. Use nonstandard units (paper clips, unifix cubes, etc.) and standard units (inches, centimeters) to measure length.

2nd grade: 4. Estimate, identify, and apply measurable attributes. b Estimate and measure length, weight, and capacity using standard units of measurement (inch, foot, yard, centimeter, meter, ounce, pound, gram, kilogram, cup, pint, quart, gallon and liter).

NCTM Standards: Understand measurable attributes of objects and the units, systems, and processes of measurement. Expectations: recognize the attributes of length; understand how to measure using nonstandard and standard units.

Anticipatory Set: TTW start a discussion of length and height. TTW introduce the term “inchworm” and ask students if they have ever seen an inchworm. TT and TLW discuss why it is called an inchworm. TTW read *Inch by Inch* aloud to the students. TTW ask students what the inchworm measured and why he measured it. TTW ask TL what they think the inchworm measured next. TTW lead in to why we measure things in our world.

Teach the Lesson: TTW show the length of an inch on the white board using a ruler to measure, then show children an inch of pipe cleaner and have them agree that it is one inch long. TTW then model how to use the pipe cleaner inchworm to measure items. TTW ask individual students to come measure items with the inchworm and identify how long the item is in terms of inches or inchworms. TTW glue the items onto construction paper and write TL’s measurement beside it.

Items to measure: footprint, plastic spoon, craft stick, gummy worm, length of ribbon

Guided Practice: TTW distribute the “Inch by Inch, We Measure Our World” paper and lead students in answering questions. TLW draw around their hand and measure the distance across it. TTW give students five items to measure (leaf, paper clip, new pencil, felt flower, and crayon) with a partner using their inchworms and

write the measurements on their paper. TTW assist learners who are having difficulty measuring with their inchworms. Then, TLW share their measurements.

Independent Practice: TLW measure and cut pieces of paper and ribbon into one-inch pieces and glue them onto the “One-inch Collage” paper distributed by the teacher. TLW also find other items that are one-inch in length and glue them onto their paper. While the collages dry, TLW play “Inchworm Race” with a partner.

Closure: TTW ask TL to describe an inch and identify a one-inch object. TTW ask a volunteer to explain his/her collage. TTW ask a volunteer to explain what we learned today.

Assessment: TTW observe students measuring and cutting one-inch pieces of materials. The collages will demonstrate an understanding of an inch.

Let’s Get Active!

Inchworm Crawl – Place both hands on the ground. Try to keep your knees stiff and legs straight. Walk forward with your hands as far as you can and then walk forward with your feet to meet back up with your hands.

Recipe for Delicious Dirt (Beierle, M. & Lynes, T., 1992)

Your students will love this delicious dirt treat!

Ingredients:

1 large bag of Oreo cookies

¼ cup butter or margarine

1 cup confectioner’s sugar

2 small packages of instant vanilla pudding

3 ½ cups milk

8 oz. package of cream cheese

1 carton (12 oz) whipped topping
gummy worms
1 package small (5 oz) paper cups
plastic spoons.

Instructions:

1. Place Oreo cookies into zip lock bag and crush into small pieces to look like dirt.
2. Mix together the cream cheese, butter, and confectioner's sugar. Set aside.
3. In another bowl, mix the pudding, milk, and whipped topping.
4. Stir together the cream cheese mixture and the pudding mixture until well-blended.
5. In each small paper cup, layer the cookie crumbs and the cream cheese/pudding mixture. Top with another layer of cookie crumbs and a few gummy worms.

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