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## Teaching NCTM standards through subject areas in the kindergarten classroom

Elizabeth Tata O'Neil  
*University of Northern Iowa*

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## Teaching NCTM standards through subject areas in the kindergarten classroom

### Abstract

Teachers are being expected to provide a full range of experiences for their students. But in reality, many early childhood programs have reading readiness and literacy as the only focus. In many situations, mathematics instruction is an afterthought. Many students are not given quality instruction because little time in the school day is left, once language arts instruction is completed. This is even more true for students in half-day programs.

One way to alleviate this disparity is to incorporate math instruction within other subject areas. This can be achieved if teachers are educated in the National Council of Teachers of Mathematics' Standards, creative in forming meaningful experiences for students, and believe that math is an equally important area of knowledge. This article provided examples of how math can be taught through language arts, science, music, art, and social studies instruction.

TEACHING NCTM STANDARDS THROUGH SUBJECT AREAS IN THE  
KINDERGARTEN CLASSROOM

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By

Elizabeth Tata O'Neil

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Has been approved as meeting the research requirement for the Degree of Master of Arts in Early Childhood Education.

July 29, 2007  
Date Approved

**Charles R. May**

\_\_\_\_\_  
Graduate Faculty Reader

July 29, 2002  
Date Approved

**Jill M. Uhlenberg**

\_\_\_\_\_  
Graduate Faculty Reader

July 29, 2002  
Date Approved

**Rick Traw**

\_\_\_\_\_  
Head, Department of  
Curriculum and Instruction

## Abstract

Teachers are being expected to provide a full range of experiences for their students, but in reality, many early childhood programs have reading readiness and literacy as the only focus. In many situations, mathematics instruction is an afterthought. Many students are not given quality instruction because little time in the school day is left, once language arts instruction is completed. This is even more true for students in half-day programs. Results in the Report of the 2000 National Survey of Science and Mathematics Education found that in self contained K-3 classes reading and language arts were taught for an average of 115 minutes per day while math instruction was taught for 52 minutes (Weiss, Banilower, McMahon, & Smith, 2001, p. 47).

One way to alleviate this disparity is to incorporate math instruction within other subject areas. This can be achieved if teachers are educated in the National Council of Teachers of Mathematics' Standards, creative in forming meaningful experiences for students, and believe that math is an equally important area of knowledge. This article provided examples of how math can be taught through language arts, science, music, art, and social studies instruction.

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In order to produce competent and knowledgeable students, the Kindergarten teacher needs to meet the needs of all students by providing instruction that is creative, relevant, and meaningful (Jennings, Jennings, Richey, & Dixon-Krauss, 1992). Teachers are being expected to provide a full range of experiences for their students; but in reality, many early childhood programs have reading readiness and literacy as the only focus. Thus, mathematical education may not be getting equal time. Results in the Report of the 2000 National Survey of Science and Mathematics Education found that in self-contained K-3 classes, reading and language arts were taught for an average of 115 minutes per day while math instruction was taught for 52 minutes (Weiss, Banilower, McMahon, & Smith, 2001, p. 47). A position statement by the National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) stated that "high-quality, challenging, and accessible mathematics education for three- to six-year-old children is a vital foundation for future mathematics learning" (NCTM News Bulletin, 2002, p. 4).

How can teachers provide quality math experiences and meet district curriculum requirements? One way may be to integrate math into subject areas. As far back as the nineteenth century, both Pestalozzi and Froebel encouraged this and the use of manipulatives (Brosterman, 1997; Sowell, 1989; Jackson & Lee, 1996). Pestalozzi advocated the use of object teaching, where children used real objects to learn. Froebel utilized many activities such as drawing, language exercises, play activities, and the use of the gifts, as ways to develop children's mathematical knowledge (Jackson & Lee, 1996). Brosterman stated that "the one universal law upon which Froebel based all of his educational principles was unity or inner connections. The interconnectedness of all things was the governing force in Froebel's philosophy and pedagogy" (1997, p. 32). The focus of this article is to provide some examples of how teachers can integrate the NCTM's five content and five process standards for mathematics education into subject areas. The following activities illustrate how the NTCM's Standards can be used in Language Arts, Science, Music, Art, and Social Studies instruction.

### Number and Operations

In teaching this standard to young children, understanding numbers, operations, rela-

tionships, and place value are the desired outcomes. This can be done in different ways. One of these ways is by introducing students to the song *Five Green and Speckled Frogs* (National Educational Network, 1993) when studying the letter Ff or pond life. Students can create frog masks and act out the song. By integrating math through music and theatrical experiences, the children can begin to understand the concept of subtraction and the numbers zero to five. This activity can involve the following: Creating a flipbook which is divided into five sections as illustrated in **figure 1**. Students draw the log and water and add five frog stickers to each section. While singing the song, they can manipulate their book and begin to visualize addition, subtraction and even fractions. Teachers can facilitate the learning by asking questions like: How many more frogs are in the water than on the log? What math sentence can you say that describes your book? How many more times can we sing before all the frogs are in the water?

Another activity uses the book *Mouse Count* (Walsh, 1991). As the teacher reads, certain students can act out the parts. Once students are very familiar with the plot, they are encouraged to fill the jar in different ways as shown in the book, but with no more than ten mice. In this activity, the children can create their own sums to get to ten and they begin to understand the associative property of addition. Not only is math being taught but also speaking skills, cooperation, sequencing, and self confidence.

### Algebra

This Standard includes activities like sorting, classifying, seriating, patterning, and using math models. Through a Winter unit there are many ways to incorporate algebraic instruction. After reading Jan Brett's *The Mitten* (1989), students can create masks of the characters which can be used in a variety of other learning situations. These include sequencing the events of the story, performing puppet shows, and discussing the habits and traits of the animals. Students can be encouraged to figure out how many feet are in the mitten at any given time. Journaling their answers provides an assessment of writing skills as well as mathematical thinking. In a center activity, stocked with a variety of mittens in different sizes and colors, the students can pattern and seriate the mittens and the teacher can have meaningful conversations with the students as they explain their rule. One other activity that

can be generated is comparing and contrasting winter activities with summer ones by using a Venn Diagram to record the student's answers.

The book *A House is a House for Me* (Hoberman, 1978) is also very good for generating patterns and relationships. After reading it, the teacher might challenge the students to come up with their own pattern. A few examples of actual Kindergartners' responses include "a flower is a house for pollen, a heart is a house for blood, and a tree is a house for a squirrel." Although these examples have nothing to do with number patterns, the students clearly classified and used logical thinking to produce their answers. One other non-mathematical activity for patterning includes a game called Annie Williams. In it, the teacher creates a list of examples and nonexamples of what Annie Williams likes and does not like. The challenge for the students is to recognize the pattern and provide another set of examples and nonexamples based on what the student perceives the rule to be. See **figure 2**. In the first example, the rule is words that start with M. In the second example, the rule is words of the "at" family. In this activity, phonemic awareness is being taught as well as the skill of looking for a pattern and extending it.

### Geometry

Students should be able to recognize two and three dimensional shapes, describe spatial relationships, recognize and create symmetry, create mental pictures, and find shapes in real life. Incorporating geometry into curriculum is easily accomplished by making students aware of the symmetry and forms present in real life situations. Nature lends itself perfectly to a study in geometry. Learners could go on a nature walk during each of the four seasons, then create a book in which they can draw and record their observations. The teacher would encourage a sharing time for each child to tell what was found. Not only will different shapes and examples of symmetry be found, but the growth the students make throughout the year is clearly seen in the development of the writing and artistic composition. The book created could be used as an authentic task for geometry acquisition and writing ability.

During Halloween, the instructor could provide a science unit of study on spiders. The books *The Very Busy Spider* (Carle, 1984), *Spiders* (Gibbons, 1993), and the factual big books on spiders by the Wright Group (1992) are good resources for this unit. A culminate

activity could have the children make an edible symmetric spider out of Oreos (Murphy, 2000) as illustrated in **figure 3**.

For a language arts activity, the books *Eight Hands Round* (Paul, 1991) and *The Quilt Story* (dePaola, 1985) can be used. The teacher would provide geoboards for students to create alphabet letters on. A task for the students might be to make a list of those letters that are symmetric and nonsymmetric. The instructor needs to encourage the learners to show proof by writing letters and showing lines of symmetry. Students could also examine their own names to determine symmetry. The children might want to create their own quilts using precut geometric shapes. Perhaps they could make a quilt with their own name out of the shapes. These art creations should be displayed around the room.

#### Measurement

The competency addressed here is the understanding of length, volume, weight, area, and time. Students need to select appropriate tools of measurement and use standard and nonstandard measures. A fun social studies unit on St. Patrick's Day uses these skills and a potato. After reading *Jaime O'Rourke and the Big Potato* (dePaola, 1992) a cooperative group of students are to investigate measurement through a potato and record their answers on a prepared form. See **figure 4**. The students go to six stations. Two stations deal with weight. The potato is weighed on a conventional scale and it is weighed on an equal arm balance using a manipulative like bear counters or unifix cubes. Both answers are recorded. Students are then asked to estimate the length and the circumference of the potato. When the team comes to a consensus, chains of links are made to represent the measurements; then they measure with yarn and compare their estimates with the actual measurements. The fifth station deals with counting the eyes of the potato. The students are challenged to determine if larger potatoes have more or less eyes than smaller ones and to defend their answer. At the final station, volume is measured through water displacement. The potato is put into a measuring cup containing water. When the potato is placed in the cup, the students can hypothesize about why the water level has changed. At the end of the investigation, each team reports out to the group at large explaining their findings.

## Data Analysis and Probability

This last content area addresses the knowledge of gathering, sorting, classifying, organizing, representing, and explaining data. At the beginning of the year, when Nursery Rhymes are taught, children can, with the aid of the teacher, compare and contrast the stories of *Goldilocks* (Marshall, 1991) and *Somebody and the Three Blairs* (Tolhurst, 1990) through a Venn Diagram. During Thanksgiving, they can refine this skill through the stories of *Cinderella* (Jeffers, 1985) and *The Rough Faced Girl* (Martin, 1993).

In the Spring, when students are more independent, and with the help of the teacher, they can collect data for a pet unit. The children can conduct interviews with other students, teachers, and parents to ascertain information about pets. Perhaps, they want to know what kind of pets people have or what class has the most pets, or if girls have more pets than boys. The students determine what information they want to research, and then, they create a graph to present to the class. This could be a pie, bar, or pictorial graph or even a Venn diagram. It is imperative that the teacher provide support and allow the students to explain their work from the beginning to the end. The product is not as important as the process.

*Principles and Standards for School Mathematics* stated that the "foundations for children's mathematical development is established in the earliest years. Mathematics learning builds on the curiosity and enthusiasm of children and grows naturally from their experiences" (2000, p. 93). The early childhood teacher has a responsibility and duty to provide quality mathematical experiences for the students. By infusing math into subject area instruction, the amount of math taught can be increased and interdependence of learning can be experienced by the students. It is critical that preschool and kindergarten teachers expose students to higher order thinking and integrate math into other curricular areas in order to allow these students to begin to understand the complex concepts of mathematics. This will become, for the students, the foundation of their mathematical learning. It is clear that the teachers must provide this instruction so that students can become effective and competent learners.

Figure 1

## Flip Book

four 4	three 3			
One jumped into the pool where it was nice and cool...				

Figure 2

Annie Williams

Ex. 1

Macaroni	Pasta
Mouse	Rat
Moon	Sun
Mom	Dad

Ex. 2

Hat	Cap
Mat	Rug
Cat	Kitten

Figure 3

Edible Symmetric Spider

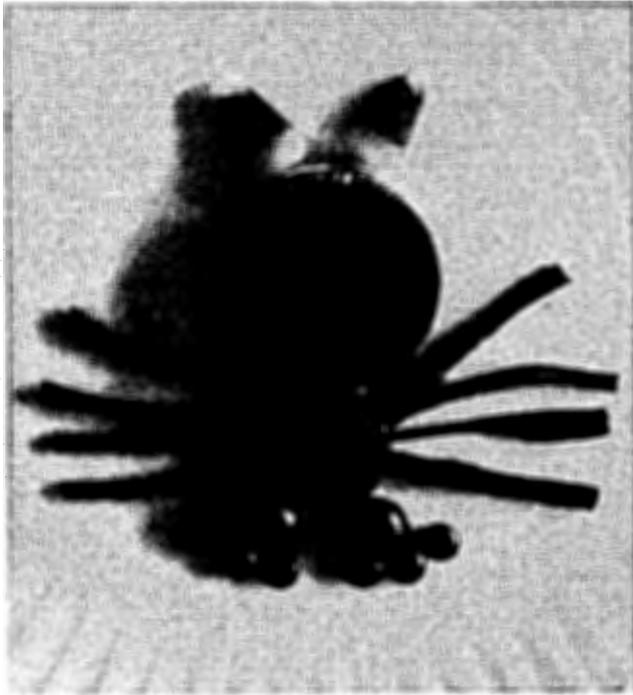


Figure 4

Group \_\_\_\_\_

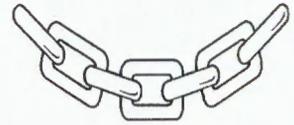


### Potato Math



We estimate our potato is \_\_\_\_\_ links long.

Our potato is \_\_\_\_\_ links long.



We estimate our potato is \_\_\_\_\_ links around.



Our potato is \_\_\_\_\_ links around.

Our potato weighs \_\_\_\_\_ pounds.



Our potato weighs \_\_\_\_\_ unifix cubes.



Our potato has \_\_\_\_\_ eyes.



Our potato made the water go  
\_\_\_\_\_ when we dropped it in.



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