Janice Novakowski

Developing "Five-ness" in Kindergarten

In the early primary grade classroom, significant time is dedicated to developing number sense. Number sense is much more than being able to write numerals, count a quantity of objects, or recognize a set of a specific quantity of objects. Number sense is knowing, for example, what five is in a variety of contexts and representations. The essence of understanding "five-ness" is understanding what the symbol 5 indicates and how five can be represented and visualized in different ways.

As suggested by the National Council of Teachers of Mathematics (NCTM 2000), students in prekindergarten through grade 2 should come to understand whole numbers in many ways. Teachers are encouraged to provide experiences that, among other goals, help students

- develop a sense of whole numbers and represent and use them in flexible ways, including relating, composing, and decomposing numbers; [and]
- connect number words and numerals to the quantities they represent, using various physical models and representations…. (p. 78)

Five is an essential benchmark number for young students, and a strong understanding of five will contribute to their understanding of ten, another significant benchmark number in our number system. Ma (1999) and Van de Walle and Lovin (2006) emphasize the importance of understanding the decomposition of ten in higher-level operations. The importance of five is also reflected in current teacher resources that include five-frames alongside the more common ten-frames.

This article will look at the types of experiences in early primary classrooms that promote number sense through composition and decomposition of whole numbers, specifically the number five. During my work over two months with my kindergarten class, I examined the ways in which a variety of experiences either support students' understanding of five or inhibit their ability to represent the number in a variety of ways. I wanted to explore different instructional approaches and contexts and examine what experiences contributed the most to students' awareness of parts of five and supported them in their recordings of five.

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Edited by **Andrew M. Tyminski**, *atyminski@purdue.edu, assistant professor of mathematics education at Purdue University, West Lafayette, IN 47907. "Early Childhood Corner" addresses the early childhood teacher's need to support young children's emerging mathematical understandings and skills in a context that conforms with current knowledge about the way that children in prekindergarten and kindergarten learn mathematics. Readers are encouraged to send submissions to this department by accessing* **tcm.msubmit.net**. *Manuscripts should not exceed eight double-spaced typed pages.*

Experiences with Five

At the beginning of the school year, I asked my kindergarteners to record what they knew about five. Many of them were able to say, "I am five!" but wondered how to record this fact. Some students drew five objects, and some drew or traced the fingers on one hand to represent five (see **fig. 1**). At this time, only one student recorded the numeral 5. Most of the students were able to count to twenty and demonstrated one-to-one correspondence when counting sets of up to ten objects. After this initial assessment, we proceeded to explore five in many ways. During the time we worked on this study of five, the students were regularly asked to record and represent what they knew about five.

Building

One of the first experiences the students had with making five was using snap cubes (Unifix cubes). The students counted out five cubes and were asked to show different ways to make five (see **fig. 2**). They grouped the cubes in different combinations and then were asked to "read" them—for example, "Two and two and one make five." I would occasionally stop the group and ask a particular student to read and share his or her combination for five. Using this approach, the students learned from

Figure 1

Student representations of five through hand tracings and drawn objects

one another and came up with a variety of ways to model five, including two-, three-, four-, and five-part models, such as "3 and 2" or "2 and 2 and 1."

I revisited this task a few times over a week with the students, building on previous experiences by recording their different combinations on a class chart. There were animated discussions about whether the combination 1, 2, and 2 was the same as or different from the combination 2, 1, and 2. Because the students often stacked their cubes in little towers, in rows, or on their fingers, the order of the parts seemed significant for them. As they shared their combinations, they seemed sure that their "way" was unique. As we recorded their ideas on a chart, we represented them as both drawings and numbers. When the students saw the same set of numbers being represented by the drawings of the cubes (even if the arrangement was different), they commented, "We already have that one!" When the students saw the numeric notation, many were able to see that the combination of cubes was the same, even if the numbers were in a different order.

Another building experience involved using wooden craft sticks. The students each counted out five craft sticks and then were asked to make designs or pictures with them (see **figs. 3a** and **3b**). The students enjoyed the creative aspect of this task, and many tried to make familiar objects such as houses, flowers, and animals with their sticks. The sticks seemed to encourage more flexibility in the students' representations and the stories they constructed about what they had made. The students described their designs in both words and numbers and "read" them as they had the snap cubes. This task was particularly effective in having students look at multiple parts of five. I think the nature of the sticks and the use of them to make "pictures"

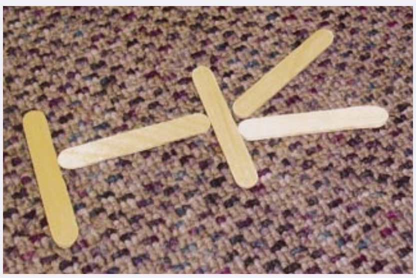
Figure 2

Students showing different combinations of cubes that make five

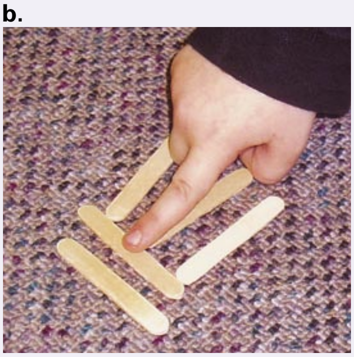
Figure 3

Two ways that the students used wooden craft sticks to make designs representing five

a.



b.



opened up more possibilities for the students to read different number combinations. Also, the students could easily record the number of craft sticks on paper by drawing lines, thus enabling everyone in the class to be successful in representing at least one way to make five (see **fig. 4**).

Literature

Many children's books published today support mathematical understanding and concept development. In particular, books based on traditional songs and stories often involve the use of five. The students in my class were excited to read Christelow's (2000) series of books based on the traditional chant "Five Little Monkeys Jumping on the Bed." Metzger (2004) has also used this traditional rhyme in his books but with a twist by substituting different animals, such as "five little bats flying in the night." I read many of these books to the students, and they often joined in, chanting along with the patterned text. We "read" the mathematics in the illustrations (i.e., "There are 3 monkeys on the bed and 2 on the floor.") and occasionally used snap cubes to represent what was happening in the story.

Reading the mathematics in the illustrations provides another visual model for students, another way to "see" five and something that they can hold on to when they attempt to represent five by drawing or building. Other books we enjoyed included Crews's *Ten Black Dots* (1995), for which the students created their own pictures using five blue dots (see **figs. 5** and **6**). In their own pictures, the students read the five dots in a variety of ways and were able to see different one-, two-, three-, four-, and five-part ways of looking at five in their pictures. We read Tang's *Math Fables* (2004), beginning at the story for one and continuing up to five. After reading the story for four, I asked students to predict what combinations the book would show for five. The students suggested the two-part combinations for five, possibly because the book showed only two-part combinations for four.

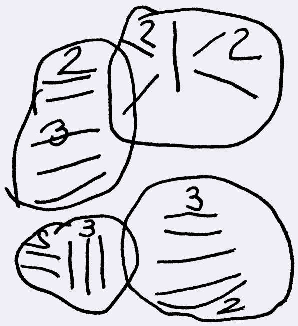
Pretend contexts

Twice during our ongoing study of five, when it was time to record on paper, I divided the class into two mixed groups. One group of students was asked to record what they knew about five. The other group was provided with a pretend context for recording five. Using pretend contexts is a common instructional approach in primary classrooms. Students are asked to imagine or pretend that, for example, the blocks they are working with are apples or animals. Many teachers believe that this approach helps make the mathematics more "real" for the students. I wanted to deliberately use this approach to see how my class would handle this approach. On the first occasion, I asked the students in the second group to pretend that they had five pieces of Halloween candy and to think about all the different ways they could make five with the pieces. The second time, I asked this group to think back to the "Five Little Monkeys" song and story and recall the different groupings of monkeys.

In both instances, the students in the second group, who were using the pretend contexts (which I had thought would support them), were able to record only one or two representations of

Figure 4

Student recordings of five through craft stick representations



five. When working within the Halloween candy context, the children spent considerable time deciding on and drawing five candies instead of thinking about combinations for five. The "Five Little Monkeys" context was also limiting because the students mostly drew just one combination for five, and it was always a two-part representation (3-2 or 4-1), because this was the model in the song and the book. Although I had asked again for the students to show as many ways as they could to make five, the contexts I provided for support at the time instead seemed to constrain the open-endedness of the task.

Discussion

As the students engaged in the range of experiences that allowed them to explore five, the importance of being able to use mental strategies and subitize became clear (Kline 1998). Clements (1999) defines *subitizing* as "instantly seeing how many," an ability he feels plays a significant role in children's development of mental computational strategies. Many kindergarteners continue to count by one instead of subitizing, but the ability to subitize plays a significant role in their developing ability to understand number. To understand five-ness, students need to understand the parts of five. By composing and decomposing numbers, they look at the parts that make the whole.

Current teacher resources often refer to such relationships as *part-part-whole relationships*, but I prefer the term *parts-whole relationship,* because it does not suggest that a number is made up of only two parts. Many authors, including Van de Walle (2006), agree that "focusing on a quantity in terms of its parts has important implications for developing number sense" (p. 48). Students need to see that a number is not just a set quantity or group of objects.

Students' Comments

Near the end of our exploration of five, I asked the students what experiences helped them understand five. I asked them to recall what they thought of when I asked them to record what they knew about five and the different ways to make it.

> "I remember building them with blocks."
>
> "I look at pictures [in the class] to remember."
>
> "I sing 'Five Little Monkeys.'"
>
> "I see the blocks in my head and draw them." (See **fig. 7**.)
>
> "The sticks were good because there were different ways, like 1, 1, 1, 1, and 1 and other designs."
>
> "I think of five balls and move them around."

Many students recalled specific classroom experiences, most of which involved the building activities. The students referred to the concrete experiences during which they physically manipulated objects, moved them into subgroups, and then "read" their combinations for five. The students' comments suggested that they were able to visualize and refer to mental images of these objects when they discussed their strategies.

Figure 5

After reading *Ten Black Dots* (Crews 1995), the students created their own dot pictures based on the story.

Figure 6

Dot pictures representing five

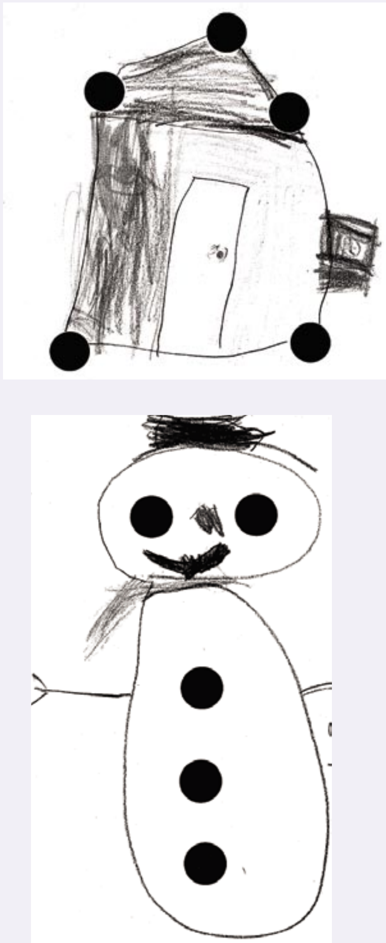
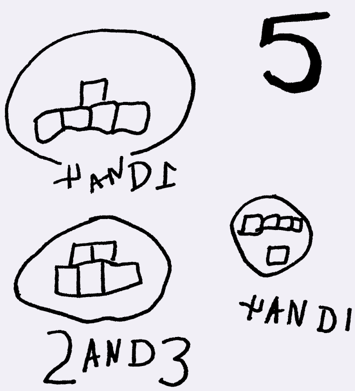


Figure 7

Students' drawings convey their mathematical thinking as they composed and decomposed 5.



Conclusion

As our exploration continued during the fall term, the students demonstrated an ability to record a wider variety of combinations of five. Most of their drawings involved lines (depicting sticks) or squares (depicting snap cubes), and some students began recording what they "read" in the picture by writing "3 and 1 and 1." I have always intuitively believed that providing a context in mathematics helps make the mathematics more meaningful and purposeful for students. Although the kindergarteners found the songs, stories, and pretend contexts engaging, I question how these contexts contributed to their understanding of the mathematical concepts we were exploring. I did find that the students were able to hold on to visual images (pictures in children's literature) or use their building experiences (with blocks and sticks) to support them when recording their representations of five. This observation is supported by British Columbia's Early Numeracy Project (British Columbia Ministry of Education 2003): "Spatial activities involving hands-on experiences provide the sensory input that helps to develop mental imagery" (p. 5).

In my work with this group of kindergarten students, I observed that the more we worked with five, the better able they were able to subitize small groups (e.g., 2, 3) within a group of five objects or images, instead of counting by one for each subgroup. Many of these students commented that they saw five things "in their heads," suggesting that they were able to manipulate and decompose their mental images. Developing this mental imagery afforded them a means of thinking flexibly about five. Over time, as the students shared and "read" their different arrangements, all developed a broader repertoire of how to make five. After a few weeks of developing "five-ness," most of these students were able to record and read many ways to make five (see **fig. 8**), including a variety of multipart combinations. As we investigate other numbers, including ten, it is my hope that students will build on what they have learned and experienced during their study of five-ness.

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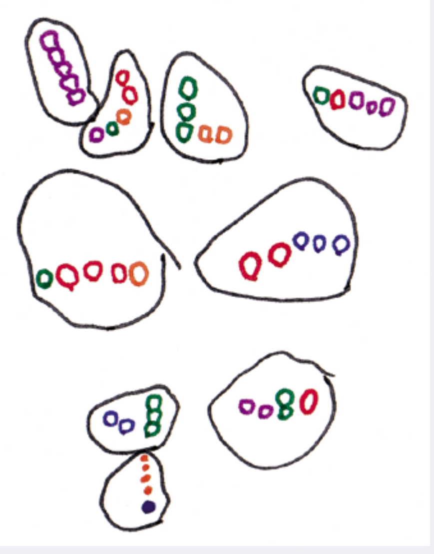
Figure 8

After developing an understanding of "five-ness," students are able to read and record a variety of multipart combinations.



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