



An Arts- Based Approach to Teaching Fractions

“Fractions have always represented a considerable challenge for students, even into the middle grades,” noted Van de Walle (2004, p. 242), and the instructional experiences of most teachers validate this statement. Despite the fact that proportional reasoning is an important

curriculum topic and a valuable life skill, students struggle to meaningfully grasp fraction concepts. To aid development of the concept of fractions, the National Council of Teachers of Mathematics (2000) recommends that students represent fractions by using physical materials and number lines. The visual and tactile input these materials afford, coupled with carefully designed reflection on the use of these tools, can bolster learning about fractions.

New research and knowledge about how the brain operates suggest that a sensory approach to learning should be given greater emphasis in the elementary classroom. On the basis of such research, Jensen (2001) argues for greater inclusion of the arts—musical, visual, and kinesthetic—as a

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valuable teaching aid, noting, “The arts enhance the process of learning. The systems they nourish, which include our integrated sensory, attentional, cognitive, emotional, and motor capacities, are, in fact, the driving forces behind all other learning” (p. 2). Jensen cites research indicating the value of movement in relation to learning, including the fact that more of the brain is activated during physical activity than during sedentary activity.

With these ideas in mind, we designed and implemented a series of three lessons intended to teach students some basic fraction concepts, in particular, foundational understanding of fractional parts and fraction equivalence. In this article, we describe the lessons and their impact on two elementary school classes in Louisville, Kentucky—one fourth-grade class with students of average ability and one fifth-grade class with students of below-average ability.

Three Lessons Incorporating Poetry, Movement, and Music

Because both movement and music enhance learning and retention of academic content (Jensen 2001), we developed a series of lessons that integrate kinesthetic activity and rhythm into teaching fractions. Our goal was to create fraction lessons that were both developmentally appropriate and engaging. (Note: For these lessons, the denominator is the name for the type of parts [thirds, fourths, etc.], while the numerator indicates how many of the parts are being considered [Van de Walle 2004].) Allow sufficient time for the students to reflect on and synthesize their learning.

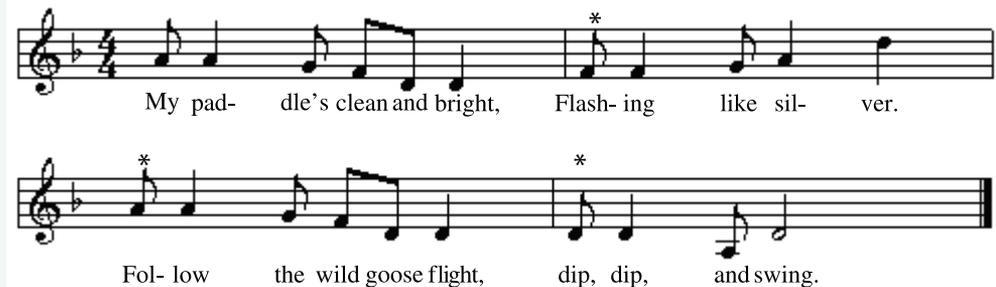
According to Reys et al. (2004), experience with a variety of concrete situations helps children



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Figure 1

“My Paddle” (also known as the “Canoe” round)



*Additional part enters at this point.
Source: www.mtrs.co.uk/rounds.htm

develop concepts more fully. We chose three methods of teaching the material: having the students recite a poem about fractions, having them jump fractional distances on a number line, and having them beat the fractional rhythms of a song (half notes, quarter notes, and eighth notes as well as whole notes) with rhythm sticks. Further, before students progress to operations with fractions, they should have a sound understanding of equivalence.

Each of the three lessons began with the poem “Fractions,” by Lee Bennett Hopkins (1997):

Broken number pieces
disconnected—

a quarter
a half
an eighth

fragmented—

out of order
out of control—

until—

I explore them
restore them

make them
whole
once more
again.

After the students had listened to and recited the poem, one asked what *fragmented* meant. We explained that it means a piece, or part, of some-

thing and related this definition to the definition of *fraction*. (For the purpose of this article and these lessons, the term *fraction* names a part of a whole or a part of a set.) To engage students in thinking about the topic and as a measure of preassessment, we asked the students to write the meaning of *fraction*, *whole*, and *quarter*. We then explained that the students would think about fractions another way: by jumping on giant number lines. (We positioned the number lines at the front of the classroom, but this activity could be conducted in any available space outside the classroom, such as the hallway or the playground.) We began with two number lines spaced four feet apart. On one number line, only the whole was labeled; on the other number line, both the whole and the half were labeled, each with a different-colored piece of tape. Each day the students stood in pairs at the first number line. On the first day one partner jumped once and recited “one whole” (or “one”), while the other jumped twice, landing on and reciting “one half” and then “two halves.” The challenge for the partners was to time their jumps so that one landed on “one whole” at the same time that the other landed on “two halves.” Then the partners switched roles so that they each could practice both parts.

Next, the class learned “My Paddle” (see **fig. 1**), a Native American song written in 4/4 time, meaning that each measure has four beats and that each quarter note gets one beat. Each student was given a pair of rhythm sticks, or claves (ours were 1/2-inch-thick dowel rods cut in 1-foot lengths), and then the students were divided into two groups. (For the music component of this lesson series, students

could also play kazoos. In this case, students could hold the notes to their full count rather than play only on the beats.) The students in the first group hit their sticks on the first beat of the measure; this was the whole-note group. The students in the second group hit their sticks on the first and third beats of the measure; this was the half-note group. The students sang the song while beating their rhythms and then switched parts and repeated the song. To help the students solidify their thinking and provide assessment information, we asked them to write the meaning of *fraction*, provide an example, and tell what they think “one whole” is. Further questions included these: “Is one-half larger or smaller than one whole? Tell why you think so, using drawings if needed,” and “How many fourths does it take to equal one-half? Explain.” (Student responses will be discussed later in this article.)

On the second day, we briefly reviewed the previous lesson’s concepts, and the students again recited the poem. A third number line indicating fourths was taped to the floor, and quarter notes were added to the song. The students were divided into three groups and assigned the role of wholes, halves, or fourths. After watching a teacher demonstrate, the student who was assigned fourths jumped four times, reciting “one-fourth,” “two-fourths,” “three-fourths,” and “four-fourths” while landing on the appropriate lines. The other members of the fraction trio did the same for their parts, timing their jumps so that they simultaneously landed on equivalent fractions (two fourths and one half; four fourths, two halves, and one whole) and simultaneously recited their fraction name. The students practiced jumping and reciting several times, rotating parts as before.

For the music lesson, students were divided into three groups. The students in the whole-note group kept the main beat, hitting their sticks on the first beat of each measure. Just as they did on the previous day, the students in the half-note group hit their sticks two times per measure. The students in the new group—the quarter notes—hit their sticks four times per measure, one hit for each beat. The students also sang the song as a three-part round and then switched parts. The class ended with the students writing answers to questions about several key concepts, such as, “How many fourths make a whole? Explain your thinking,” and “How are the three number lines like the three parts in the song?”

We began class on the third day by asking the students several review questions about equivalent frac-

tions and one question asking them to describe how the previous day’s number line and music activities related to each other. A fourth number line, this one showing eighths, was added. Before the students began jumping, however, we asked how they might time their jumps so that they would simultaneously land on equivalent fractions. They responded that the students assigned the smallest fractional part would start first and wait for those assigned the larger fractional parts to jump with them.

Eighth notes were added to the song. The class was now divided into four groups, with the fourth group striking eight beats per measure (eighth notes). Again, the students sang while keeping the rhythm, this time singing the same song as a four-part round. Each group took a turn playing every rhythmic part. As in the first two lessons, the students wrote answers to questions following the activities. The first four questions reviewed material from the first two days, while the remaining items asked students such questions as, “Is one-eighth smaller than one-half? Explain your thinking,” and “How many eighths does it take to make a whole? A half? A fourth?” The final question asked the students to explain where sixteenths would be placed on the number line and in the song if we were to add that part. **Figure 2** shows a summary of the lesson components for the three days.

Figure 2

Overview of the three arts-based fraction lessons

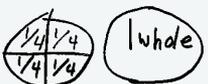
Day 1	Day 2	Day 3
Poem	Oral review	Oral review
Written preassessment	Poem	Poem
Wholes and halves on number line	Wholes, halves, and fourths on number line	Whole, halves, fourths, and eighths on number line
Whole notes and half notes with rhythm sticks	Whole, half, and quarter notes with rhythm sticks	Whole, half, quarter, and eighth notes with rhythm sticks
Written assessment	Written assessment	Written assessment

Reflections on the Lessons

The students appeared to be engaged in the lessons. They stayed on task and needed little redirection, possibly because both the movement and the song were teaching methods not commonly used in their mathematics class. The students seemed to understand the first lesson on wholes and halves fairly well, especially general ideas about the meaning of

Figure 3

Sample student responses to questions at the end of lesson 2

- a.
How many fourths make a whole? Explain your thinking. 4 because 4 fourths make a whole
- 
- b.
Is one-half ($1/2$) larger or smaller than one-fourth ($1/4$)? Tell why you think so and use drawings if needed.
- $1/2$ is bigger 
- It's bigger bec. 
 $1/2$ is one fourth bigger.

fraction and *whole*. They tended to see fractions as pieces, or parts, of a whole and wholes as shapes and numbers not broken into parts. The students had somewhat greater difficulty knowing whether one-half was larger or smaller than one whole and how many fourths equal one-half. Interestingly, those who had difficulty with these last two concepts seemed to understand the concept but made communication errors in either understanding the question or relating their thinking in writing. For example, three students drew an accurate picture showing that one-half is smaller than a whole but wrote that one-half is larger.

When fourths were added on the second day, the students were a bit more challenged. Some had difficulty timing their number-line jumps with their partner, simultaneously landing on one-half and two-fourths and saying the fraction name. Adding the quarter notes to the song did not prove as daunting; in fact, adding this third part seemed to increase students' enthusiasm. At the end of this lesson, nearly all the students explained correctly in writing how many fourths make a whole and how one-half relates in size to one-fourth (see **fig. 3**). However, no students explained satisfactorily how the number line and the song were alike. They may have intuitively understood the idea, but they were unable to express in writing how these two modes of representation compared. Several made

a comment such as, "It has the same beat." The best student attempt at answering this question was this: "They are the same because when you jump the number lines and when you pat the beat [beat] of the song, patting is like jumping and jumping is like patting."

Although we anticipated that the students might struggle when eighths were added to the number line, asking them to think of a way to time their jumps so that they landed simultaneously on equivalent fractions helped ensure greater success with this task. On this day, some students demonstrated while others observed (see **fig. 4**). The students then traded parts until each had a chance to jump all four number lines. Given the students' responses to the questions asked on the last day, it appears that even those watching understood the concepts.

Somewhat surprisingly, the class had little trouble with the song. With each added rhythmic layer, the students rose to the challenge and were able to play and sing the song accurately. They were eager to play the four different parts and sing the song as a four-part round as well as assume the more difficult roles of eighth and sixteenth notes. Teachers who do not feel comfortable leading the music portion of these lessons might collaborate with a music teacher or a musical parent or community volunteer. To save time, teachers might want to use a song students are familiar with, arrange to use a song that the students have learned in their music class, or teach students an easily learned song, such as "My Paddle."

After completing the third lesson, nearly all the students answered the review questions about wholes, halves, and fourths correctly, and the majority accurately answered questions about eighths. For example, when asked how many eighths make a whole, one student drew this representation (see **fig. 5**), and another wrote, "It takes $8/8$ to make a whole, because $4/4 = 1$, so $8/8 = 1$." Several students verified their answer to the question "How many eighths does it take to make one-half?" by drawing a number line. Only a few students were able to answer the last question: "Explain where sixteenths would be placed on the number line or in the song." One such student wrote, "Split the eighth notes in half," and another said to "go by the eighths because $8 \times 2 = 16$."

After the three lessons, the students in the fifth-grade class also wrote about what they had learned about the general concepts. These "exit comments" fell into two main categories: the conceptual meaning of fractions and the conceptual meaning of

Figure 4

A student demonstrates jumping the number line, now marked off in eighths.

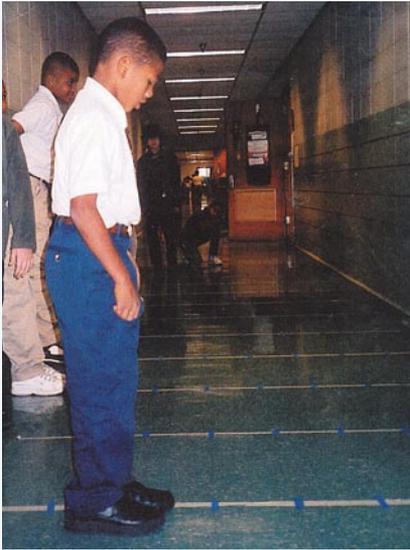


Figure 5

Sample student response to questions at the end of lesson 3

How many eighths make a whole?
Explain your thinking.

A handwritten student response showing a number line with 8 tick marks and the equation $\frac{8}{8} = \frac{1}{1}$.

Students also made a number of comments about equivalent fractions. One student wrote, “I learned a lot from the number line, and it was if you have $\frac{1}{2}$ another way of saying it is $\frac{4}{8}$. Just like saying $\frac{8}{8} = 1$ whole.” Another student also referred to the number line: “One more thing I learned is when we were outside of the classroom in the hallway is that equevlit [equivalent] fractions is that 2 of 4 is equevilt to 1 half.”

Classroom Implications

This short excursion into broader inclusion of the arts in teaching basic fraction concepts proved worthwhile. The students clearly enjoyed the activity and seemed to meet the simple objectives established. The emotional and psychological benefits of incorporating the arts in learning cannot be underestimated (Jensen 2001). Although pressure for evidence-based results in a crowded curriculum discourages classroom methods that require greater time investment, the potential for affective—in addition to cognitive—benefits deserves strong consideration. In addition to potential short-term advantages, using arts-based methods for teaching mathematics can have a long-term impact that may be quite substantial, despite the fact that such cause-and-effect can be difficult to measure.

Several written comments indicate that the students were aware of the various teaching methods used in this lesson series. One girl said, “She taught us fractions in a different way,” and another wrote, “Today at school we didn’t have time to do math so instead Dr. Goral came in and taught us a poem.” Clearly, students in most classrooms, like this one, are not used to more expansive use of the arts as methods for learning traditional subjects. Moreover, that a student could not recognize mathematics cloaked in an unconventional format is sobering.

The fourth-grade students who participated in the lesson series in the spring were interviewed the following fall by their teacher. The teacher wanted to get a sense of whether the students had developed and retained a deeper understanding of equivalent fractions through the arts-based method described here than they might have through more traditional manipulatives. Asked why drawings of two fractions (three-sixths and sixth-twelfths) were equivalent, Zach, a high-achieving mathematics student, explained the idea of equivalent fractions by using examples from the number line activity: “Well, if I wanted to jump to the halfway mark, I’d just leap

equivalent fractions. Frequent mention was also made of the various methods used—reciting the poem, hopping on the number line, and singing and tapping out rhythms—indicating the importance of these methods to the students.

Regarding the conceptual meaning of fractions, one student wrote, “Fractions are numbers that are not exactly whole. The only time that they can be whole is if the denominator is the same as the numerator” (e.g., $\frac{4}{4}$ or $\frac{8}{8}$). Three students, using words from the poem, commented that fractions are broken number pieces, while one wrote, “I learn[ed] that you cane brake a number that is a whole.” Referring to the song, one student wrote, “When it is $\frac{1}{4}$, [it] is 4 beats in a mesure so we are sopposed to do it 4 times.”

three times. But if you wanted to meet me at the same place, you'd take smaller leaps, but you'd have six jumps and I'd only have three." This comment illustrates that the concept not only was clear but also did not require reteaching. Zach was then asked to tap out quarter notes on the rhythm sticks while his teacher played whole notes, and he happily tapped out four beats to her one. Kiera, a struggling mathematics student, said, "Using the number line and jumping helped me see how many halves or fourths I was counting." When her teacher placed a set of fraction bars representing three-thirds and one whole in front of her, she said, "See, I'd jump three little steps, but you'd take one whole jump. I liked playing that game. It helped me remember what to do."

Classroom teachers should strive to find ways to incorporate musical, visual, and kinesthetic arts into mathematics instruction at all grade levels, if only for more difficult concepts and for those concepts that lend themselves more readily to representation through poetry, music, and movement. This approach may improve mathematics understanding, while serving often-neglected art objectives. The potential

short- and long-term benefits to student learning and attitudes will be worth the time and effort.

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The authors wish to thank Candace Renn and Donna Stottman for their cooperation in conducting these lessons in their elementary school classrooms. ▲