Number Line Misunderstandings

Summary: A key aspect of number sense involves understanding a number line and the relationship of numbers to one another. However, this can often be surprisingly difficult for elementary school students, especially when fractions and decimals are involved. In an article for *Teaching Children Mathematics*, University of Michigan researcher Megan Shaughnessy reports on a study that uncovered some of the most common student misunderstandings about number lines.

Practical Applications

Shaughnessy pulls out four main categories of misunderstandings:

- **Using Unconventional Notation.** This occurs when students may understand the relationship between a number and benchmarks on the line, but do not understand how to label those points. For instance, a student may understand that the eighth interval between 0 and 1 is two intervals from 1 and eight intervals from 0, but may notate it as "0.08" because of a misunderstanding of how to convert that relationship into a decimal. Studies show that students have more trouble accurately labeling fractions on number lines than decimals.

- **Redefining the Unit**. Since students are often taught partial numbers with number lines that go from 0 to 1, it can throw them off when faced with number lines that go longer, say from 0 to 2. (the same likely applies to younger students and a 0-to-10 scale). Thus, on a 0 to 2 scale, students might think that the eighth interval between 0 and 1 is 8/20, because they are assuming the full distance is involved as a unit of measure.

- **A Two-Count Strategy**. This misunderstanding happens when students apply a strategy of counting all the tick marks as the denominator and then tick marks to the target number as the numerator. So, with ten tick marks between 0 and 1 and eight tick marks to the target, the target number is labeled at 8/10. This is accurate, however, only when number lines have equal intervals, and shows a lack of conceptual understanding of numerical relationships.

- **A One-Count Strategy**. Students displaying this confusion will use the number of tick marks to the target as the denominator, and then choose the closest whole number as the numerator. So, the eighth tick mark between 0 and 1 may become 1/8.

In order to combat these misunderstandings, the author suggests strategies such as:

- Give students number lines with unequal intervals (e.g. the interval between 0.1 and 0.2 is larger than the interval between 0.3 and 0.4) to force them to think conceptually

- Showing students examples of number lines that have been labeled incorrectly using one of the four common misunderstandings and have them work through the errors.

- Analyze student work to identify the category of misunderstanding a student may be displaying and take steps to help clarify their confusion.

Conclusion and Citation

Number lines and number sense run through all of math. By knowing where students may have trouble, teachers can set them up for success.

Shaughnessy, M. "Identify Fractions and Decimals on a Number Line," *Teaching Children Mathematics*, Mar. 2011, pp. 429-434. **http://tinyurl.com/3nzg9ad** (subscription only).