

Number lines: Building conceptual and procedural skill in the elementary and middle school classroom

Verónica Ocampo
Milwaukee Public Schools
Greenfield Bilingual School
ocampovocampvo@gmail.com

Types of number lines

- Empty (no beginning or end points)
- Closed (with beginning and end points)
- Open (with a beginning but no end point or viceversa)
- Structured (with well-defined partitions and labeling)
- Semi-structured (with some partitions and labeling missing)
- Proper fraction number lines (<1). Applies to decimals.
- Improper fraction of mixed numbers number lines (>1) Applies to decimals.
- Positive and negative integers number lines

Common number line tasks (Elementary)

- Memorization and practice of counting and creating patterns with cardinal and ordinal numbers.
- Operations with whole numbers
- Representation and understanding of benchmark fractions
- Comparing and ordering fractions, and equivalent fractions
- Representing/identifying fractions as magnitudes on a number line
- Operations with fractions

Common number line tasks (Middle School)

- Extend representation of numbers to decimal numbers, positive and negative integers, and square and cubic roots
 - Comparing and ordering rational numbers
 - Operations with all rational numbers
 - Solving and graphing inequalities
 - Demonstrate density of fractions and decimals
 - Locate extreme values in a number line
 - Determine best scales to represent different magnitudes
- Middle school: Number lines are powerful tools to make the transition from arithmetic to algebra and the launching for higher mathematics.

Areas of improvement when using number lines

When teaching

- Emphasis on area models
- Low-level tasks on a closed number line
- Limited range of whole numbers (numbers no larger than five)
- Treating positive and negative integers as another category of numbers, rather than as part of the rational numbers system
- Treating negative fractions as another category of numbers, rather than as part of the rational numbers system

When evaluating

- Create a strong rubric before observing and evaluating student work.
- Make a preliminary list of possible answers and misunderstandings.
- Solve your tasks before students and generate a list of the mental strategies and mistakes that you might possibly encounter when analyzing student work.

Improving teaching with number lines

- Introduce different kinds of tasks.
- Use different kinds of numbers (whole numbers, fractions, decimals, positive and negative integers, negative fractions, square and cubic roots, irrational numbers, π , and big and small numbers)
- Depending on the problem and types of numbers, share your strategies with students.
- Elicit discussion on why you or other students chose a number line type over others.
- Analyze student work, preserving anonymity.
- Have students work in pairs and groups to solve challenging problems.
- Model flexibly and encourage students to show flexibility in their approaches, design, and problem solving with number lines.

Online resources

Learning Mathematics Through Representations Curriculum (LMR) –
University of Berkeley

<http://www.culturecognition.com/lmr/>

Number line generator

<http://www.senteacher.org/worksheet/104/NumberLineMaker.html>

Number line image generator

http://www.oliverboorman.biz/projects/tools/number_lines.php

Printable number lines and quizzes

http://www.helpingwithmath.com/resources/oth_number_lines.htm

Measurement of number sense and Approximate Number System (ANS)

<http://panamath.org/>