



# Rethinking Fractions Greater than One: Building Bridges to Advanced Mathematics

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As math educators, we see firsthand the moment when fractions enter the curriculum and student confidence falters (yeah, fractions are the bane of our existence!). Many students persistently misunderstand fractions and specifically have difficulty assessing fraction magnitude (Malone & Fuchs, 2016). The 2013 National Assessment of Educational Progress (NAEP) highlighted that:

- 40% of fourth-grade students could not determine that thirds were bigger than fourths, fifths, and sixths.
- 65% of eighth-grade students could not explain that  $\frac{1}{2} + \frac{3}{8} + \frac{3}{8}$  was greater than one.

These aren't just statistics; they are consequences of how we have traditionally taught fractions. Recent international comparisons from the TIMSS 2015 confirm this isn't unique to the learning experience of American students. Globally, students continue to struggle with fraction magnitude, especially when connecting fractions to decimals (Ayieko, et al., 2022). What's more, these misconceptions don't resolve themselves as students advance - they compound, creating barriers to success in algebra, statistics, calculus, and beyond (University of Delaware, 2016).

So let's talk about the "improper" problem...

## The Improper Problem

Our programs in elementary and middle grades often rigidly support students converting any fraction with a numerator larger than its denominator into a mixed number. Colloquially, we have labeled these numbers we are converting as "improper fractions" and rushed students to change  $\frac{7}{4}$  into  $1\frac{3}{4}$ . But what are we really communicating with that language? That there's something wrong with  $\frac{7}{4}$  as a



mathematical expression; that it needs “fixing.” While the language label is a seemingly small detail, it reinforces a problematic view that fractions are primarily about “parts of a whole” rather than numbers in their own right.

### **Why Fractions Greater Than One Matter**

When we examine how fractions appear in higher mathematics, we find that fractions greater than one are often preferred in their “improper” form:

- In middle school, students start to grapple with rates of change and have to interpret the slope as both a single number and the meaning of the parts in context. (i.e. a slope of  $5/4$  is both a rate of change of 1.25 and a vertical change of 5 units for every horizontal change of 4 units)
- In algebra, rational expressions like  $(6x + 2)/4$  can be simplified or operated on, but there is no mixed number equivalent.
- In statistics, students consider probabilities of compounding events that may be greater than one.
- In calculus, quantities like  $5\pi/2$  are standard notation.
- Generally speaking, solutions in higher level mathematics are left as fractions for precision.
- Engineers, scientists and data analysts regularly use fractions greater than one in their work.

By treating fractions greater than one as somehow “wrong” or “temporary,” we set students up for confusion and create barriers to accessing the mathematics when they encounter these forms in advanced courses.

### **The Cost of Conversion: What We Lose When We Always Convert**

When we insist that  $7/4$  must become  $1\frac{3}{4}$ , we're inadvertently teaching students that mathematical expressions have only one "correct" form. Yet mathematical flexibility—seeing the same quantity represented in different ways—is exactly what students need for higher-level thinking.

Consider these scenarios:

- A student who always converts  $5/2$  to  $2\frac{1}{2}$  might struggle to see that  $5/2 = 2.5 = 250\%$ , missing the connections between fraction, decimal, and percent representations
- When solving a problem like  $(7/4) \times (8/3)$ , converting to mixed numbers actually makes the calculation more complex.
- Students who see fractions like  $15/8$  as "wrong" often struggle with calculator results that display answers as decimal approximations rather than mixed numbers.
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By normalizing fractions greater than one, we're not just teaching a notation—we're fostering mathematical flexibility and number sense that serves students throughout their education and beyond.



## What's Really Going On: The Whole Number Bias

Remember A&W's  $\frac{1}{3}$  pound burger? In the 1980's, A&W introduced a  $\frac{1}{3}$  pound burger to compete with McDonald's Quarter Pounder. Despite taste tests showing customers preferred A&W's burger, it was a major flop. Why? Focus groups revealed that many customers thought  $\frac{1}{3}$  was smaller than  $\frac{1}{4}$  because 3 is less than 4. They believed they were getting less burger for more money!

While amusingly anecdotal, this illustrates the "whole number bias" that students (and many adults) try to apply when reasoning about fractional quantities. That's to say, students naturally apply what they know about whole numbers to think about fractions, but the properties are fundamentally different:

Whole numbers are:

- successive (the distance between 5 and 6 is the same as the distance between 87 and 88).
- discrete (there are no whole numbers between 4 and 5).

Fractions are neither:

- successive (the "distance" between fractions varies:  $\frac{3}{4}$  is closer to  $\frac{4}{5}$  than  $\frac{1}{2}$  is to  $\frac{1}{3}$ ).
- discrete (there are infinitely many fractions between any two given fractions)

(Malone & Fuchs, 2016)

When we rush to create mixed numbers, we are unintentionally reinforcing whole number thinking instead of helping students develop true fraction understanding.

## A Better Approach: What Research Tells Us

Recent research highlights that students need to see fractions as real numbers that live on the number line. The Institute of Education Sciences specifically recommends using number lines to help students visualize fractions as points on a continuum (Griffin & Ibama-Johnson, 2022). (In contrast, closed figure representations like area models or circles/"pizzas" help develop students' reasoning about fractions less than one.)

The latest NAEP frameworks for 2025 emphasize understanding fraction magnitude rather than procedural conversion.

## Building Bridges, Not Barriers: Practical Steps for Your Classroom

1. **Embrace the number line:** Position fractions (including those greater than one) on number lines to reinforce their status as numbers with specific values.
2. **Use precise language:** Replace "improper fractions" with "fractions greater than one" to remove the stigma.
3. **Emphasize magnitude estimation:** Practice approximating the size of fractions to develop number sense.
4. **Make connections explicit:** Frequently ask students, "How else might we write our answer?"



5. **Create flexible thinkers:** Teach conversion to mixed numbers as a tool, not a requirement.

### **Finding Balance: A Shift in Perspective**

Don't get me wrong - mixed numbers definitely have their place. They are handy in cooking, carpentry, and many other real-world contexts. The problem isn't that mixed numbers exist; it's that we have emphasized conversion at the expense of understanding. Fractions greater than one aren't "improper" – they are real numbers and a big part of real math.

When students truly understand fractions as numbers - including those greater than one - they develop the flexible mathematical thinking needed to approximate values, compare magnitudes, and reason about operations. By normalizing fractions greater than one as legitimate mathematical expressions, we are building conceptual bridges rather than procedural barriers.

#### RESOURCES

Ayieko, R. A., Moreano, G., & Harter, L. (2022). A cross-national comparison of fourth grade students' understanding of fraction magnitude. *International Electronic Journal of Mathematics Education*, 17(4). <https://doi.org/10.29333/iejme/12287>

Griffin, M., & Ibama-Johnson, B. (2022, October 3). Five recommendations for teaching fractions at the start of middle school. Institute of Education Sciences.

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Malone, A. S., & Fuchs, L. S. (2016). Error patterns in ordering fractions among at-risk fourth-grade students. *Journal of Learning Disabilities*, 50(3).

<https://doi.org/10.1177/0022219416629647>

NAEP 2025 Mathematics Assessment and Item Specifications.

<https://www.nagb.gov/content/dam/nagb/en/documents/what-we-do/quarterly-board-meeting-materials/2020-03/10-naep-mathematics-specifications.pdf>

University of Delaware. (2016, January 12). Predicting and addressing difficulties with fractions. University of Delaware: Education & Human Development.

<https://www.cehd.udel.edu/predicting-and-addressing-fraction-confusion/>

**What Now?** Scan the QR code and scroll to the bottom of the post for links to next steps



1. Check out our Fraction Foundations Progressions (available to our [All Learners Online Unlimited members](#) or for purchase [here](#)) to learn more about how we approach teaching fractions.
2. [Watch our recent 30-minute workshop](#) all about multiplicative reasoning and fraction games!
3. Bring All Learners Network (ALN) into your school or district for [embedded professional development](#).

