Solving the Fractions Problem: From Research to Classroom
Explore Learning
Every student can learn fractions
Fractions knowledge in grade 5 uniquely predicts student success in Algebra and beyond

Source: Early predictors of high school mathematics achievement
2012 longitudinal study

Fractions knowledge in grade 5 uniquely predicts student success in Algebra and beyond

Even after controlling for:
- Whole number knowledge
- IQ
- Working memory
- Reading comprehension
- Family income and education level

Source: *Early predictors of high school mathematics achievement*
“Knowledge of fractions is the most important foundational skill not currently developed among American students.”

– National Mathematics Advisory Panel

\[
\frac{12}{13} + \frac{7}{8}
\]

is closest to:

1
2
19
21
I don’t know

In 1978, 24% of students answered this problem correctly.
In 2014, **27% of students** answered this problem correctly.

1978 NAEP question:

\[ \frac{12}{13} + \frac{7}{8} \]

is closest to:

1
2
19
21
I don’t know

1978 NAEP question

\[
\frac{12}{13} + \frac{7}{8} \quad \text{is closest to:}
\]

1

2

19

21

I don’t know

It’s not a hard problem...

- 12/13 is close to 1
- 7/8 is also close to 1
- Add two numbers close to 1 and you get a number close to 2

It’s not a hard problem...

- $\frac{12}{13}$ is close to 1
- $\frac{7}{8}$ is also close to 1
- Add two numbers close to 1 and you get a number close to 2

The most common answers? 19 and 21
How can we do better?

Insights from modern research
<table>
<thead>
<tr>
<th>Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every real number has <strong>magnitude (size)</strong> that determines its place on the number line.</td>
</tr>
</tbody>
</table>
Modern Research

Understanding fraction magnitude is crucial for:

- Conceptual understanding of fractions
- Learning and understanding fraction arithmetic
Understanding fraction magnitude
Understanding fraction magnitude

Like whole numbers

• Each fraction has a place on the number line

• Fractions can be ordered and compared with any other number
Understanding fraction magnitude

Like whole numbers
• Each fraction has a place on the number line
• Fractions can be ordered and compared with any other number

Unlike whole numbers
• Fraction magnitude depends on the relationship between two numbers rather than on the individual numbers themselves
Key representations for understanding fractions as numbers

**Length models**: strips or blocks, each with a unit length (1 or a unit fraction)
Key representations for understanding fractions as numbers

Length models: strips or blocks, each with a unit length (1 or a unit fraction)
Key representations for understanding fractions as numbers

**Number lines**: where all the real numbers live

![Number line example with fractions](image-url)
Key representations for understanding fractions as numbers

**Number lines:** where all the real numbers live
Key representations for understanding fractions as numbers

**Number lines**: where all the real numbers live

![Number line with fractions](image)
Frax

Every student can learn fractions

Introducing ExploreLearning Frax. Adaptive and game-based, it uses the latest research-based instructional methods to create a better way to learn fractions.
Take a journey into fractions

The Frax approach

✓ Treat fractions as numbers first
✓ Build magnitude understanding
✓ Build understanding of fraction arithmetic
✓ Use key representations
  + Length models
  + Number lines
Take a journey into fractions

Frax key features

+ Learning through fun, adaptive games
+ Rewards for effort and progress
+ Real-time monitoring
+ Fun offline group activities
Take a journey into fractions

**Frax Foundations I**
Building a strong platform

- 27 story-driven missions
  - 20–30 minutes per mission
- Extra practice and rewards in the Arcade
- 6 offline classroom experiences
- Year-end review features
Take a journey into fractions

**Frax Foundations I**

Major areas of focus

- Understanding fractions
  - Length models
  - Number lines
  - Area models

- Fraction magnitude
  - Comparing and ordering
  - Basic equivalence
  - Beginning number line estimation
Take a journey into fractions

Frax Foundations II

- Early fraction arithmetic
  - Decomposing fractions
  - Addition and subtraction with like denominators
  - Multiplication of a whole number by a fraction

- Understanding decimal fractions

- Fraction (and decimal) magnitude
  - Creating equivalent fractions
  - Intermediate estimation
Take a journey into fractions

**Frax Foundations III**

- Advanced fraction arithmetic
  - Using equivalence in computation
  - Addition and subtraction with unlike denominators
  - Multiplication and division of fractions by fractions

- Magnitude
  - Advanced estimation
  - Advanced fraction sense
Offline student activities

• Give students the opportunity to verbalize their thinking with others
• Are a fun, collaborative way to celebrate their progress through the missions
• Use task cards in creative ways
• Provide the teacher with tools that can be used to assist students
• Can easily be differentiated
Dear Fraxionauts-in-training,

You have become skilled block makers during your first four missions. I need you to put those skills to use to help us develop a block maker training program.

Your assignment:

1. You and your partner will complete 10 task cards and then select the 4 task cards that you think will be most helpful to future makers as they learn about building blocks.

2. Make sure you clearly explain to the future makers how to complete the tasks.
Offline student activities

Summary

A briefing for the teacher

- This activity will allow students to talk about fractions with their peers, verbalizing their thinking about concepts they encountered in the Missions 1-4.
- In missions 1-4, students spent their time making and naming blocks models. The objective of Maker's Manual is for students to begin to build a manual instructing future block makers how to efficiently build models.
- Students will work with a partner to solve 10 task cards. Once they complete all tasks the pair will collaboratively decide which 4 contain the most important lessons new block makers need to know to be successful.
- The pair will write, video record, or audio record an explanation of how to complete the four selected tasks to assist future block makers.
- The four tasks and their explanations will be added to each student’s Maker’s Manual.
- Once the completed manuals are submitted to the Captain, the class is rewarded with a Block Party.
Frax

Every student can learn fractions

Start the journey with
Frax Foundations I