Rational Number Knowledge Math Battery
Fraction Ball R&D Team
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Rational Number Knowledge Math Battery

This assessment provides insight to students' understanding of rational number concepts using both timed and untimed items.

Purpose

- The Rational Number Knowledge Math Battery consists of a timed section and untimed section. The timed section assesses students' processing efficiency using decimal and fraction representations of rational numbers. The untimed section measures students' conceptual understanding and procedural fluency of rational numbers and magnitude.

Measure Details

- The Rational Number Knowledge Math Battery has 50 items that can be divided into 28 timed items and 22 untimed items, across 8 mutually exclusive subscales:
    - Timed Fraction to Decimal Conversion: 8 items
    - Timed Decimal to Fraction Conversion: 10 items
    - Timed Fraction Addition: 10 items
    - Untimed Fraction to Decimal Conversion: 3 items
    - Untimed Decimal to Fraction Conversion: 3 items
    - Untimed Fraction Addition: 8 items
    - Fraction Estimation on a 0 to 1 Number Line: 4 items
    - Fraction Estimation on a 0 to 5 Number Line: 4 items
- All conversion and addition items are dichotomously scored as correct or incorrect. Fraction items do not have to be reduced to their simplest form, and decimal answers must be correct to the hundredths place. An average standardized composite score can be created across these 6 subtests.
- Number line estimation items were scored using percent absolute error (PAE) of the students' placement of the value on the number line.
- Administration of the battery takes about 20 minutes for a whole class of elementary students.

Contribution to the Field

- Research has established that rational number knowledge is a key content area with implications for students' long term mathematics achievement. There are several related components that lead to students' conceptual understanding of rational numbers, including fraction magnitude and flexibility and coordination across fraction and decimal representations. This battery was developed to assess a broad set of rational number skills.
- This measure was also developed in alignment with the mathematical concepts targeted through the design of Fraction Ball, an elementary math product focused on playful fraction learning. including its emphasis on number line representations and addition of

fractions and decimals to score points as part of its embodied cognition, play-based approach to math learning.

Development History and Previous Uses

- The Rational Number Knowledge Math Battery has been used in several researcher-led efficacy studies of the Fraction Ball intervention. In addition, the battery has been used in two mid-to-large scale independent evaluation studies of Fraction Ball. Each of these studies has been conducted with demographically diverse samples of 4th and 5th grade students.
- As the battery has been administered, analyses have been conducted to explore its measurement structure and scoring protocols.

Accessing the Measure

- To access the measure, please contact:
    - Dr. Andres Bustamante at asbustam@uci.edu

Associated Publications

Bustamante, A. S., Begolli, K. N., Alvarez-Vargas, D., Bailey, D. H., & Richland, L. E. (2022). Fraction ball: Playful and physically active fraction and decimal learning. *Journal of Educational Psychology, 114*(6), 1307–1320. https://doi.org/10.1037/edu0000714.

- Open access available at: https://doi.org/10.31219/osf.io/dnpsj

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Smith, T., Williams, R., Rich, K., Park, S., Meyer, C., Margolin, J., Zhu, B, & Pruitt-Britton, T. (2025, August). *Fraction Ball phase 4 evaluation: Final report.* American Institutes for Research. https://osf.io/fvj5q