

## Math Fact Fluency Assessment

This digital measure provides insight to students' fluency in performing whole number arithmetic across the four basic operations within a timed assessment.

### Purpose

- The Math Fact Fluency Assessment consists of two timed sections of randomized arithmetic problems. The arithmetic problems in the measure are evenly balanced across the four basic operations: addition, subtraction, multiplication, and division.
- Fact fluency is the skill to solve arithmetic problems flexibly, accurately, and efficiently; it is an essential skill in elementary mathematics and supports conceptual understanding and number sense for content in later grades.

### Measure Details

- The assessment consists of two sections of items, each three minutes long. Items are presented in "blocks" of four items, one of each operation; the order of the operations is randomized within each block.
- The items themselves are also randomized, pulling from a bank of 120 possible problems for each operation. Values within the problems (addends, minuends and subtrahends, factors, and dividends and divisors) range from 0 to 10.
- Student performance is measured by the number of problems students can correctly solve over the 6 minute span.
- Additional metrics are also able to be captured within the assessment system, such as time to answer each item or ability to analyze item difficulty or performance on items with particular values, though these data are not intended as the primary form of assessing student fluency.

### Contribution to the Field

- Research shows the importance of procedural fluency in mathematics learning (National Research Council, 2001); fact fluency is a subcomponent of procedural fluency that is connected with whole-number number sense. Fluency has been shown to be predictive of mathematics achievement (e.g. Cowan, et al., 2011), and requires students to develop automaticity alongside conceptual understanding of arithmetic operations.
- The Math Fact Fluency assessment presents a novel improvement in relation to existing measures of fluency in the field, such as the Woodcock-Johnson Math Fluency subtest (Woodcock, et al., 2007), which may unevenly attend to the basic operations or only assess fluency on a focal operation or set of arithmetic problems. This measure offers a randomized, comprehensive approach to assessing all four basic operations, and is convergently validated with the Woodcock-Johnson subtest.
- The randomization of items that appear to students also contributes to a strong test-retest reliability of the overall assessment.

### **Development History and Previous Uses**

- An earlier version of this measure, with one section using the randomized problem bank and the other section using items directly from the Woodcock-Johnson math fluency subtest was used in several researcher-led efficacy studies of MathFluency+, an elementary math product focused on fact fluency and executive function skills.
- Data from one of these efficacy studies was used to conduct psychometric analyses, comparing student performance on the novel section to that on the Woodcock-Johnson subtest at each time point.
- The current version of the assessment has been used in a large-scale independent evaluation study of MathFluency+.

### **Accessing the Measure**

- To access the measure, please contact:
  - [The Brain Game Center for Mental Fitness and Well-Being](#)
  - Dr. Susanne Jaeggi at [s.jaeggi@northeastern.edu](mailto:s.jaeggi@northeastern.edu)
  - Dr. Martin Buschkuehl at [mbuschkuehl@mindresearch.org](mailto:mbuschkuehl@mindresearch.org)

### **Associated Publications**

Buschkuehl, M., Seitz, A.R., Pahor, A., Ramani, G., & Jaeggi, S.M. (under review).

Operation-specific links between math fact fluency and different domains of executive functions.