Digital Adaptive Rational Number Knowledge Task
Fraction Ball R&D Team
Last updated 11.5.25

Digital Adaptive Rational Number Knowledge Task

This measure assesses students' executive function skills within the context of rational number problem-solving.

Purpose

- The Digital Adaptive Rational Number Knowledge Task (Adaptive RNK) is an untimed measure where participants are asked to create as many arithmetic sums as they can using a provided arrangement of rational numbers.

Measure Details

- The Digital Adaptive RNK task consists of four items: two items provide students with unique sets of fractional numbers, and two items require students to make their arithmetic sums with unique sets of decimal numbers.
- A student's score on each item is the total number of combinations they create that are both unique and correct.

Contribution to the Field

- This measure iterates upon an existing adaptive rational number knowledge task (McMullen, et al., 2020). The original task provides students with sets of both fraction and decimal representations of rational numbers to create their arithmetic sums, and each item has a different target number students must sum to. The original task was developed and tested with 7th and 8th grade students.
- The Digital Adaptive RNK task adjusts the task design to be appropriate for elementary grades, and was validated with 4th and 5th grade students.
- This measure also leverages a digital format, which allows for more flexible administration of the task alongside other measures of mathematical knowledge and cognitive skills.

Development History and Previous Uses

- The Digital Adaptive RNK demonstrated convergent validity with a math battery measuring rational number knowledge (Begolli, et al., 2024) and with multiple traditional measures of executive function skills, including Flanker and Reverse Flanker tasks, as well as the Shallice Tower of London task. These relationships suggest that the Digital Adaptive RNK measures students' executive function skills within the context of rational number problem-solving.
- After the referenced validation study, the Digital Adaptive RNK has been used in two mid-to-large scale evaluation studies for a mathematics learning product focused on fraction knowledge, Fraction Ball, with elementary students.

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Accessing the Measure

- You may access the original adaptive rational number knowledge task here:
    - McMullen, J., Hannula-Sormunen, M. M., Lehtinen, E., & Siegler, R. S. (2020). Distinguishing adaptive from routine expertise with rational number arithmetic. *Learning and Instruction, 68,* 101347. https://doi.org/10.1016/j.learninstruc.2020.101347
- For additional information on the Digital Adaptive Rational Number Task, please contact:
    - Dr. Katherine Rhodes at ktrhodes@uci.edu

Associated Publications

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