

## Fraction Ball: Exactly

This measure assesses students' planning within the context of a mathematical task through a game-based platform.

### Purpose

- FBE leverages a basketball-based-game context, aligned with the math learning product Fraction Ball, where players move around a court to shoot baskets and earn fractional points, with different point values depending on the selected location of the shot on the court. The assessment consists of multiple games, each with a different target score to reach, without going over, in order to measure the player's ability to plan a strategy and update that strategy as they progress through the game.

### Measure Details

- The game-based assessment can be adjusted to include games that use either fraction or decimal notation for point values. The games can also be set to:
  - Limited: game settings limit the number of shots the player can take, forcing players to consider efficiency in their planning,
  - Unlimited: game settings allow for unlimited shots to be taken in order to achieve the game's target score, but players must also manage the likelihood of making a shot from different places on the court, with a lower probability of scoring when further away from the basket
- Planning is measured by FBE through dichotomous scoring of accuracy for each round if players achieve the target score exactly. Composite scores can also be created to sum across all game trials in an assessment administration.
- Note: The Fraction Ball:Exactly assessment was designed to capture multiple forms of data when playing the games, including the different types of shots, the number of shots taken, and the ways the players engage with the platform. At this time, validation analyses suggest a single measure of "accuracy" can best capture children's planning skills. Analyses will continue to explore if other facets of planning are able to be captured through this assessment.

### Contribution to the Field

- Research shows that executive function skills are related to mathematics achievement as well as student engagement in learning processes. Further, executive function skills are context-dependent, suggesting that students' must be given opportunities to use their executive function skills when learning mathematics. In this vein, we must also develop context-dependent assessments of students' executive function skills within mathematics learning.
- Planning is an executive function skill which is deeply related to mathematics learning, yet there are limited assessments that can be used to understand how students'

planning skills may develop over time, how their development may be related to different mathematics content, or how they may be supported through instructional strategies or activity design. This assessment presents one such approach to understanding planning within a math context, and particularly within rational number learning.

- The uni-dimensional model for children's accuracy demonstrated convergent validity with the Shallice Tower of London and with mathematical knowledge measured through a rational number math battery (Bustamante, et al., 2022; Begolli, et al., 2024). These relationships suggest that FBE measures students' planning within a mathematics context.

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

- The measure was validated with both adult and child (8-11 year old) populations and resulted in different measurement models for the different developmental groups.
- After the referenced validation study, the FBE 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. In these evaluation studies, children played four rounds of the game, across all possible combinations of game design settings described above (limited fraction, limited decimal, unlimited fraction, and unlimited decimal).

### **Accessing the Measure**

- To access the measure, please contact:
  - Dr. Katherine Rhodes at [ktrhodes@uci.edu](mailto:ktrhodes@uci.edu)

### **Associated Publications**

Lopez, J.L, Rhodes, K.T, Begolli, K. N, Bustamante, A.S, & Ahn, J. (2025). What "Exactly" describes planning in a math game-based assessment? Introducing "Fraction Ball: Exactly." *Proceedings of the 58th Hawaii International Conference on System Sciences*. <https://hdl.handle.net/10125/109434>

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>

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>