

A Rasch Analysis of the KeyMath-3 Diagnostic Assessment

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The KeyMath-3 Diagnostic Assessment (Connolly, 2008)¹ is a widely used assessment of children’s mathematical abilities. In this study, we assessed the psychometric properties of this measure at the item level with a diverse sample of 308 young children ages 5-8 years old. Results suggest that the Foundational Concepts subscale of this assessment is a good measure of children’s understanding of basic mathematical concepts; however, there are some caveats.

Mathematics learning during the early elementary school years provides a strong foundation for students’ later academic achievement and life success. Mathematics assessments are used by both researchers and practitioners to capture this learning.

Assessments are used to both understand where students are initially in their skill level, as well as determining how much students have grown over a period of time. School professionals use such results to make placement decisions and to prepare appropriate instructional supports. Given these practical uses, assessments that either underestimate or overestimate students’ knowledge and skills may lead to inaccurate conclusions and practices. Therefore, it is important to understand the accuracy and quality of assessments that are commonly used to measure students’ mathematics achievement.

One widely used assessment is the KeyMath-3 Diagnostic Assessment (KeyMath-3 DA; Connolly, 2008¹), a comprehensive, norm-referenced measure that can be used for individuals ages 4 ½ to 21 years old. The KeyMath-3 DA was designed so that the items are directly aligned with the content and standards described in the National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics (NCTM, 2000)². Despite the widespread use of this diagnostic assessment, the measurement properties of the KeyMath-3 DA have not been examined at the item level.

The Study

Participants for this study included a diverse sample of 308 kindergarten through second graders, between the ages of five and eight (see Figure 1). Children were part of a larger study on the effectiveness of an after-school fine motor skills program that took place in eight schools in two states in the South and the Mid-Atlantic regions. This study uses test scores from the beginning of the school year prior to the start of

the after-school program.

Numeration, geometry, and measurement are the major foundational components of mathematics for young children (National Research Council, 2009)³. These three components are all measured as part of the KeyMath-3 DA. In this study, we first combined items from these three areas to form a measure of children’s Foundational Concepts (see Figure 2). These are the basic mathematical skills that children need to have in place prior to future learning. We then conducted item-level analyses on this measure to investigate the accuracy and quality of each item for assessing children’s conceptual understanding of mathematics.

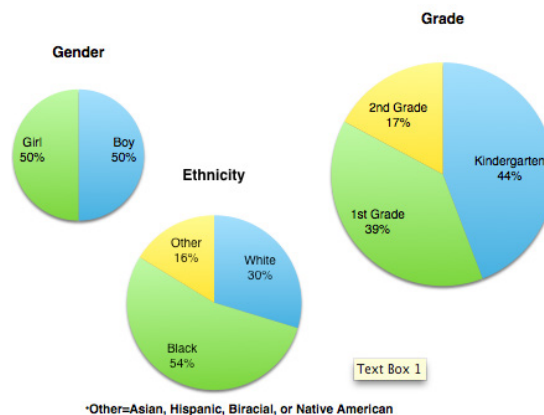


Figure 1: Participants Characteristics (N=308)

Findings

The most important finding was that all items on the Foundational Concepts measure worked collectively to assess children’s basic understanding of mathematical concepts. In other words, this measure was good at capturing foundational mathematical skills for most students.

At the same time, the results point to some issues to consider before making the decision to use this assessment for all children.

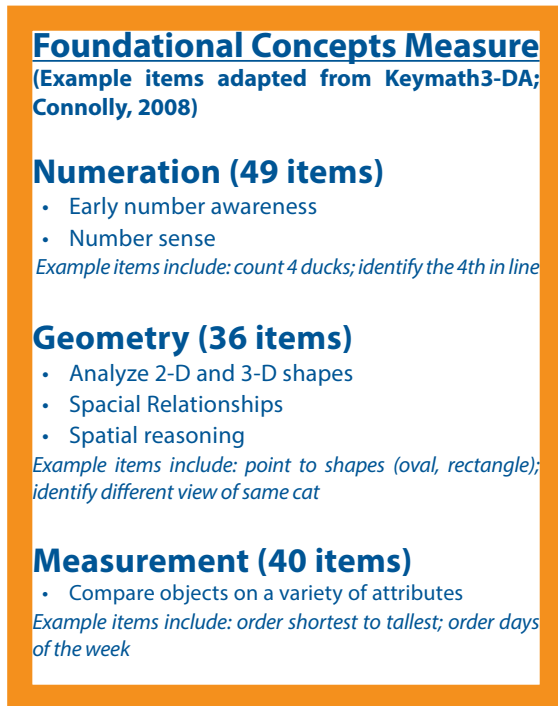


Figure 2

For instance, there are very few items (5 out of 125 items) that adequately distinguish between children at the lowest levels of mathematical ability in our sample. This suggests that for certain populations, such as children living in poverty, Foundational Concepts should be used in conjunction with other mathematics measures that are able to differentiate between students with low levels of mathematical understanding.

Like most similar measures, development of this measure led to items being ordered from easiest to most difficult. We found, however, that this ordering did not hold up for this sample of children. Children were sometimes able to answer more “difficult” problems, while not being able to answer “easier” ones. This suggests that the current ordering is not necessarily appropriate for the study sample. This is important because the test stops once a student answers four consecutive items incorrectly. Therefore, if items are not ordered from easiest to most difficult, the test may not accurately be measuring students’ ability levels. More investigation is needed in this area, especially because our sample included many children living in poverty, whose mathematics skills were low.

Practical Implications

Teachers and school psychologists are informally and formally assessing students throughout the year

to help identify specific areas where children need to be given opportunities to learn and practice their mathematics skills.

The KeyMath 3-DA is widely used, but prior to this study, item-level analyses have not been conducted on this assessment, to the best of our knowledge.

Taken together, our findings suggest that Foundational Concepts provides a good measure of students’ mathematical abilities in general. Yet this measure should be used with caution to support students with the lowest levels of mathematical conceptual understanding. Professionals may consider incorporating an additional assessment—perhaps one focused on informal mathematical knowledge—to help identify the specific math-related subskills on which children need further attention to improve.

Footnotes:

¹ Connolly, A. J. (2008). *KeyMath3-Diagnostic Assessment*. San Antonio, TX: Pearson.

² National Council of Teachers of Mathematics (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

³ National Research Council, Division of Behavior and Social Sciences and Education, Center for Education, Committee on Early Childhood Mathematics (2009). *Mathematics learning in early childhood: Paths toward excellence and equity*. Washington, DC: National Academies Press.

More Info:

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