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Understanding and Meeting the Challenge of Rigor

We are a nation consumed and driven by testing. There seems to be a test for every condition, desire, personality, and career choice. We seek to explain and identify who we are, and what we should do or become, by taking tests. Tests, frequently multiple-choice, are used to determine our capacity to perform in certain arenas of life. Clearly, schools are no exception to the test-taking phenomenon and are, perhaps, more consumed by testing than many other systems or institutions.

We are also a nation in a hurry. Time always seems to be a pressure point. In response to this apparent pressure, we expect tests to be rather brief in nature with short responses, and quick to score. While there is no inherent problem in administering or taking tests, difficulties arise when tests and their results are either not considered or are used as the only source to make decisions. These situations are especially problematic when the decisions made directly impact or control an individual's life. Issues now arise as to whether the test is reliable, valid, and unbiased. Is the very fine line between a score of 68 and 70 truly accurate enough to determine the placement of an individual adult or child? There is rarely something definitive derived from a single test.

National Assessments

Regardless of concerns that may be raised around testing, and the accuracy of the resulting decisions, testing for students is solidly embedded from the national level down. Individual states, individual districts, individual schools, and individual students are all defined by test results. The results can lead to praise and acclaim, or they can be devastating. Testing programs and test results greatly influence school decisions and actions at all levels. Testing is a reality that shows no signs of abating.

The Common Core State Standards are no exception to the pressures of testing either. Once the content is adopted into the individual state standards, the content is formatted into tests. Students are tested to determine their degree of mastery of the content. Yet there are issues being raised.

Within the Common Core Content Standards are the Standards for Mathematical Practice. These Standards are being widely distributed and the pros and cons are being discussed. Leaders and teachers are attempting to relate the Practices to instructional research. In July 2013, Presidents of the Conference Board of the Mathematical Societies (Conference Board of the Mathematical Sciences, 2013) put forth a statement of support for the Standards, noting, "If properly implemented, these rigorous new standards hold the promise of elevating the mathematical knowledge and skill of every young American to levels competitive with the best in the world, of preparing our college entrants to undertake advanced work in the mathematical sciences, and of readying the next generation for the jobs their world will demand." Furthermore, teaching strategies will need to shift to meet the demands of the Practices. For this reason, serious work is taking place to provide tests that actually assess students' conceptual understanding, thinking, and reasoning in mathematics.

Since curricular decisions are strongly influenced by state-administered tests as well as district-level ones, there are definite reasons to believe that this shift in assessment will also greatly influence curricular decisions. There is, nonetheless, a caveat. In general, state and district tests have greatly influenced the mathematics content that is taught. This testing impact has not been nearly as significant on instructional strategies. Now, with the Practices being assessed, instructional strategies must change if students are to perform even satisfactorily on the newly developed tests by Partnership for Assessment of Readiness for College and Careers (PARCC), Smarter Balanced, or individual states. If students are truly assessed on their thinking, reasoning, and problem-solving abilities, then they must spend significant time thinking, reasoning, and solving challenging problems.

Teacher Evaluation

The demand to shift instructional strategies to increase students' mathematical learning is rather intense by itself. Focused conversations and, hopefully, purposeful professional learning opportunities are occurring around the Standards for Mathematical Practice and the related instructional strategies that support the Practices in the classroom.

However, this is not the only demand that is surfacing. On a parallel path, and not tied to Common Core adoption, is a significant national trend concerning teacher performance. There is a tremendous push by a variety of stakeholders to directly relate teacher evaluation to student performance. This push is not about a general, nonspecific relationship between overall teachers' performance and students' performance, but rather specifically tied to a teacher and his or her students' progress, with students' progress being heavily, if not solely, defined by a test.

Teachers, understandably, have legitimate concerns about relating student performance with student assessment results. The relationship is difficult to accurately demonstrate using current testing techniques. Multiple-choice tests derived from specific content are fraught with accuracy issues when taken to an individual student level. The problem is greatly increased when tests are offered as a onetime event at the end of a school year.

The difficulties exist even if the tests are statistically valid and reliable. Issues related to student learning and multiple-choice test scores are numerous, but what happens when future technological advances allow for a wider variety of assessment formats, and more accurate tracking of individual student progress? We all shall quickly see because that future is here as PARCC, Smarter Balanced, and states continue to roll out various sample test items.

Learning Shifts

Teachers are faced with some very difficult and serious questions that cannot be ignored. With the trend of evaluating students at a conceptual level of learning and understanding, and with students' test results directly impacting teachers' evaluations, teachers need to carefully consider how to address the challenges. Addressing the forthcoming challenges requires thinking about teaching and learning in a whole different perspective—from the student's point of view. One thing is for sure, maintaining the current instructional approach—focused on teacher actions and reactions—will not prove a successful way of meeting the rising challenges. Yet teachers must not feel overwhelmed. Manageable, successful shifts that we describe in this book are achievable.

Meeting the Challenges

Common Core adoption is moving forward. The Standards for Mathematical Practice are moving forward. Assessment shifts are moving forward, and technology to support assessments is moving forward. Teachers,

mathematics leaders, and school leaders do not have time to waste; they too must move forward. Standing still and waiting to see what happens is just not a good decision. The signs are pointing in the direction that more challenging assessments are here.

While the issue of student performance and teacher evaluation will take many twists and turns, and appear in different states in varied ways, the issue shows no indication of fading. This issue, while certainly a concern, should not be the motivating force for teachers to change their instructional strategies to meet the demands of the Practices. The motivating force should be that there is only positive that comes from shifting instruction so that practically every student successfully learns mathematics. There is absolutely no downside to using the Practices to teach the Common Core content. When students are able to think and reason mathematically, and when they understand mathematical concepts and connections, they will excel on any form of assessment. Moreover, students greatly increase their chances of excelling in their selected career and open possibilities for more career paths when they understand mathematical concepts and connections. Attaining this type of mathematical rigor through incorporating the Practices is a win-win situation.

Looking at Assessments

To help understand what students are expected to be able to do on forthcoming assessments, some examples may prove helpful. These examples, while significant, do not display all the different ways technology allows for answer choices to be recorded. New technology provides answers that can be "dragged and dropped" into an answer format. Free responses may be "bubbled in" or recorded by hand. In some cases, where multiple choices are provided, more than one answer is correct, rather than just one of the A, B, C, or D choices. New assessment items will be dynamic and interactive. Two problem examples are provided in Box 1.1.

After reviewing these two problems, it is obvious that they are more challenging for students, and they are also the very types of problems our students should do. A "traditional" item similar to Example 2 might have shown the first figure and merely asked students to shade 1/6 of the figure. With the new wording of the problem, students must exhibit some type of spatial sense, an understanding of diagonals of a regular hexagon, possibly an understanding of perpendicular bisectors of a line segment, and the identification of equilateral triangles or kites. Newer

Box 1.1

Sample Problem 1

The five fastest recorded times without wind assistance for boys under the age of 18 in the 100-meter dash are the following: 10.19, 10.23, 10.24, 10.25, and 10.26.

If the five boys ran a race, explain how the results of the race would change if the timers used stopwatches that rounded to the nearest tenth.

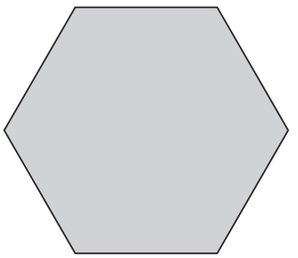
(Statistical times from: wikipedia.org/wiki/100_metres#Youth_.28under_18.29_boys)

Based on the times to the nearest hundredth, 10.19 is the fastest time. However, when rounded to the nearest tenth, the times become 10.2, 10.2, 10.2, 10.3, and 10.3, creating a three-way tie for first place.

Sample Problem 2

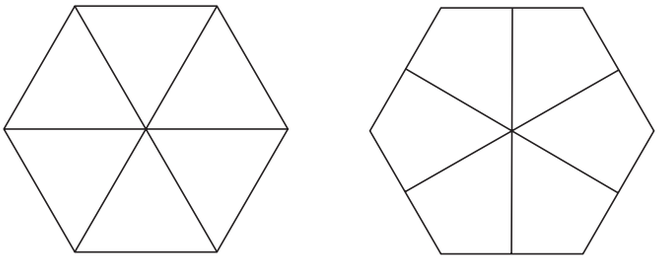
Mariana is learning about fractions.

Show how she can divide this hexagon into six equal pieces. Write a fraction that shows how much of the hexagon each piece represents.



(from http://www.ccsstoolbox.com/parcc/PARCCPrototype_main.html and http://www.parcconline.org)

Explanation: As noted by PARCC, this particular Grade 3 sample item addresses more than one content area of mathematics. In this case, Number and Operations—Fractions, Measurement and Data, and Geometry are all involved. There are at least two ways to partition the hexagon into six equal pieces with each piece having a value of 1/6. Two common solutions are shown here. In the first figure, students understand that the diagonals of a hexagon partition it into six equilateral triangles. Therefore, each equilateral triangle has a value of 1/6. In the second figure, bisectors of the parallel sides of the hexagon are constructed, creating six congruent kites. Each has an area of 1/6.



assessment items better indicate student understanding, and serve to resolve many of the difficulties outlined at the beginning of the chapter concerning limitations of multiple-choice tests.

Rigor as a Common Factor

The elements we have described—teacher evaluation shifts, assessment shifts, learning shifts—all have something in common. They demand that our students be engaged in a rigorous mathematics program. Rigor requires a deep understanding of mathematics, the type of understanding where students can transfer their learning to novel situations. This depth of understanding allows students to successfully meet new assessment challenges. Superficial exposure to skills will not lead to student success. Rigor, even though the term has been in the mathematics vocabulary for some time, has never been truly clarified. More important, rigor has not been defined in a way most educators commonly accept as accurate. Since there is no common acceptance, people use the term for their own purposes and with their own meaning. As a result, mathematics teachers and leaders have a difficult task gauging whether mathematical rigor is occurring in classrooms or if it is consistently being applied from classroom to classroom. However, with the Common Core content and Practices, that task is about to change. Rigor, then, must be explored and clarified.