

RIGOR

NARRATOR'S SCRIPT

CONTENTS

Introduction and Purpose	1
Key Concepts	1
Rigor	1
How to Match the Rigor of Assessment Items to the Rigor of Skills	2
How to Use Verbs to Determine a Skill's Level of Rigor	3
Tools to Help You Think About Rigor	4
How to Measure a Range of Student Thinking and Understanding	5
How to Use the Assessment Blueprint	6
Check for Understanding	7
Sources	9

INTRODUCTION AND PURPOSE

Rigor. That's what you bring to your instruction every day. You make sure that your students work hard and think hard each and every lesson. You also want to bring rigor to your assessments, which is why rigor is an element of assessment design.

Rigor is the focus of this module.

This module has several goals. By the end of this module, you should be able to (1) define what rigor means for the purpose of these modules; (2) use the verbs in standards and tools that teachers have available to identify the cognitive complexity in the relevant standards; (3) explain why assessments with an appropriate level of rigor also measure a range of student thinking and understanding; and (4) use the assessment blueprint to document the level of rigor of each skill you are measuring in assessments you write or select. The level of rigor of this module is high!

KEY CONCEPTS

Rigor

Let's get started.

For the purpose of this series of modules, rigor is the cognitive complexity of a skill within a standard or of an assessment item.

An assessment has "an appropriate level of rigor" if it includes items that match the level of rigor of the skill or skills you intend students to master. It also has an appropriate level of rigor if it measures a range of student thinking and understanding so that it measures what all students know and can do.¹

¹ Kansas State Department of Education, "Assessment Literacy Project"; Ohio Department of Education, "Assessment Literacy: Identifying and Developing Valid and Reliable Assessments" (2013); Relay Graduate School of Education,

We will explore these two aspects of rigor one at a time.

How to Match the Rigor of Assessment Items to the Rigor of Skills

To ensure that the rigor or cognitive complexity of each assessment item matches the rigor or cognitive complexity of the skill you intend it to assess, you can study the standard to determine the complexity of each skill embedded within it.

For example, let's consider the third-grade mathematics standard from Tennessee that we discussed in the module about alignment.

*Interpret whole-number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.*²

In the module about alignment, we unpacked this standard into a single skill: *Interpret whole-number quotients of whole numbers*.

We also explained that the item “*What is $12 \div 3$?*” is well aligned with the content of the standard because it asks students to work with the whole-number quotient of whole numbers. However, we cannot assume a student's mastery of this standard just because he or she answers it correctly. This is because the rigor of this specific item does not match the cognitive complexity of the standard.

The standard states that students must be able to *interpret* the answer to a division problem involving whole numbers, not simply calculate it. Interpretation and calculation require different skill sets. Interpretation is more complex than calculation.

An assessment would need to include a different item or additional items to measure whether students have mastered interpretation.

For example, here is an item that you might add to your assessment so that it measures mastery of the actual standard:

Suppose there are 4 tanks and 3 fish in each tank. The total number of fish in this situation can be expressed as $4 \times 3 = 12$.

a. Describe what is meant in this situation by $12 \div 3 = 4$.

*b. Describe what is meant in this situation by $12 \div 4 = 3$.*³

Designing and Evaluating Assessments (2014); and Rhode Island Department of Education, “Deeping Assessment Literacy.”

² Tennessee Department of Education, “Tennessee’s State Mathematics Standards: Grade 3” (2010).

³ “Fish Tanks,” Illustrative Mathematics.

Unlike “*What is $12 \div 3$?*,” this item asks students to interpret whole-number quotients of whole numbers within a real-life context.

This is what we mean when we say that the item has an *appropriate level of rigor*. In the above example, the cognitive complexities of both the item and the standard match.

How to Use Verbs to Determine a Skill’s Level of Rigor

It is easy to misjudge the rigor in a standard. One common pitfall is to use important words found in the standards to simplify complicated standards. For example, you might think of the standard in the previous example as “the division standard” for third grade and ignore the part of the skill in the standard that requires a student to *interpret* the answer to a division problem. A helpful tip that we will explore in this module is how to use the *verbs*, in the context of the standard as a whole, to determine a skill’s level of cognitive complexity.

For example, take this fifth-grade literacy standard from New York. Pay attention to the key verb “use.”

*Use the relationship between particular words (e.g., synonyms, antonyms, homographs) to better understand each of the words.*⁴

If you were to narrow the focus to only a couple of key words in the standard, you might focus only on synonyms and antonyms. If you have used a textbook to teach synonyms and antonyms, you might conclude that you have successfully addressed this standard. But what if the goal of the textbook is to do nothing more than help students *recognize* synonyms and antonyms, and it contains assessment items that test only recognition?

Here’s an example from that hypothetical textbook:

Which of the following words is an antonym of “tense”?

- a. *troubled;*
 - b. *calm;*
 - c. *concerned or*
 - d. *smooth*
-

This item does not measure mastery of the New York standard because it does not ask students to *use* the relationship between antonyms to better understand each of the words.

Here’s an example that can measure mastery of this standard.

Read the passage below. Then answer the question.

⁴ New York State Department of Education, “New York State P-12 Common Core Learning Standards for English Language Arts & Literacy” (2010).

Last year my family went to a national park for our vacation. We saw wild animals that we had seen only in books, and we were amazed by the landscape of trees and rivers. The highlight of the trip was an **arduous** hike we took to the top of a small mountain. Though the hike was not easy, due to all the loose rocks and exposed roots on the path, the spectacular view from the top was worth it!

What does the word "arduous" mean in this passage?⁵

This item can measure mastery of this standard because students must *use* their understanding of antonyms to better understand an unfamiliar word. In this case, a student who does not know the definition of the word "arduous" can look for clue words in the surrounding sentences to infer from the context that "easy" means the opposite of "arduous." An appropriate student response might be "difficult." Instead of just *recognizing* an antonym from a list, as in the previous example, this assessment item requires students to *use* their understanding of these relationships between words to improve reading comprehension.

Tools to Help You Think About Rigor

You may be familiar with the different tools experts have developed to help you think about rigor. For example, Webb's Depth of Knowledge levels categorize rigor into four levels. Level 1 skills, such as recalling and matching, require the lowest level of understanding. Level 4 skills, such as creating and analyzing, require the deepest level of understanding.⁶ If Webb's Depth of Knowledge levels are unfamiliar to you, pause this video and take a moment to think about the different skills in each level.

Bloom's Taxonomy is another tool to help you think about rigor. It categorizes cognitive skills into six levels: (1) remembering, (2) understanding, (3) applying, (4) analyzing, (5) evaluating and (6) creating. Lower-order thinking skills, such as remembering, understanding and applying, appear at the bottom of Bloom's Taxonomy. Higher-order thinking skills, such as analyzing, evaluating and creating, appear at the top of the taxonomy.⁷

For simplicity, we will use only one tool in this module series: Bloom's Taxonomy.

You can find online several resources to help you categorize verbs according to Bloom's Taxonomy. For the sake of example, this chart lists a few verbs representative of each level of rigor. For example:

- Level 1, "remember," includes verbs like "recognize" and "recall."
 - Level 4, "analyze," includes verbs like "differentiate," "organize" and "attribute."
 - Level 6, "create," includes verbs like "generate," "plan" and "produce."⁸
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⁵ "Part 6 Language, 6.3 Vocabulary Acquisition and Use: Antonyms," The McGraw-Hill Companies.

⁶ Mississippi Department of Education, *Webb's Depth of Knowledge Guide: Career and Technical Education Definitions* (2009).

⁷ Moody, Michael, and Jason Stricker, *Strategic Design for Student Achievement* (2008).

⁸ Ibid.

This chart and others like it can help you differentiate between a multiple-choice item that asks students to *recognize* an antonym of “tense,” which is a level 1 skill, and an item that asks students to *use* the relationship between antonyms to better *understand* each of the words, which is a level 2 skill.

Let’s use Bloom’s Taxonomy to practice using key verbs to determine a skill’s level of rigor. What are the key verbs in this sixth-grade literacy standard from Rhode Island? What do these verbs tell us about the cognitive level or levels of the skills in the standard? Does the standard contain other evidence that provides information about the cognitive level or levels required to master this standard?

*Integrate information presented in different media or formats (e.g., visually, quantitatively), as well as in words, to develop a coherent understanding of a topic or issue.*⁹

The key verbs in this standard are “integrate” and “develop.” Both of these verbs are associated with the ability to “create,” a level 6 skill that requires higher cognitive demand. The standard is succinct and does not contain additional information about the cognitive level required to master the standard.

How to Measure a Range of Student Thinking and Understanding

In addition to each assessment item matching the level of rigor of the skill you intend to measure, an assessment with an appropriate level of rigor measures a range of student thinking and understanding so that it measures what all students know and can do. If assessments are too easy, some students may not have the opportunity to demonstrate the upper bounds of what they know and can do. Assessments should include items that challenge all students. You may refer to these questions as “stretch” questions because they require students to push themselves to the upper bounds of what they know and can do. On the other hand, if assessments are too complex, some students may not be able to showcase their knowledge and skills at all. Assessments should include items that require lower-level thinking to reveal where learning breaks down among students struggling to master a standard.

You can organize items sequentially in order of difficulty so that students can feel successful early in the assessment and more challenged as they progress. You might include the most difficult questions in a separate bonus section to motivate more advanced students and not discourage others.

For example, let’s look at an assessment based on a seventh-grade mathematics standard from Texas that addresses percentages.

The standard reads:

*The student solves problems involving direct proportional relationships. The student is expected to estimate and find solutions to application problems involving percent; and estimate and find solutions to application problems involving proportional relationships such as similarity, scaling, unit costs, and related measurement units.*¹⁰

⁹ Rhode Island Department of Education, “Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects” (2010).

¹⁰ Texas Education Agency Student Assessment Division, “Grade 7 Mathematics Assessment” (2010).

You might measure a range of levels of rigor with an assessment aligned with this standard.

For example, notice how these assessment items gradually increase in rigor.

The assessment starts with a question that requires lower-ordering thinking, that is, “What is 67 percent of 81?” and ends with a question that requires higher-order thinking, that is, “Christine argued that if Adam and Jamie each made their next 10 shots, their shooting percentages would go up the same amount. Is this true? Why or why not? Describe in detail how you arrived at your answers.”¹¹

One of the main verbs in this standard is “solve,” which, according to Bloom’s Taxonomy, requires lower-order thinking. The standard also indicates that students should be able to estimate and find solutions to application problems involving percent and proportional relationships, which calls for higher-order thinking.

This assessment includes some straightforward calculation problems that can help you identify students who may not understand how to calculate percentages and students who got lost at a later step in the multi-step problem.

How to Use the Assessment Blueprint¹²

Let’s use the assessment blueprint and assessment blueprint example to document the level of rigor in several skills and identify possible types of assessment items you might use to measure those skills.

Imagine that you are a fifth-grade teacher planning a unit focused on reading and writing about informational texts. You expect the unit to last approximately four weeks.¹³

At the end of the unit, you plan to use a summative assessment to measure how well your students have mastered the relevant standards.

You have determined that the unit will focus on four reading informational text standards and one writing standard. You have “unpacked” the standards to identify and paraphrase the skills you plan to teach and assess.

Step 4 of the assessment blueprint asks you to identify the level(s) of rigor of each standard or skill you plan to assess.

Try to use Bloom’s Taxonomy to identify the levels of rigor in each of these skill. Use the verbs in each standard and skill to guide you, but keep in mind that the meaning of the verbs, and therefore the levels of rigor, depend on the context of the standard.

¹¹ Paul Bambrick-Santoyo, “Data in the Driver’s Seat” (2007–2008).

¹² Adapted from Ohio Department of Education, “Assessment Literacy: Identifying and Developing Valid and Reliable Assessments” (2013).

¹³ Ohio Department of Education, “Ohio’s New Learning Standards: English Language Standards” (2010); Student Achievement Partners, “Mini-Assessment for *Who Was Marco Polo?* by Joan Holub and *The Adventures of Marco Polo* by Russell Freedman” (2014).

Pause this video if you want a few moments to think about your answer or discuss it with colleagues.

We suggest that the levels of rigor for each of the six skills are 1, 2, 2, 4, 5 and 5, respectively. You may have reached a slightly different conclusion, and that's okay. What's important is taking the time to consider the level of rigor of each skill you will assess, not getting the "right answer" or filling out the blueprint template for its own sake. In this case, the process you go through to determine the level of rigor for each skill on your assessment can help you even better understand the content of the standards you plan to assess and teach.

Once you determine the level(s) of rigor within a standard, you can consider the implications for how best to assess that standard.

Higher-order cognitive skills lend themselves more to robust assessment types like constructed-response items and performance tasks.

Step 5 of the blueprint asks you to document possible types of items you may use to assess each skill.

We suggest that you may use selected- and constructed-response items to address the first four skills and constructed-response items or performance tasks to address the final two.¹⁴ (Remember that to answer selected-response items, students select the correct answer from a list of options included in the item; to answer constructed-response items and to complete performance tasks, students perform tasks to demonstrate their mastery of particular skills.)

You can often efficiently assess lower-order skills through selected-response items and use constructed-response items and performance tasks to assess higher-order cognitive skills. However, this is not a hard and fast rule. You can also use a well-designed selected-response item to assess higher-order cognitive skills.

CHECK FOR UNDERSTANDING

We have addressed the key concepts in this module, so let's review our goals.

At the outset of the module, we set goals that you would be able to (1) define what rigor means for the purpose of these modules; (2) use the verbs in standards and tools that teachers have available to identify the cognitive complexity in the relevant standards; (3) explain why assessments with an appropriate level of rigor also measure for a range of student thinking and understanding; and (4) use the assessment blueprint to document the level of rigor of each skill you are measuring in assessments you write or select.

To determine whether we have achieved our goals, let's check your understanding with two assessment items.

Here's the first item:

¹⁴ Student Achievement Partners, "Mini-Assessment for *Who Was Marco Polo?* by Joan Holub and *The Adventures of Marco Polo* by Russell Freedman" (2014).

Using Bloom's Taxonomy, identify the level or levels of rigor in this standard from Iowa. Remember to pay close attention to the verbs.

Understand the use of geographic tools to locate and analyze information about people, places, and environments.¹⁵

Pause this video if you want a few moments to think about your answer or discuss it with colleagues.

A sample answer to the first item would be: The key verbs in the skills in this standard are "use" and "analyze," which are associated with lower- and higher-order skills. "Understand" is a level 1 skill, and "analyze" is a level 4 skill.

Here's the second item:

Explain in your own words why well-designed assessments should measure a range of student thinking and understanding.

Pause this video if you want a few moments to think about your answer or discuss it with colleagues.

A sample answer to the second item would be: Well-designed assessments include items with various levels of rigor to ensure that they measure what all students know and can do. If assessments are too easy, some students may not have the opportunity to demonstrate the upper bounds of what they know and can do. I should include items in my assessment that challenge all of my students. On the other hand, if assessments are too complex, some students may not be able to showcase their knowledge and skills at all. I can include items that require lower-level thinking to reveal where learning breaks down among students struggling to master a standard.

Good work! Thank you for completing the module on rigor. Please view additional modules to continue your learning.

¹⁵ Iowa Department of Education, "Iowa Core K-12 Social Studies" (2010).

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