



College and Career Readiness Standards-in-Action

Foundational
Unit

3

FACILITATOR GUIDE
MATHEMATICS

**ENGAGING THE
THREE COMPONENTS
OF RIGOR**

Produced Under U.S. Department of Education
Contract No. ED-VAE-13-C-0066 With StandardsWork, Inc.

2016

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Background and Purpose

The College and Career Readiness (CCR) Standards for Adult Education exemplify three key advances in instruction prompted by the Common Core State Standards (CCSS). This unit provides adult educators an introduction to *rigor*, the third of these three advances. The CCR Standards are a rigorous set of expectations. Rigor, as defined in the standards, involves more than including expectations that are challenging, difficult, or complex. Rigor in the CCR Standards is exemplified by the pursuit of conceptual understanding, procedural skill and fluency, and rigorous application of mathematics in real-world contexts—all with equal intensity. Surveys of employers and professors of entry-level college mathematics courses indicate that college- and career-ready students need to have this balanced repertoire to ensure rigorous instruction.¹

Research indicates that it is not enough for students to know how to perform mathematical procedures by rote. Nor is it enough for them to understand mathematical concepts. They must be able to use those concepts to solve problems. Students with solid conceptual understanding see mathematics as more than a set of procedures. They know more than “how to get the answer.” They can use appropriate concepts and procedures, even when not prompted, in content areas outside of mathematics.

The word “understand” is used frequently in the CCR Standards to set clear and explicit expectations for conceptual understanding of a range of mathematical topics. The CCR Standards also include expectations that require speed and accuracy in calculations using all number systems and opportunities for students to apply

¹ *Ready or Not: Creating a High School Diploma That Counts*. American Diploma Project, 2004; and 2009 ACT National Curriculum Survey.

mathematics in context. Examples include calculations related to geometric figures involving rational number measures; the calculation of probabilities as fractions, decimals, or percentages; and statistical analysis of rational data.

There are also frequent references to students' solving real-world and mathematical problems. The Standards for Mathematical Practice, which are an integral part of the CCR Standards, reinforce rigor by calling for students to attend to precision (which involves calculating accurately and efficiently), model with mathematics, and use mathematics to make sense of and solve problems.

This unit prepares participants to relate rigor to the focus concepts of each level and to the progressions in content across the levels. Participants also learn the importance of the three components of rigor in teaching students to go beyond merely producing correct answers to being able to address and apply mathematical concepts using different perspectives.

Overview

This unit will allow participants to investigate the three components of rigor. It will teach participants how to recognize each component of rigor from the language of the standards, and how to make important connections among these components in instruction.

Participants will search selected CCR Standards for clues concerning which of the components of rigor seem to be expected. For example, at various levels, specific content standards use the word “fluently,” which means “quickly and accurately.” These refer to procedural skill and fluency. If a standard requires that students know a definition or use a memorized procedure, then again the targeted standard is procedural skill and not conceptual understanding.

However, if a standard requires explanations, analogies, comparisons, contrasts, or interpretations, it is aimed at assessing conceptual understanding.

Several standards refer explicitly to real-world problems, but there are also examples of purely mathematical applications. For example, after learning to rewrite polynomial expressions by combining like terms (a procedural skill), a student may be asked to apply that skill to finding the factors of a quadratic expression by splitting the linear term into two like terms and then finding the common factor for each pair. Application, as a component of rigor in the CCR Standards, is more than simply solving a verbal problem. In this sense, applications might be contextual (real-world), or purely mathematical.

The goal for participants is to discern the full meaning of each standard. Understanding the demands of a standard will allow them to confirm that the requirements of the standard have been met.

Some common misconceptions about rigor also will be addressed. They include the belief that:

- “Rigor” means the required mathematical technique must be complex, as opposed to requiring complex thinking;
- “Real-world” means “everyday,” as opposed to “connected to problems presented in contexts that might, or might not, be academic”; and
- “Rigorous” means “difficult.”

During the activity, small- and large-group discussions will help participants gain a clear and shared understanding of the three components of rigor and what it means to engage each of the three components with equal intensity.

Materials You Need

For Participants (one copy per participant):

- Directions for Participants
- Worksheet: Engaging the Three Components of Rigor
- Resource: CCR Standards for Adult Education (one copy per table)

For Facilitators:

- Unit 3 PowerPoint Presentation: Engaging the Three Components of Rigor
- Answer Key: Engaging the Three Components of Rigor

Time Frame to Complete the Unit

Allow **60 minutes** to complete this unit, using the following guidance to help divide the time:

- 15 minutes – Introduce the unit.
- 30 minutes – Work in pairs or small groups to complete the activity.
- 15 minutes – Discuss reflections.

NOTE: Participants who are unfamiliar with the CCR Standards for Mathematics will need more time to complete the activity. They will need this time to closely read and understand the standards involved in the rigor activity.

Guidelines for Implementation

Step 1: Preparations

- a) **Create small groups of participants, ideally with four to eight participants at each table.** The maximum size of a group for this session depends on your space, need, and comfort level. A guiding principle

is to make sure the group is small enough that you can be in touch with each table of participants to determine whether they understand the concepts and are fully engaged or they are struggling and need more support.

- b) **For best results, select table leaders in advance or ask each table of participants during the session to choose one person to be their lead.** The table leader will be responsible for keeping track of time, bringing participants together at the appropriate times, making sure participants are moving along, sharing information at appropriate times, and notifying you if there are questions or the group needs more support. (If table leaders are selected in advance, provide them with copies of the PowerPoint Presentation, handouts, and answer key so they can prepare for the session.)
- c) **As a general strategy, be prepared to circulate around the room when participants are working individually or in pairs.** Circulating will allow you to check on their understanding and be readily available to answer questions.
- d) **Prepare the materials for participants.** Provide a single copy of the CCR Standards for each table. In advance of the session, advise participants who think they might need their own copy of the CCR Standards to bring it with them.
- e) **Become familiar with the PowerPoint Presentation and materials, including the answer key.** This will allow you to be at ease with the information and flow of the unit. Detailed notes are provided within the PowerPoint Presentation to help you prepare for the session. In particular, notes for each slide include the identification of the Big Idea, Facilitator Talking Points, and Facilitator Notes. These can help you frame your presentation and provide you important detail and

context. This information is coupled with that offered in this Facilitator Guide—including the research base, rationale, advice, and other guidelines—to give you the support and guidance you require.

Reviewing the answer key will also support your efforts to stimulate discussion about rigor, its three components, and how the components relate to one another. The answer key is for your edification and is not meant to be handed out to participants. It includes “right” answers, but not necessarily the only right answers; it includes well-supported judgments that will guide you as you reflect on participant questions and answers. Participants may have other interpretations, and these should be considered and discussed.

Step 2: Implementation (15 minutes to introduce; 30 additional minutes working in pairs or small groups)

Introduce the three key advances in the CCR Standards for Mathematics.

Slide 2: Discuss with participants the three key advances and how they interact and build up to college and career readiness. While Unit 3 emphasizes *rigor*, which is Key Advance 3, it is important to understand that the CCR Standards were developed to reflect and exemplify the three key advances of *focus*, *coherence*, and *rigor*.

Remind participants that in Unit 1 they learned about *focus* and used the Major Work of the Levels resource to become familiar with the topics emphasized within each CCR level. In Unit 2, they learned about *coherence* and how the CCR Standards are designed with a flow and progression of content within and across levels, grounded in the major work of the levels. Unit 3 introduces the concept of *rigor* and clarifies for participants that the CCR Standards were developed to ensure that students develop conceptual

understanding, procedural skill and fluency, and the ability to apply their mathematical understandings and skills to solve problems. Regular work with the Standards for Mathematical Practice (a focus of Unit 4) reinforces the elements of *rigor* addressed in Unit 3. It is the interaction of these key advances of *focus*, *coherence*, and *rigor* within the CCR Standards, coupled with the Standards for Mathematical Practice, that results in a set of standards that will prepare adult learners for college and careers.

Introduce the concept of rigor in mathematics instruction.

Slide 3: Explain the objectives of the unit: 1) to learn how the three components of rigor are meant to work together; 2) to understand the importance of each of the three components in teaching students to go beyond merely producing correct answers to being able to apply mathematical concepts from different perspectives; and 3) to clear up common misconceptions about rigor.

Slide 4: Tell participants that a number of surveys of employers and professors of first-year, credit-bearing mathematics courses have been conducted. Results indicate the importance of all three aspects of rigor. While it is important for students and employees to be able to perform basic calculations and procedures accurately and quickly, knowing more than how to get the right answer is important. Conceptual understanding and the ability to use mathematics to understand and solve problems are also important.

Slide 5: Implementing the CCR Standards in adult education will have implications for classroom instruction. Participants need to understand that rigor has a close connection to the other key advances (*focus* and *coherence*). Building students' deep conceptual understanding, procedural skill and fluency, and the ability to solve problems must be connected to those concepts

that are most crucial for students to learn at each level. The examples described in the Facilitator Talking Points for Slide 5 are intended to clarify for participants what the three components of rigor mean when operationalized on a lower-level math concept ($7 \times 8 = 56$).

Begin the hands-on activity of Engaging the Three Components of Rigor.

Slides 6-7: *Distribute the participants' materials for Engaging the Three Components of Rigor.* This includes directions for participants, the Engaging the Three Components of Rigor worksheet, and one copy of the CCR Standards for Adult Education for each table of participants.

Slide 8-9: *Provide directions to participants on how to complete the activity.* Have table leaders divide their groups into twos or threes for this activity. Then, check in with the whole group to make sure all instructions are clearly understood before beginning the activity.

Here are the directions to give participants:

1. Check the component(s) of rigor that are likely to be required in a lesson, activity, or task that targets each CCR Standard on the Engaging the Three Components of Rigor worksheet. Make notes about your rationales.
2. Discuss your reasoning at your table, using these questions to guide your discussion:
 - What makes you think a particular component of rigor applies?
 - Are there certain words or phrases in the standard that provide clues?
 - Which components of rigor might appear together in a single standard? Explain.

- Which components of rigor are not likely to appear together in a single standard? Explain.

Reflections: Thinking Back and Looking Forward (15 minutes)

Slide 10: Bring the whole group together to share insights gathered from the small-group discussions. Ask groups at the tables to share their thinking about the connections they made between the content standards and components of rigor. Use the following guiding questions to stimulate discussion on the common misconceptions about rigor:

- How do you define “real-world” in application problems? *“Real-world” does not mean “everyday”; rather, it means problems presented in contexts that might or might not be academic.*
- Is it enough to give very difficult problems to students to advance rigor in a lesson? *No, “rigor” does not mean that the required mathematical technique must be complex. Rather, “rigor” means the technique requires complex thinking.*
- How can we separate difficulty of technique from rigorous thinking? *We must understand that they are two different characteristics of problems. “Rigor” is not synonymous with “difficulty.”*
- Did your understanding of the meaning of “rigor” change as a result of this activity? If so, how?

Slide 11: After participants complete the hands-on activity, ask them to reflect on and then discuss what they have learned. Ask them also to consider how they plan to use

what they have learned. Below are some questions for participants' reflections on their next steps:

- How has participating in this activity changed your thinking about the CCR Standards?
- How will you use the information and understanding you have acquired to improve your teaching practice and student learning?
- What additional training or tools would strengthen your ability to do so?

Once participants understand the need for a clear focus on the major work of each level, coherent progressions within and across the levels, and rigor in the mathematics curriculum, the next priority is to focus on the Standards for Mathematical Practice. The Standards for Mathematical Practice reflect important processes and proficiencies with long-standing importance in mathematics education, such as problem-solving, reasoning and proof, and precise communications. The Standards for Mathematical Practice do not and cannot exist in isolation. One engages the Standards for Mathematical Practice only through mathematical content. In Unit 4, *Connecting Standards for Mathematical Practice to Content*, participants will learn how to integrate the Standards for Mathematical Practice into lessons related to specific content.