Louisiana Believes

Common Core State Standards for Mathematics

TEACHER SELF-LEARNING SERIES

Module 4

A First Look at the Standards for Mathematical Practice

DEPARTMENT of EDUCATION
Louisiana Believes

COMMON CORE STATE STANDARDS for Mathematics

TEACHER LEARNING SERIES

Module 4: A First Look at the Standards for Mathematical Practice

Time Frame: Approximately 2 hours. This module is designed so that some videos are to be viewed by all learners. For others, learners will choose one video to view for each of seven practices. The length of each video and the number of times that a video is watched will affect the time needed for this module. The time frame provided is based on viewing each video once. It is not necessary that this module be completed in one session.

Audience: Teachers, principals, and additional school faculty of all grade levels and all content areas (having a partner or completing this module in a small group would be beneficial)

Module Description: This module assumes that the information presented in previous modules is well known to the learner. Module 4 is the first of three modules (4, 5, and 6) designed to provide an in-depth look at the Standards of Mathematical Practice which are part of the Common Core State Standards for Mathematics. Module 4 focuses on developing an initial understanding of the Standards by Mathematical Practices by closely examining the wording of the descriptions for each practice and viewing instructional videos in which evidence of a practice can be found.

Course Objectives: By the end of the module, the learner will be able to:

a. identify the roles that teachers and students play when Standards for Mathematical Practice are implemented.
b. find examples of use of a practice when viewing an instructional video.

Materials Needed to Complete Module: copy of the Common Core State Standards for Mathematics, access to the Internet, The Standards for Mathematical Practice in bulleted format posted at http://tinyurl.com/ay9n5du (optional)

Pre-Assessment: Those who can answer the questions below with confidence may want to skip this module.

1) How is the role of teacher when implementing the Math Practices different than the expected role of the past?

2) What is the primary role of the student in implementing the Math Practices?

3) Define each of these phrases and terms as they are used in the Math Practices: persevering in problem solving, reasoning abstractly, viable argument, modeling, precision, make use of structure, express regularity in repeated reasoning.

Primary Resource: Instructional Videos

http://www.insidemathematics.org/index.php/commmon-core-math-intro

Introduction

The Standards for Mathematical Practice (often referred to as Math Practices) start on page 6 of the Common Core State Standards for Mathematics (CCSSM) document. The first paragraph has been copied below and provides information relative to the purpose and foundation of the Math Practices.

> ***The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students****[emphasis added]. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).*

While the ideas behind the Standards for Mathematical Practice are not new, implementation of the practices are critical to implementation of the shift of Rigor. It is through the Math Practices that deep conceptual understanding, fluency and procedural skill, and application are attained.

The eight Standards of Mathematical Practice are listed below.

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Watch the video, *The Importance of the Mathematical Practices*, posted at http://tinyurl.com/akwogba to get an overview of these standards.

Understanding the Math Practices in Terms of Student and Teacher Roles

The wording of some of the practices could be interpreted in many ways, depending on a person's understanding of some of the terms used. For example, "model with mathematics" has been interpreted by some as "the teacher demonstrates how to do something and then the student mimics the process." This interpretation is the result of the way that mathematics has typically been taught in many classrooms for centuries. Fortunately, the CCSSM writers have elaborated on the meanings of the Math Practices by

providing descriptions for each one. The descriptions give us insight as to student and teacher behaviors when practices are implemented in the classroom.

Self-Check: Read the first three words in each of the Math Practices' descriptions. Who are the standards describing? (See self-check answers on page 6 of this module, if needed.)

The Importance of the Verbs in the Math Practices

Dev Sinha, a contributor to the Illustrative Mathematics project, was invited to post his thoughts relative to the use of verbs in the Math Practices on the *Tools for the Common Core* blog. Dr. Sinha writes:

> *Mathematical objects are key components of content standards. Practice standards on the other hand describe student actions. Thus while we usually pay attention to nouns in content standards, for practice standards we must pay attention to verbs.*

The complete text of Dr. Sinha's post is available at http://commoncoretools.me/2013/02/09/attend-to-the-verbs-in-the-mathematical-practices/. Jason Zimba, a CCSSM author, responds to reinforce Dr. Sinha's ideas; however, Dr. Zimba points out that verbs are also important in the content standards and gives several examples. Thus, while the verbs are critical to understanding student proficiencies and behaviors, they have roles in both the content standards and the practices.

Read the description for Math Practice 1 (copied below) and focus on the highlighted verbs or other behavioral words as recommended by Dr. Sinha.

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

Reflection Time

Imagine this standard at work in the classroom. If you are a teacher, it's best to think of what you might see in your classroom when teaching a particular topic or lesson. If you are not a classroom teacher, think about a classroom in some grade level/course with which you are familiar. Commit your thoughts to paper by jotting down answers to these questions with reference to Math Practice 1:

- What would the students be doing?

- What would the teacher be doing?
- Based on what students and teachers would be doing, what are the roles for each of these groups if Math Practices are to be implemented effectively?

These questions will be revisited in the next section.

Finding Classroom Evidence Using Instructional Videos

A collection of videos posted at www.InsideMathematics.org has been aligned to the Standards for Mathematical Practice. Watch the video posted at http://tinyurl.com/ahe64ow which is aligned to Math Practice 1. Many of the verbs from the description of this practice have been transferred to the chart below. While watching the video, decide how the task assigned by the teacher fits with the intent of this practice. Record your findings in the Student Action and Teacher Action columns of the chart as you see evidence that relates to one of the verbs. Remember that the verbs are related to making sense of problems and persevering. You may add to the list, if needed. Some behaviors may not be seen in the video, and there may be multiple examples for some desired behaviors. You may want to view this video more than one time to ensure your understanding of what the verb means.

VIDEO EVIDENCE FORM		
Math Practice # 1		
	Video Examples	
Verb	**Student Action**	**Teacher Action**
Explain		
Look for		
Analyze		
Plan		
Consider		
Try		
Change		
Rely		
Check		
Understand		

Self Check: See page 6 for possible answers.

Continue with the process of reading the remaining Standards for Mathematical Practice, focusing on the verbs and what they mean in the context of each standard, and then viewing an instructional video to help bring meaning to each practice. Suggestions to make this exercise more beneficial.

- Use the bulleted format at http://tinyurl.com/ay9n5du for ease in reading.

- Review the video for your grade or a nearby grade if one is available.
- If possible, engage with a colleague when viewing of these videos and discuss the evidence seen.
- Use the blank form provided on page 7 of this module to record your findings.

Links to Math Practice videos are posted at http://www.insidemathematics.org/index.php/commmon-core-math-intro.

Self Check: Once student and teacher actions have been analyzed for all Math Practices, the most critical question remains to be answered:

> Based on what students and teachers are doing in each of these videos, what are the roles for students and teachers if the Standards for Mathematical Practice are to be implemented effectively? (See self-check answers on page 6.)

Closing

Watch the video posted at http://vimeo.com/30924981 featuring Dr. Phil Daro as he discusses methods that promote "answer getting" rather than development of the understanding required by the Standards for Mathematical Practice.

Assignment

Return to the PreAssessment. You should now be able to answer questions with ease. You may want to use the descriptions found in the Math Practices when answering item 3 as it generally takes more than one reading to internalize the meanings. Meanings become more evident with experience and additional study.

Up Next

Module 5 will be a continuation of the study of the Standards for Mathematical Practice with a focus on connecting the practices to the content of the CCSS.

Self-Check Answers

Page 3: The Standards for Mathematical Practice describe "mathematically proficient students." In other words, they provide the desired characteristics and behaviors that mathematically proficient students should exhibit.

Page 4: Possible answers are provided below for the video on Math Practice 1, but answers may vary.

VIDEO EVIDENCE FORM		
Math Practice # 1		
	Video Examples	
Verb	**Student Action**	**Teacher Action**
Explain	Multiple instances of students indicating the steps that they took in solving the problem. For example, the little girl in pink explained how she used counting up to find the answer to the subtraction problem.	The teacher developed the task and determined what students were to discuss upon completion. She copied the students' work so that they could not change it in the course of the discussion. She established that a pair share (dyad) would be the instructional strategy. It was evident that students had used dyads before as a student could tell her what the focus of the discussion was to be. The teacher gave explicit instructions. She had students switch after a given amount of time so that each person could contribute. Since this video consists of clips from the activity lesson, it is not evident what actions the teacher took as students worked and discussed.
Look for		
Analyze	The little girl in pink stressed the word *more* when her partner asked her how she got the answer.	
Plan		
Consider	Students listened to each other and considered their partner's solution to determine if the process was logical and accurate.	
Try		
Change		
Rely	The little girl in pink told the boy to draw pictures to help him understand what his mistake was.	
Check	The little girl in pink counted on her fingers to "show" her partner that 12 minus 8 was four.	
Understand		

Page 5: The students' primary role is to do the math. The primary role of the teacher is to develop lessons with tasks that allow students to develop the characteristics and behaviors of mathematically proficient students over time. The teacher's role once the task has been given to the students is to act as a facilitator of learning by questioning, encouraging, monitoring, etc.

VIDEO EVIDENCE FORM		
Math Practice # ____		
	Video Examples	
Verb	**Student Action**	**Teacher Action**