As you arrive…

- Review the handout with the descriptions of the eight Standards for Mathematical Practice (SMP).

- Choose at least one SMP and describe it in your own words in one or two sentences.

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Interpreting the Standards for Math. Practice

Paul Goldenberg, Al Cuoco, Mark Driscoll, June Mark, Deborah Spencer, Katherine Schwinden, Victor Mateas, **Johannah Nikula**, Matt McLeod, Jane Kang, Mary Fries

Advisors: *Diane Briars, Dan Chazan, Brad Findell, Bill McCallum, Barbara Reys, Mike Shaugnessy*

The Implementing the Mathematical Practice Standards project is supported by the National Science Foundation under Grant No. DRL 1119163. Any opinions, findings, and conclusions or recommendations expressed are those of the author and do not necessarily reflect the views of the National Science Foundation.

Project Goals

- Increase awareness of the Standards for Mathematical Practice (SMP)
- Support understanding of the SMP connected to content standards
- Cultivate capacity to identify these SMP in student thinking
- Support teachers to plan instruction to support these SMP

Plan for Session

- ***Background:*** Learn about resources we are developing to support teacher learning about the standards for mathematical practice (SMP)
- ***Math Task:*** Engage as learners in an experience of one mathematics task then discuss how we used habits of mind aligned with the SMP.
- ***(Introduce Lesson Planning Protocol if we have time.)***
- ***Part II (9:30-10:30):*** Look at student dialogue on this task.

Illustrations of the SMP

- 30+ Illustrations developed and reviewed to date
  (mathpractices.edc.org; see bookmark with QR code)

- Range of mathematical tasks, some more open-ended

- Grade levels from 5-10
- Number, algebra, geometry, data and statistics

- Multiple SMP identified in each dialogue
- Several Illustrations that address each SMP

Implementing the Mathematical Practice Standards

7. Look for and make use of structure.

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Need help understanding the mathematical practices?

Explore this site to learn more about the Common Core Standards for Mathematical Practice (SMP) and how they can be connected to the content standards. Use our Illustrations, centered on student dialogues, to see the Standards for Mathematical Practice in action.

See All Illustrations

About Illustrations

Each Illustration of the Standards for Mathematical Practice (SMP) consists of a mathematics task; a student dialogue based on that task; information about grade level, standards, and the context for the dialogue; teacher reflection questions; a mathematical overview; and optional student materials. While the primary use of Illustrations is for teacher learning about the SMP, some components are designed for classroom use with students. Go to "Browse Illustrations" to find Illustrations for particular SMP.

Web Survey

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Spotlight on...

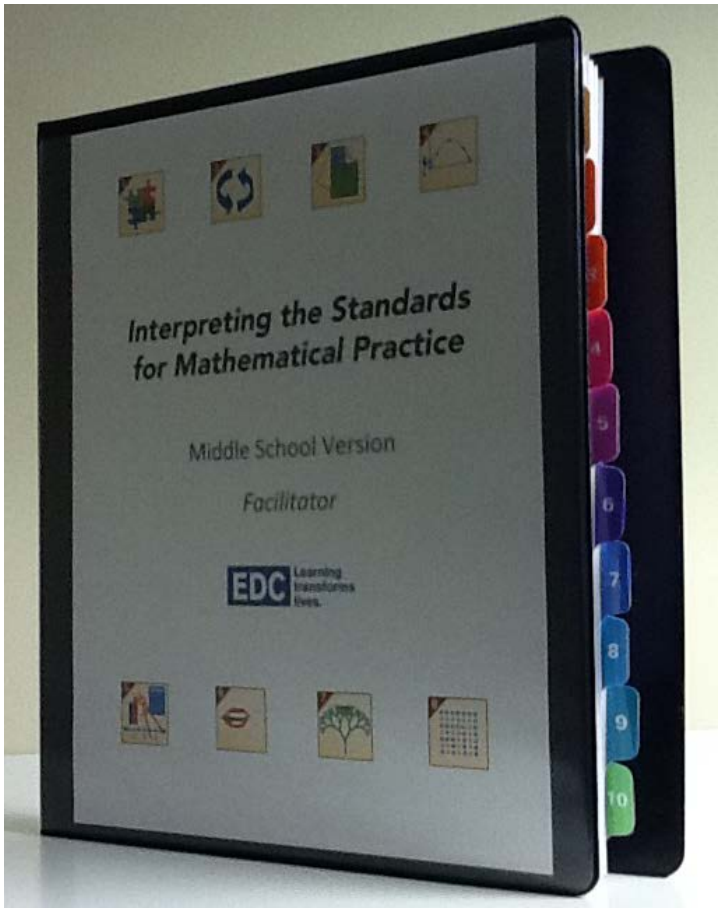
Mathematical Practice 8: Look for and express regularity in repeated reasoning.

Professional Development

Materials for 20 Hour
Professional Development Course
(MS & HS Versions)

Three Main Activity Types:

- Doing and Discussing Mathematics
- Analyzing Artifacts of
  Student Thinking
- Connecting to Classroom Practice



Why are the Standards for Mathematical Practice, and the habits of thinking they describe, important?

(See video.)

Exploring an Illustration: Postage Stamps – Integer Combinations

1) Work on mathematics task (individual then pairs)

2) Sharing/debriefing mathematics of task (full group)

3) During Part II (9:30-10:30): Read and discuss student dialogue and mathematical overview.

Postage Stamps – Integer Combinations: Math Task

Part 1: Suppose the post office only sold five-cent stamps and seven-cent stamps. Some amounts of postage can be made with just those two kinds of stamps. For example, 1 five-cent and 2 seven-cent stamps make 19 cents in postage, and 2 five-cent stamps makes 10 cents in postage. Which amounts of postage is it impossible to make using only five-cent and seven-cent stamps?

Part 2: Suppose the post office only sold six-cent and nine-cent stamps. Which amounts of postage is it impossible to make?

Work individually for 3 min (quietly), then in pairs (loudly ☺).
Keep track of thinking, questions, wrong turns, etc.

Postage Stamps – Integer Combinations: Discussing Mathematics

What strategies did you use to explore the problem?

How did you start the problem?

What conjectures or questions do you have at this point?

Postage Stamps – Integer Combinations: Reflecting on the SMP

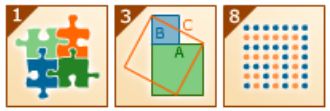
What evidence of the SMP did you see in…

1) Your own work on the task?

2) Colleagues' work on the task?

Integer Combinations—Postage Stamps Problem (MS Version)

Open Student Dialogue (in its own window)
Jump to Comment section



The mathematics task is intended to be a problem or question that encourages the use of mathematical practices. The dialogue is meant to show how students might engage in the mathematical practices as they work on the task. Before reading the dialogue, work on the mathematics task. Next reflect on the mathematical practices you engaged in while working on the task. Finally read the student dialogue.

Mathematics Task

Suppose the post office only sold five-cent stamps and seven-cent stamps. Some amounts of postage can be made with just those two kinds of stamps. For example, **1** five-cent and **2** seven-cent stamps make **19** cents in postage, and **2** five-cent stamps makes **10** cents in postage. Which amounts of postage is it impossible to make using only five-cent and seven-cent stamps?

Student Dialogue

Students in this dialogue have learned about factorization and multiples. They are now exploring what numbers can be produced by adding only two types of numbers.

(1) ***Sam*** Well, let's see. I can make postage that is **5** cents, **10** cents, **15** cents, and so on using only five-cent stamps. And I can make postage that is **7** cents, **14** cents, **21** cents, and so on using seven-cent stamps.

(2) ***Dana*** So, it looks like all multiples of **5** and **7** can be made.

(3) ***Anita*** Yes, but so can combinations of different stamps. Like the problem said, you can have **1** five-cent stamp and **2** seven-cent stamps to make **19** cents.

(4) ***Dana*** You're right. Why don't we make a table to keep track of everything? How about a table like this: *[draws the following]*

Total Postage	How?

We can already start filling out some of this. We know we can't make any postage smaller than **5** since the five-cent stamp is the smallest stamp we have.

Planning Protocol

- Identify goals related to SMP and mathematical content
- Anticipate student thinking and strategies to support students to engage in the SMP
- Plan questions to ask students

Planning Instruction to Support SMP

In pairs, work for a few minutes on the following:

1) Anticipate student thinking on this task.

2) List questions & supports that will create and develop opportunities for students to engage in the SMP.

Planning for SMP

What do you want to keep in mind as you plan instruction that supports student engagement in the SMP?

(For this task or other tasks…)

Implementing the Mathematical Practice Standards

Questions?

mathpractices.edc.org
(QR code on bookmark)

Thank you! Come back at 9:30 to examine student dialogues and work.

(If you are interested in having a group in the 2014-2015 fieldtest of the PD curriculum, talk to me or email mathpractices@edc.org or jnikula@edc.org)

Interpreting the Standards for Math. Practice As you arrive, complete sentence starters…

- Something I understand about the Standards for Mathematical Practice (SMP) is…

- An SMP I want to understand better is…

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- Support teachers to plan instruction to support these SMP

Plan for Session

- ***Part I (already happened):*** Explored a mathematics task and planning protocol.
- ***Background:*** Learn more about the Student Dialogues that are part of the Illustrations.
- ***Student dialogue*** Engage as learners in an experience of analyzing a student dialgogue and analyzing the students' use of habits of mind aligned with the SMP.
- ***(If time – brief student work analysis)***

Implementing the Mathematical Practice Standards

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Spotlight on...

Mathematical Practice 8: Look for and express regularity in repeated reasoning.

Illustrations

- Student dialogues clarify the *meaning* of SMP by showing what a conversation among students engaging in SMP might look like.
  - Embedded in the context of specific mathematical content.
  - Model productive mathematical discourse.
  - Strategically chosen student characters.

- Each dialogue is accompanied by supporting materials:
  - A mathematical problem
  - Teacher discussion/reflection questions
  - A mathematical overview
  - Follow-up activities and discussion questions for students

Illustration Development Process

- Two cycles of Illustration development
- Internal mathematical review
- Teacher Advisory Group
  - MS and HS teachers, math coaches, teacher leaders, math directors
- Expert panel review
  - Mathematicians, math educators, and mathematics teachers
  - Facilitated by TERC/external evaluators
  - Reviews provide feedback and specific suggestions for revision
- Revision and final review
- Final edit and preparation for website

About the Illustrations as a Set

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- Range of mathematical tasks, some more open-ended

- Grade levels from 5-10
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- Multiple SMP identified in each dialogue
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Exploring an Illustration: Postage Stamps – Integer Combinations

1) Work on mathematics task (individual then pairs)
2) Sharing/debriefing mathematics of task (full group)

3) Read student dialogue – working on math task
4) Discuss dialogue (small groups)
5) Debrief MPs from the task/dialogue (whole group)

6) Review Mathematical Overview

Postage Stamps – Integer Combinations: Math Task

Part 1: Suppose the post office only sold five-cent stamps and seven-cent stamps. Some amounts of postage can be made with just those two kinds of stamps. For example, 1 five-cent and 2 seven-cent stamps make 19 cents in postage, and 2 five-cent stamps makes 10 cents in postage. Which amounts of postage is it impossible to make using only five-cent and seven-cent stamps?

Part 2: Suppose the post office only sold six-cent and nine-cent stamps. Which amounts of postage is it impossible to make?

Work individually for 5 min, then in pairs.

Keep track of thinking, questions, wrong turns, etc.

Student Dialogue Exploration: Introduce Student Dialogues – Part I

- Dialogue between three fictitious middle grades or high school characters (either Sam, Dana, and Anita, or Chris, Lee, and Matei) working on a mathematics task

- The dialogues are intended to:
  - Clarify the *meaning* of particular SMP by showing what student discourse could be
  - Illustrate *key ideas* about the Standards for Mathematical Practice (SMP) in context using specific mathematical content
  - Serve as an artifact to promote discussion among educators about the SMP, about mathematics, and about issues of teaching practice.

Student Dialogue Exploration: Introduce Student Dialogues – Part II

- Given the intention to illustrate the meaning and key ideas of the SMP:
  - Plausible student thinking, but the discourse may not always sound realistic.
  - The student characters are "caricatures," intended to illustrate particular types of thinking and discussion.
  - A teacher voice is intentionally not included.
  - Discussion of whether or how a teacher might intervene, or of how to promote similar thinking with your own students, are productive avenues for discussion.

Reading the Student Dialogue

- 3 volunteers read the student dialogue out loud

- Re-read the dialogue individually:
  - Try to understand how the students are thinking about the task.
  - Then, note places where the students seem to be engaging in any of the Standards for Mathematical Practice.

Discuss Student Dialogue in Small Groups

(Be specific about evidence in dialogue. Refer to SMP handout.)

1. **Describe the strategies used by students in the Student Dialogue as they work on the mathematics task.**
2. **Where in the Student Dialogue do you see students constructing viable arguments and critiquing the reasoning of others (MP 3)?**
3. **What other evidence do you see of students engaging in any of the Standards for Mathematical Practice?**
4. **Had the students in the dialogue started to randomly list combinations, how (if at all) would you intervene? Had the students used the table approach in the dialogue but continued making combinations up to 60 without noticing a pattern or generalizing an argument, how (if at all) would you intervene?**
5. *What conjectures do you have about what characterizes two postage denominations, and , for which … (a) can all postage values after a certain point be made, and (b) will always have postage values that can't be made?*

Mathematical Overview

Review the mathematical overview – what surprises you or resonates with you?

Student Work Analysis: Learn to Use the Protocol

- "Evidence of Student Thinking" column is to record evidence of students' mathematical approaches or thinking about the task
- "SMP" column is to record when you think students are engaged in one or more of the Standards for Mathematical Practice (SMP).
- "Inferences/Questions/Wonderings" column is to note possible interpretations and questions about the student thinking identified.

Student Work Analysis: Discuss Student Thinking

Spend time individually analyzing 1-2 pieces of student work and filling in the protocol for each piece of work.

Discuss findings and questions in small groups.

- Use evidence from the student work during the discussion.
- Discussion questions include:
  - How would you characterize the students' understanding and approaches to the task?
  - Describe how a particular piece of work provides evidence of one or more the SMP (or a "seed" for one of the SMP).
  - Did all (or most) samples of student work show evidence of the same SMP?
  - Choose an inference, question, or wondering from column 3 to share and discuss.

Professional Development

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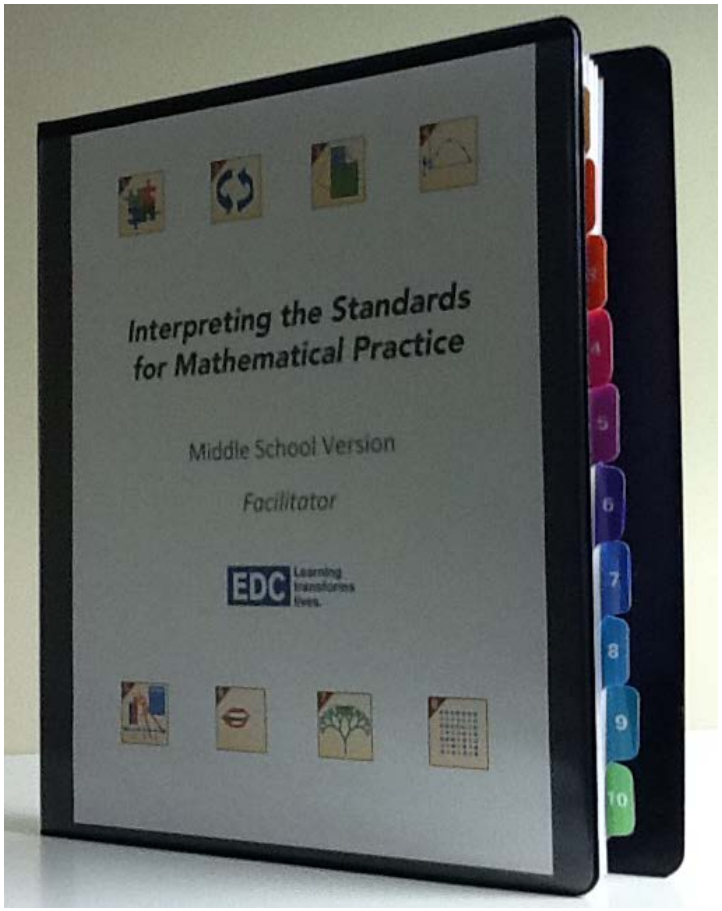
Three Main Activity Types:

- Doing and Discussing Mathematics
- Analyzing Artifacts of
  Student Thinking
- Connecting to Classroom Practice



Implementing the Mathematical Practice Standards

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