Exploring the Standards for Mathematical Practices

The Common Core State Standards

National Council of Supervisors of Mathematics
www.mathedleadership.org

Illinois Mathematics Project
Where to Start?

Two types of mathematics standards

- Standards for **Content**
- Standards for **Practice**
Session Goals

- Explore the Standards for Mathematical Practice
- Demonstrate how the Practice Standards bring **Rigor** to the grade level content standards
- Answer the question - What implications might the standards of mathematical practice have on the teaching, learning, and assessment in your classroom or your position?
National Council of Teachers of Mathematics

5 Process Standards

- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representations

Underlying Frameworks

Strands of Mathematical Proficiency

- Strategic Competence
- Conceptual Understanding
- Adaptive Reasoning
- Productive Disposition
- Procedural Fluency

Conceptual Understanding – comprehension of mathematical concepts, operations, and relations

Procedural Fluency – skill in carrying out procedures flexibly, accurately, efficiently, and appropriately

Strategic Competence – ability to formulate, represent, and solve mathematical problems

Adaptive Reasoning – capacity for logical thought, reflection, explanation, and justification

Productive Disposition – habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one’s own efficacy.

NCTM Process Standards

- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representations
Visualize a classroom of students **DOING Mathematics**

*What verbs describe what you hope to see them doing in your classroom?*
Take a moment to examine the first three words of each of the 8 mathematical practices… what do you notice?

Mathematically Proficient Students…
What are the *verbs* that illustrate the student actions for your assigned mathematical practice?

*Circle, highlight or underline them for your assigned practice...*

*Discuss in your table group:*

*How does this practice compare to your current practice?*
Comparison

• Deeper – lot more reasoning
• Higher level thinking
• Critical thinking
• Reflecting – thinking on how they got results
• Monitoring and evaluating
• Justifying – mathematically
• Change course – self monitoring, teaching to ask questions
• Students are doing most of the talking
• Interpret, draw conclusions, analyze
During the MARS task, refer back to the bulleted list and check those practices your group is engaged in.
1. Individually complete parts 1 - 3.

2. Then work with a partner to compare your work and complete part 4. Look for as many ways to solve parts 3 and 4 as possible.

3. Consider each of the following questions and be prepared to share your thinking with the group:
   a) What mathematics *content* is needed to complete the task?
   b) Which mathematical *practices* are needed to complete the task?
Buttons Task

Gita plays with her grandmother’s collection of black & white buttons. She arranges them in patterns. Her first 3 patterns are shown below.

<table>
<thead>
<tr>
<th>Pattern #1</th>
<th>Pattern #2</th>
<th>Pattern #3</th>
<th>Pattern #4</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Pattern #1" /></td>
<td><img src="image2" alt="Pattern #2" /></td>
<td><img src="image3" alt="Pattern #3" /></td>
<td><img src="image4" alt="Pattern #4" /></td>
</tr>
</tbody>
</table>

1. Draw pattern 4 next to pattern 3.
2. How many white buttons does Gita need for Pattern 5 and Pattern 6? Explain how you figured this out.
3. How many buttons in all does Gita need to make Pattern 11? Explain how you figured this out.
4. Gita thinks she needs 69 buttons in all to make Pattern 24. How do you know that she is not correct? How many buttons does she need to make Pattern 24?
Button Task

1. Individually complete parts 1 - 3.

2. Then work with a partner to compare your work and complete part 4. Look for as many ways to solve parts 3 and 4 as possible.

3. Consider each of the following questions and be prepared to share your thinking with the group:
   a) What mathematics content is needed to complete the task?
   b) Which mathematical practices are needed to complete the task? Refer to your Bulleted List of Math Practices.
The Nature of Tasks Used in the Classroom …

Will Impact Student Learning!

Tasks as they appear in curricular materials

Student learning
But, WHAT TEACHERS DO with the tasks matters, too!

The Mathematical Tasks Framework

Tasks as they appear in curricular materials → Tasks as set up by teachers → Tasks as enacted by teachers and students → Student learning

Stein, Grover & Henningsen (1996)
Smith & Stein (1998)
Stein, Smith, Henningsen & Silver (2000)
A re-engagement lesson using the Button Task
Francis Dickinson, San Carlos Elementary, Grade 5
Pictorial Representation
What does Learner A see staying the same? What does Learner A see changing? Draw a picture to show how Learner A sees this pattern growing through the first 3 stages. Color coding and modeling with square tiles may come in handy.

Verbal Representation
Describe in your own words how Learner A sees this pattern growing. Be sure to mention what is staying the same and what is changing.
Learner B

3. How many buttons in all does Gita need to make Pattern 11?

\[ \frac{4}{2} + \frac{3}{3} + \frac{3}{3} + \frac{3}{3} + \frac{3}{3} + \frac{3}{3} = 34 \]

Explain how you figured this out.

\[ \text{I added } 4 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 34 \text{ which is the # of buttons.} \]

Pictorial Representation
What does Learner B see staying the same? What does Learner B see changing? Draw a picture to show how Learner B sees this pattern growing through the first 3 stages. Color coding and modeling with square tiles may come in handy.

Verbal Representation
Describe in your own words how Learner B sees this pattern growing. Be sure to mention what is staying the same and what is changing.
Button Task Revisited

• Which of the Standards of Mathematical Practice were evident? Cite explicit examples to support your thinking.
• What math understanding is evident from the student work?
• What did Mr. Dickinson get out of using the same math task two days in a row, rather than switching to a different task(s)?
• How did the way the lesson was facilitated support the development of the Standards of Practice for students?
What practices do you see in students?

- Students begin working on re-engagement task
- Girls discussing Learner B work
- Closure
Button Task Revisited

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• What math understanding is evident from the student work?

• What did Mr. Dickinson get out of using the same math task two days in a row, rather than switching to a different task(s)?

• How did the way the lesson was facilitated support the development of the Standards of Practice for students?
Teachers and Tasks Matter

The Mathematical Tasks Framework

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Stein, Grover & Henningsen (1996)
Smith & Stein (1998)
Stein, Smith, Henningsen & Silver (2000)
What implications might the standards of mathematical practice have on the teaching, learning, and assessing in your setting?
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.
2. Reason abstractly and quantitatively

3. Construct viable arguments and critique the reasoning of others

4. Model with mathematics

5. Use appropriate tools strategically

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.
What does mathematical understanding look like?

• Read *Understanding Mathematics*, page 4

• **Read** *Connecting the Standards for Mathematical Practice to the Standards for Mathematical Content* – page 8

• Talk at your table – **What does mathematical understanding look like?**
What does Understand mean?

Understand is used in the CCSS to mean that students can explain the concept with mathematical reasoning, including:

• giving concrete illustrations and

• providing mathematical representations and example applications.
What does mathematical understanding look like?

In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices.

Page 8, CCSS
Standards that begin with “understand” are good opportunities to connect the practices to the content.

CCSS: p. 8
Reflections

- What were the big ideas in this session?
- How can I implement the ideas from this session?
- What do I still need?