Focus on the Question: Making Sense of Problems and Persevering in Solving Them

NCTM 100 Days of Professional Development
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“Middle school mathematics programs should cultivate students’ positive mathematical identities so that students...”

Develop deep mathematical understanding

Understand and critique the world through mathematics

Experience the wonder, joy, and beauty of mathematics
Today’s Outcomes

Learning Intentions
• Participate in the structure: Focus on the Question
• Explore how to use it with various learning models
• Have examples to use for the upcoming school year

Success Criteria
• Explain the Focus on the Question structure as a participant
• Determine how you will use Focus on the Question in your learning structure
• Use, build on and share examples of Focus on the Question
Standard for Mathematical Practice 1

Make sense of problems and persevere in solving them.
Focus on the Question

1. Post a set of data in the classroom on Monday. That data remains posted for the week.
2. Each day pose a different problem in which students must use some or all the data.
3. Each day, students talk to partners about what they are being asked to solve, what data will help them solve it, and how they would solve it.
4. Facilitate a class discussion in which students share their ideas about how the problem could be solved.
5. No answers are needed, and written work is not required. The activity generally takes no more than 10 minutes.
### Mathematics Teaching Practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Establish mathematics goals to focus learning.</strong></td>
<td>Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.</td>
</tr>
<tr>
<td><strong>Implement tasks that promote reasoning and problem solving.</strong></td>
<td>Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.</td>
</tr>
<tr>
<td><strong>Use and connect mathematical representations.</strong></td>
<td>Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.</td>
</tr>
<tr>
<td><strong>Facilitate meaningful mathematical discourse.</strong></td>
<td>Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.</td>
</tr>
<tr>
<td><strong>Pose purposeful questions.</strong></td>
<td>Effective teaching of mathematics uses purposeful questions to assess and advance students’ reasoning and sense making about important mathematical ideas and relationships.</td>
</tr>
<tr>
<td><strong>Build procedural fluency from conceptual understanding.</strong></td>
<td>Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.</td>
</tr>
<tr>
<td><strong>Support productive struggle in learning mathematics.</strong></td>
<td>Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.</td>
</tr>
<tr>
<td><strong>Elicit and use evidence of student thinking.</strong></td>
<td>Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.</td>
</tr>
</tbody>
</table>
How do they all fit?

<table>
<thead>
<tr>
<th>Effective Mathematics Teaching Practices</th>
<th>how teachers engage students in the mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards for Mathematical Practice</td>
<td>how students interact with the content standards</td>
</tr>
<tr>
<td>Content Standards</td>
<td>what</td>
</tr>
</tbody>
</table>
Monday
What do you notice?

Write your noticings in the chat box.

“I notice ....”

What do you wonder?

Write your wonderings in the chat box.

“I wonder....”

What mathematical concepts do you see?

Write your observations in the chat box.

Tuesday
What other ways can you record the data shown in the graph below to make conjectures on the future? What are the benefits of each?

Write your approaches in the chat box.

“I would .... because...”

Wednesday
If the chain had three interactions per person, how many people would be exposed after 4 interactions? Tell how you would solve the problem.

Write your approach in the chat box.

“I would ….”

Thursday
How many interactions for each model would it take to infect 100,000 people? Explain how you would find the answer.

Write your approach in the chat box.

“I would ....”

Friday
If indoor gatherings are limited to 10 people and outdoor gatherings are limited to 50 people, how many more people could be infected? Explain how you would find the answer.

Write your approach in the chat box.

“I would ….”

Debrief

Goal – use mathematical models to describe the world around us

See patterns

Discuss exponential growth

Construct viable arguments

Make sense of problems
Standard for Mathematical Practice 1

Make sense of problems and persevere in solving them.
Student Actions for SMP 1

• Have or value sense-making
• Use patience and persistence to listen to others
• Be able to use and make sense of strategies
• Monitor progress and change course, if needed
• Be able to show, use, and explain representations and use them to solve problems
• Communicate, verbally and in written format
• Be able to deduce what is a reasonable solution in the context of the problem
Teacher Actions for SMP 1

• Provide open-ended and rich problems
• Ask probing questions
• Model multiple problem-solving strategies through Think-Alouds
• Promote and value discourse, collaboration, and student presentations
• Provide cross-curricular integrations
• Probe student responses (correct or incorrect) for understanding of approaches
• Provide solutions
Focus on the Question

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<th>3 Models of Focus on the Question</th>
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<tr>
<td><strong>In-Person</strong></td>
</tr>
<tr>
<td>• Post the data set in the classroom.</td>
</tr>
<tr>
<td>• Post the question on the board by the question.</td>
</tr>
<tr>
<td>• Have students pair-share, then have a class discussion.</td>
</tr>
<tr>
<td><strong>Hybrid</strong></td>
</tr>
<tr>
<td>• Post the data on the board and online.</td>
</tr>
<tr>
<td>• Post the question on the board and online.</td>
</tr>
<tr>
<td>• Have students pair share that are in the classroom and have students post their responses.</td>
</tr>
<tr>
<td><strong>Remote Learning</strong></td>
</tr>
<tr>
<td>• Post the data in announcement, or materials.</td>
</tr>
<tr>
<td>• Post the question in daily announcement, or on the lesson slides, or on a form.</td>
</tr>
<tr>
<td>• Students write their answer and view what the others have written to then respond.</td>
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</tbody>
</table>
Goal:
Proportions, graphs, ratios

What do you notice and wonder?
What combinations of traditional sales percentages can you make that are equivalent (or close to) to streaming R&B/Hip-Hop? How do you know?
If, in 2018, the total number of streaming sales were the same amount as the traditional sales, how many more rock traditional sales were there compared with streaming? How would you find the answer?
If there were equal numbers of traditional and streaming sales, is 23% of the pop traditional sales greater or less than 19% of the total sales? How do you know?
Compare what the white spaces in each bar graph represent. Which is greater? How do you know?

2018 music consumption by genre...

INCLUDING STREAMING

<table>
<thead>
<tr>
<th>Genre</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>R&amp;B/HIP-HOP</td>
<td>54%</td>
</tr>
<tr>
<td>POP</td>
<td>19%</td>
</tr>
<tr>
<td>ROCK</td>
<td>13%</td>
</tr>
<tr>
<td>COUNTRY</td>
<td>9.5%</td>
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</table>

TRADITIONAL SALES ONLY

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<th>Genre</th>
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<td>ROCK</td>
<td>33%</td>
</tr>
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<td>COUNTRY</td>
<td>14%</td>
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Source: Nielsen Music

2018 music consumption by genre...

INCLUDING STREAMING
- 54%
- 19%
- 13%
- 9.5%

TRADITIONAL SALES ONLY
- 20%
- 23%
- 33%
- 14%

Source: Nielsen Music

Application: Question generation
Goal: Fractions, area, ratios

- What do you notice and wonder?
- If the figure is one whole, what is the value of the white square?
- What ratio of blue colored squares are there to non-blue colored squares?
- If the pink square is one unit, what is the value of the light green rectangle?
- What combinations of figures could you make that would have the same area of the dark blue rectangle?
Application: Notice and Wonder on chart paper
Mrs. Smith’s 7th grade class has a ratio of five boys for every four girls.

Goal: Ratio
$0.1x + \frac{2}{5} = 4\left(\frac{1}{40}x + 0.1\right)$

Goal: expressions, equivalence, fractions and decimals

- (Cover up the 4 on the right.)
- What do you notice and wonder?
- What would the box have to be to make the equation true?
  - (Uncover the 4.)
  - Create an equivalent equation so that it there are no decimals. Explain what you did.
- Create a new expression on the right side of the equation that is equivalent to the expression on the left of the equation.
- Create an equivalent expression to the left side of the equation that includes subtraction. (not of zero!)
- Replace the fractions and decimals with your own to create a new equation.
Application: Desmos Activity

What do you notice? Write your answers in complete sentences.

\[ 0.1x + \frac{2}{5} = 4 \left( \frac{1}{40} x + 0.1 \right) \]
### 8th grade absences vs. math scores

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<th>Math scores</th>
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<tbody>
<tr>
<td>3</td>
<td>65</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>1</td>
<td>95</td>
</tr>
<tr>
<td>1</td>
<td>85</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>34</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
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**Goal: Statistics**

- What do you notice and wonder?
- How would you arrange/display the data so that trends can be seen? Explain your choice.
- What would be a better measure of central tendency, mean, median or mode. Explain your answer.
- What one piece of data would you add to make the mean of the math scores higher? Explain your reasoning.
- What would be the best way to describe math scores with three absences? Explain your reasoning.

Source: 8th Grade Chapter, CA Mathematics Framework
Focus on the Question

Monday, August 10, 2020

8th Grade Absences vs. Math Scores

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Source: 8th Grade Chapter, CA Mathematics Framework

What do you notice?

Application: Google Forms
Questions?
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Resources


• Principles to Actions: Ensuring Mathematical Success for All. NCTM, National Council of Teachers of Mathematics, 2014.


• National Council of Teachers of Mathematics. Catalyzing Change in Middle School Mathematics. NCTM, National Council of Teachers of Mathematics 2020.

• https://www.nytimes.com/column/whats-going-on-in-this-graph


• Number Search https://photos.google.com/share/AF1QipPUhweMG3cpSQ2CRL0scB2KtlKi2D6UFUuTvBuBNpr_z-UWsqce6nz2GmKW1SUWA?key=QlZfb2Rtd05vbxRiVU5dIUGV1SVMxd2hINXJh
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