Mathematically Productive Instructional Routines and Planning for Equity

Presented by: Aaron Rumack

 Routinely using a 5- to 15-minute learning activity can create a structure for teachers and students to engage together in mathematics. This positions students at the center of sense making in the classroom. We’ll use two such routines, Notice and Wonder and 10-Minute Talks, to explore Stembridge’s five questions for planning with equity in mind.
welcome 2022
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Notice & Wonder

Annie Fetter
https://www.nctm.org/online-learning/Webinars/Details/552

Graham Fletcher
https://www.nctm.org/online-learning/Webinars/Details/553

Capturing Mathematical Curiosity with Notice and Wonder
https://pubs.nctm.org/view/journals/mtms/24/7/article-p394.xml
Notice & Wonder

* Students see problems in big picture ways and discover multiple strategies for tackling them

* Each and every student can have their curiosity piqued and thus access the content

* Engagement soars as students build self-confidence and reflective skills

https://www.learning-space.org/Page/58

https://www.oercommons.org/courseware/lesson/78969/overview (after June 30)
Notice & Wonder

• Show students a scenario, an image, a data set, a problem situation, or a word problem stem with the question removed.

• At first, try a two-column approach.

<table>
<thead>
<tr>
<th>Notice</th>
<th>Wonder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

• Prompt students to share out, and record their thoughts for all to see.
  - Avoid praising, restating, clarifying, or asking questions.
  - List noticings first, then wonderings.

• Decision point — Based on your goals for the lesson:
  - Steer the conversation to wondering about something mathematical that the class is about to focus on, or
  - Leave it more open and allow students to choose a question to explore on their own or in partners.
MPIRs

Why are they important?
A number of researchers have recently begun to identify certain instructional routines, aligned with the rigor of the State Standards and the NCTM Mathematics Teaching Practices, that “can significantly affect the quality of teaching and subsequent learning of students” (Heibert & Morris, 2012). *Mathematically productive* instructional routines make students’ mathematical thinking visible and require teachers to pay attention to, build on, and respond to student thinking. Using such routines frequently can support the development of a classroom culture in which sense-making is at the heart of all activity, and mistakes are “expected, respected, and inspected.”

• giving up control

https://www.oercommons.org/courseware/lesson/78969/overview
**BOOK STUDY: Dr. Adeyemi Stembridge author of Culturally Responsive Education in the Classroom:**

<table>
<thead>
<tr>
<th>CULTURAL IDENTITY</th>
<th>RELATIONSHIPS</th>
</tr>
</thead>
</table>
| • In what ways does instruction make reference of culture?  
• How does instruction allow students to draw from their cultural knapsack?  
• How does instruction support students in bridging their social/cultural identities with their academic identities? | • How does instructional design and coordinated support affirm relationships between students and teachers? Among students?  
• How does the lesson and instructional design further build community in the classroom?  
• How do teachers leverage relationships with (1) highly engaged, (2) moderately engaged, and (3) minimally engaged students to maximize learning experiences? |

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>VULNERABILITY</th>
</tr>
</thead>
</table>
| • How are students’ strengths (both in terms of process and content knowledge and also dispositions and interests) leveraged in instruction?  
• In what ways are students encouraged to understand their strengths and tendencies as learners? | • What environmental risk factors does this student face?  
• What protective factors are (or could be) in place to mitigate those risks?  
• How does the lesson and instructional design encourage appropriate risk-taking? |

<table>
<thead>
<tr>
<th>ENGAGEMENT</th>
<th>RIGOR</th>
</tr>
</thead>
</table>
| • How does instruction engage students behaviorally, affectively, and cognitively?  
• How does the instructional design model for students what engagement looks like?  
• How does the lesson differentiate for highly engaged, moderately engaged, and minimally engaged students? | • How does the instructional design encourage students to employ higher order thinking skills beyond mere recall?  
• In what ways are students led to construct their own meaning and interpretations from content?  
• How does the instruction lead students into stretching their understandings of content? |
Guidelines for Courageous Conversations

• Stay Engaged
• Speak Your Truth
• Experience Discomfort
• Expect & Accept Non-Closure
• Listen for Understanding

(Singleton & Hays 2008, p. 22)
WHAT YOU DONT KNOW

WHAT YOU KNOW

WHAT YOU DONT KNOW
Planning

1. What do I want students to understand?
2. What do I want students to feel?
3. What are the targets for rigor?
4. What are the indicators of engagement?
5. What are the opportunities to be responsive?

Link to today's comments
Being Responsive

Brilliant Teaching

Diagram showing the overlap between Being Responsive and Brilliant Teaching.
Being Responsive

Brilliant Teaching
Being Responsive

Brilliant Teaching

- Being
- Brilliant
- Responsive
- Teaching

Venn Diagram

Intersection of Being and Brilliant Teaching
<table>
<thead>
<tr>
<th>Expression</th>
<th>x</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x^2$</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>$x^2$</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>$x^2$</td>
<td>-1</td>
<td>-2</td>
</tr>
<tr>
<td>$x^2$</td>
<td>-2</td>
<td>-4</td>
</tr>
</tbody>
</table>

Pattern: $2x$
Being Responsive

Brilliant Teaching
True or False?

The only place a rabbit sweats is through the pads on its feet.

Source: Nigerian Tribune (tribune.com.ng)
True or False?

TRUE!

Source: Nigerian Tribune (tribune.com.ng)
A 4-lb. rabbit will drink as much water as a 20-lb. dog.

Source: Nigerian Tribune (tribune.com.ng)
True or False?

TRUE!

Source: Nigerian Tribune (tribune.com.ng)
One day...

Jake hops 3 times toward the rising sun in the East.
And then...

Jake hops 6 times toward the shade under a tree to the West.
However...

Jake likes the sunshine better, so he hops 11 times back to the East.
Pose a problem!

Jake hops:
- 3 times to the East
- 6 times to the West
- 11 times back toward the East
Possible Problems

1. Where did Jake end up relative to his starting point?

2. How far did Jake hop?
Key Concept

-5 + (-4) = -9

- **start**: the addend before the plus sign
- **change**: the addend after the plus sign
- **finish**: the sum
-5 + (-4) = -9

- **start**: the addend before the plus sign
- **change**: the addend after the plus sign
- **finish**: the sum
Group Roles

- reader: announce the next problem (remind as needed)
- starter: announce where the starting chip goes
- builder: announce the color & number of linear pieces
- finisher: announce where the finishing chip goes

1. $-2 + (-6)$
2. $-4 + 11$
3. $3 + (-7)$
4. $5 + 4$
5. $-1 + (-6)$
YOU ARE THE STAR IN N.P.H.'S LIFE STORY!

NEIL PATRICK HARRIS

CHOOSE YOUR OWN AUTOBIOGRAPHY
YOU ARE THE STAR IN N.P.H.'S LIFE STORY!

NEIL PATRICK HARRIS

CHOOSE YOUR OWN AUTOBIOGRAPHY
1. What do I want students to understand?
2. What do I want students to feel?
3. What are the targets for rigor?
4. What are the indicators of engagement?
5. What are the opportunities to be responsive?

Link to today's comments
10-Minute Talk

Step 0
• Identify a mathematical goal

- Meaning
- Representation
- Structure
- Number sense

• Consider what supports your students need to engage in productive discussion
10-Minute Talk

Step 1
• Share the prompt

Step 2
• Independent think time (2 min)

Step 3
• Partner discussion (1 min)
10-Minute Talk

Step 4
• Whole-Group Discussion (4 min)
  - Seek a volunteer to share ONE statement or idea
  - Record the idea in a non-evaluative way
  - Seek another volunteer to either ask a clarifying question about the first idea or add on to the first idea
10-Minute Talk

Step 5
• Review student work

- On your own time, reflect on the mathematics that came up
Feel

What emotions propel an increasing number of students away from “I’m not a math person”? 
Engagement

What can you see and hear when students are at the perfect intersection of challenge and skill?
Responsive

What strategies support an increasing number of students, and generate trust in the classroom?
Our thoughts and emotions are always developed within a web of social context, cognitive activity, and biological interoceptions.

Barret & Simmons 2015, Baer 2017
When students are affectively engaged in their learning, they are much more likely to find the conceptual connections that are most meaningful for them and are more likely to trust the people and spaces in which others are likewise invested.

Stembridge 2020

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