Integrating Effective Teaching Practices

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Engaging Students in Mathematical Thinking

“We are currently preparing students for jobs that don’t yet exist . . . using technologies that haven’t yet been invented . . . in order to solve problems we don’t even know are problems yet.”

—The Jobs Revolution Richard Riley
Engaging Students in Mathematical Thinking

Standards for Mathematical Practice (CCSS, 2010)

Mathematically proficient students:

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. Choose appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning
Engaging Students in Mathematical Thinking

**NCTM Teaching Practices** (NCTM, 2014)

*Effective mathematics educators:*

1. Establish mathematical goals that focus learning
2. Implement tasks that promote reasoning and problem solving
3. Use and connect mathematical representations
4. Facilitate meaningful mathematical discourse
5. Pose purposeful questions
6. Build procedural fluency from conceptual understanding
7. Support productive struggle in learning mathematics
8. Elicit and use evidence of student thinking
Instructional Routines
Develop Practices

• Mathematical *Thinking* Practices
• Mathematical *Teaching* Practices

“Instructional routines are meant to be repeated, and this repetition makes them very effective vehicles for developing mathematical practices.”
(Kelemanik, Lucenta, Janssen Creighton, 2016)
What’s an Instructional Routine?

Instructional routines are designs for interaction that organize classroom activities. 

(Magdalene Lampert, NCSM 2015)

Try–Discuss–Connect Routine

Try It
Make sense of the problem.
Solve and support your thinking.

Discuss It
Share your thinking with a partner and the whole class.
Compare class strategies.

Connect It
Make connections between strategies.
Apply your thinking to new problems.

#ReadyClassroom
Discourse Moves
Embedded in Routines

Individual
Think Time

Turn
and Talk

4 Rs

#ReadyClassroom
Individual Think Time

**What?**
Time for students to think or work privately before discussing with a partner, a small group, or the whole class

**Why?**
To allow students to make sense of the question or problem, begin to gather their thoughts and questions, and significantly increase both the quantity and quality of student talk and engagement in the thinking

**How?**
- Explicitly prompt Individual Think Time
- Time Individual Think Time purposefully
When Do Students Need Individual Think Time?

A. When the teacher places another student’s work under document camera

B. When the teacher poses a question to the whole class

C. Before students work with partners to solve a problem

D. All of the above
**Turn and Talks**

**What?**
An opportunity for students to work out mathematical ideas and language together.

**Why?**
So that each and every student has an opportunity to speak, develop language and thinking, and so that the teacher can hear from many students.

**How?**
Provide a purpose, prompt, and product.
When Should Teachers Facilitate a Turn and Talk?

A. Allow students to process an idea and language before a full group conversation

B. When no student offers to share an idea during whole class discussion

C. When teachers need to hear student ideas in order to make a decision in the moment

D. When every student is eager to share an idea

E. All of the above
Steps of a Turn and Talk

1. Pose (and possibly record or project) a clear question or prompt.

2. Provide a sentence frame or starter to prompt partner talk.

3. Provide a time estimate (that you may adjust as you listen to students).

4. Listen to students as they discuss, select, and sequence responses.

5. Reconvene the class and remind them of the prompt.

6. Purposefully call on students to share their thinking and transition back to a full group discussion.
To allow students to make sense of the question or problem, begin to gather their thoughts and questions, and significantly increase both the quantity and quality of student talk and engagement in the thinking.

4 Rs

**What?**
Repeat, Rephrase, Reword, Record

**Why?**
To process and refine mathematical ideas and language

**How?**
- Prompt students to *Repeat, Rephrase, or Reword*.
- Ensure students repeat, rephrase, reword.
- *Record* important language and ideas.
When Do You Use Each R?

1. If you think everyone understands the idea, and you want to add precision, which of the four Rs do you implement?
   A. Repeat    B. Rephrase    C. Reword    D. Record

2. If a student shares an idea, and you’re not sure everyone heard, which of the four Rs do you implement?
   A. Repeat    B. Rephrase    C. Reword    D. Record

3. If everyone heard an idea, and you want to check for understanding, which of the four Rs do you implement?
   A. Repeat    B. Rephrase    C. Reword    D. Record
Questions?
Try–Discuss–Connect

TRY IT
- Make sense of the problem.
- Solve and support your thinking.

DISCUSS IT
- Share your thinking with a partner.
- Compare class strategies.

CONNECT IT
- Make connections and reflect on what you have learned.
- Apply your thinking to new problems.

#ReadyClassroom
Make sense of the problem

- What is the problem about?
TRY IT  Make sense of the problem

Perez has 205 flower seeds.
He plants 137 seeds.

- What are you trying to find out?
Make sense of the problem

Perez has 205 flower seeds.
He plants 137 seeds.
How many flower seeds does Perez have left?

- What information is important?
TRY IT  Solve and support your thinking

Perez has 205 flower seeds. He plants 137 seeds. How many flower seeds does Perez have left?

Math Toolkit
- base-ten blocks
- place-value charts
- number lines
DISCUSS IT

Share your thinking with a partner

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I knew . . . so I . . .
Perez has 205 flower seeds. 
He plants 137 seeds.
How many flower seeds does Perez have left?
Discuss It

Compare class strategies

Perez has 205 flower seeds.
He plants 137 seeds.
How many flower seeds does Perez have left?

\[
\begin{align*}
205 - 5 &= 200 \\
137 + 3 &= 140 \\
5 + 3 &= 8 \\
200 - 140 &= 60 \\
160 + 8 &= 68
\end{align*}
\]
Perez has 205 flower seeds.
He plants 137 seeds.
How many flower seeds does Perez have left?
Compare strategies
Compare strategies

You can use a number line to add on to find a difference.

You can also solve the problem with the addition equation $137 + \square = 205$.
Use a number line to add on to 137 to get to 205.

Find the numbers that you add to get to the next number:

$137 + 3 = 140$
$140 + 60 = 200$
$200 + 5 = 205$
**Make connections and explain your thinking**

Now you will use the problem from the previous page and a place-value chart to help you understand how to add on to subtract.

1. Start at 137. What is the next ten? How many ones do you add to get to the next ten? This first number is written in the chart for you.

<table>
<thead>
<tr>
<th></th>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>137 +</td>
<td></td>
<td>3</td>
<td>= 140</td>
</tr>
<tr>
<td>140 +</td>
<td></td>
<td></td>
<td>= 200</td>
</tr>
<tr>
<td>200 +</td>
<td></td>
<td></td>
<td>= 205</td>
</tr>
</tbody>
</table>

2. How many tens do you add to get from 140 to the hundred you need? Write your answer in the chart.

3. Now what do you add to get from 200 to 205? Write your answer in the chart.

4. Write an addition equation to show what you added.

How many flower seeds does Perez have left? seeds

5. Explain how you would add on to find this difference: 202 − 195.
6 Reflect

Look back at your Try It, strategies by classmates, and Model It. Which models or strategies do you like best for subtracting three-digit numbers? Explain.
Edith has $600. She spends $84. How much does Edith have left? Show your work.
Apply your thinking to a new problem

Find the difference between 430 and 182.

A. 148  
B. 240  
C. 248  
D. 310
When and how do discourse moves support the development of mathematical thinking in Try–Discuss–Connect?

Try–Discuss–Connect Routine
includes Individual Think Time, Turn and Talk, and the Four Rs

**Try It**
Make sense of the problem
Solve and support your thinking

**Discuss It**
Share your thinking with a partner and the whole class
Compare class strategies

**Connect It**
Make connections
Apply your thinking to new problems
When and how do discourse moves support the development of mathematical thinking in Try–Discuss–Connect?

**Try–Discuss–Connect Routine**

- *Try It*
  - Make sense of the problem
  - Four Rs
  - Solve and support your thinking
  - Individual Think Time

- *Discuss It*
  - Share your thinking with a partner and the whole class
    - Four Rs
    - Turn and Talk
  - Compare class strategies
    - Four Rs
    - Turn and Talk

- *Connect It*
  - Make connections
    - Four Rs
    - Turn and Talk
  - Apply your thinking to new problems
    - Individual Think Time
Questions?