Mapping Out Tasks to Engage Students in Productive Struggle

Grades 3 – 5

Christine Roberts
christine.roberts@tcoe.org
@mathschristine

Keep the Conversation Going

Keep the conversation going on twitter. Please use the CMC hashtag, #cmcmath, and if tweeting tag @CAMathCouncil and @mathschristine.
Session Evaluation

• Please take the time to provide feedback on my session, it helps my planning for future sessions and it helps the conference committee determine your needs and wants.

• Use the ERMobile app by downloading it.

• Go to this session and go to Complete Session Survey.

Thank you for your feedback!

Welcome & Introductions

• Introduce yourself to the people at your table (name, district, role, interesting fact).

Discuss:

In what ways do you support students while they are working on challenging tasks?
Think about it . . .

What is your current definition of productive struggle?

*Please write down your current definition on your handout.*

Session Outcomes

- Redefine the role that effort and struggle play in learning mathematics in your classroom.
- Develop strategies to help students build perseverance as they makes sense of and solve problems.
- Explore ways to select and structure tasks to engage your students in productive struggle.
Teacher Reflection

- How do your students respond to challenging tasks?
- Do they work hard and focus on the task or do they get frustrated and give up?
- How do you respond?

Productive Struggle

What we know . . .

- Problem solving is at the heart of mathematics.
- Struggle* is critical in the learning process.
- Students must talk to learn.
What we know . . .

• Problem solving is at the heart of mathematics.
• Struggle* is critical in the learning process.
• Students must talk to learn.

What we should do . . .

• Support students in becoming problem solvers.
• Provide opportunities for struggle*.
• Support students in having conversations about their thinking.

What is productive struggle?

How does our view of struggle impact our instruction?
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.

Creating a Classroom that Supports Productive Struggle

Opening Up Mathematics

Foster student understanding

Number Routines

Manipulatives

Visual Math

Structuring Mathematical Tasks to Engage Students in Productive Struggle, NCTM – Nick Lopez, DUSD & Christine Roberts, TCOE
How can we make math accessible again?

- Number Routines
- Manipulatives
- Visual Math

Creating a Classroom that Supports Productive Struggle

**Teacher Steps**

*Foster growth mindsets*

**Messaging**

**Feedback**

**Norms & Expectations**

Nick Lopez, DUSD
Creating a Classroom that Supports Productive Struggle

Student Actions

Foster student ownership

Evidence of Learning

Goal setting

Reflection Self-Assessment

Nick Lopez, DUSD
Number Puzzles Card Sort

A - This number can make a rectangle with.

B - This number has exactly 8 factors.

C - 1 factor of this number is ___.

D - This number is not a multiple of 5 or 7.

NUMBER PUZZLE 1:

Clue 1 - A
Clue 2 - B
Clue 3 - C
Clue 4 - D

Productive Struggle Scale

1. I’m frustrated and need help.
2. I’m stuck and could use a hint.
3. I’m not sure what to do next and could use a question.
4. I have an idea and am exploring. Give me some time.
5. I have an approach and can explain my thinking.
Reflection: Number Puzzles Card Sort

• How did the task promote reasoning and problem solving?

• Which aspects of the task do you think would be challenging for students?

• What supports would you put into place and why?
Mapping Out Tasks to Engage Students in Productive Struggle

What types of tasks and which strategies support students as they make sense of problems and build perseverance?

Mathematical Task Framework

Stein et al., 2000
Low Floor High Ceiling Task:

What’s the Secret Code?
Green Group

1. Use the clues to find the code number:
   - It is between 8,500 and 8,800.
   - When multiplied by 8, the result is a whole number.
   - The digit in the hundreds place is \( \frac{3}{4} \) the digit in the thousands place.
   - The sum of all digits in the number is 26.
   - The digit in the hundredths place is 200% of the digit in the tenths place.
   - There are no zeros in the decimal places.

2. What code numbers fit these clues?

Productive Struggle Scale

1. I’m frustrated and need help.
2. I’m stuck and could use a hint.
3. I’m not sure what to do next and could use a question.
4. I have an idea and am exploring. Give me some time.
5. I have an approach and can explain my thinking.
Reflection: The Secret Code

• How did the task promote reasoning and problem solving?

• Which aspects of the task do you think would be challenging for students?

• What supports would you put into place and why?

Student Support

Beginning of the Task

Read and Flip

Individual Think/Work Time

Group Huddle

Nick Lopez, DUSD
Student Support

During the Task

Spy
Collaborative Structures
Teacher Questioning
Student Questioning
Just in time support

Ways to Initiate Conversation with Students

• Show me what you've tried so far.
• Tell me about what you've done.
• Do you know where you're stuck? If so, show and tell me about it.
• Where are you confused?
• I noticed you did this [something in their work]. Explain that to me.
• I noticed you have something circled here. Tell me why that makes sense to you.

http://mr-stadel.blogspot.com/2016/01/productive-struggle-part-2.html
Teacher Responses to Student Struggle

- As you read, consider how you would react in this situation.
- Discuss how Ms. Flahive and Ms. Ramirez responded.
- What do their responses convey to students?

As told in Figure 21, the two teachers, Ms. Flahive and Ms. Ramirez, present a real-world task related to fractions to two classes of fifth-grade students. In both classrooms, some students are momentarily at a loss, and vocal about their feeling that they don’t know what to do. The two teachers respond to their students’ discomfort in different ways.

Illustration

Figure 21 illustrates how two teachers, Ms. Flahive and Ms. Ramirez, present a real-world task related to fractions to two classes of fifth-grade students. In both classrooms, some students are momentarily at a loss, and vocal about their feeling that they don’t know what to do. The two teachers respond to their students’ discomfort in different ways.

Ms. Flahive and Ms. Ramirez teach 5th-grade students. They have created a Shopping Trip task where students have to solve a problem involving fractions. The task requires students to solve a multi-step word problem.

Shopping Trip Task

Joseph went to the mall with his friends to spend the money that he had received for his birthday. When he got home, he had spent $12 on books and $12 on candy. How much money did he spend?

How much money had he received for his birthday?

When Ms. Flahive and Ms. Ramirez present the problem in their classrooms, both teachers use students struggling to get started. Some students in both classrooms immediately raise their hands, saying “I don’t know” or “I don’t know what to do.”

Ms. Ramirez encourages the students by saying, “How do you think you could solve this problem?”

Mr. Ramirez gives students time to draw a diagram and show fraction to divide in fifth grade to represent what Joseph had spent and what he had left. He then guides the students to use step-by-step they have labeled each one fifth of the rectangle or area $12, as a divisor. Finally, he tells the students to use the information in the diagram to figure out the answer to the question.

NCTM’s Principles to Actions: Ensuring Mathematical Success for All
Mindset, Effort, & Feedback

In what ways do mindsets impact how students view and approach challenging situations?

Reframing Struggle as Expending Effort

Matt Larson, “Seeking Equilibrium” CMC South 2015 Ignite
### Fixed Mindset vs. Growth Mindset

<table>
<thead>
<tr>
<th>From . . .</th>
<th>To . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t get it.</td>
<td>I am confused on this part, but with a little help I know I can figure it out.</td>
</tr>
<tr>
<td>Math is hard.</td>
<td>Math is challenging. When I work hard at it, I can figure it out.</td>
</tr>
<tr>
<td>I give up.</td>
<td>If I stick with it and try different ideas, I can find a way to complete the problem.</td>
</tr>
<tr>
<td>Math is easy.</td>
<td>Math usually comes easy to me, so I like to be challenged with new and different problems.</td>
</tr>
</tbody>
</table>

### Communicating Goals about Productive Struggle

- **Students**
  - Explain your expectations to students
  - Discuss struggle with students
  - You are not trying to be unhelpful, you are trying to help them learn
- **Others**
  - Share what you are doing with your students and why
  - Explain how you offer support for struggling students

Adapted from Robert Kaplinsky, “Productive Struggle” CMC South Ignite 2015
Types of Tasks that Promote Productive Struggle

- Low Floor – High Ceiling Tasks
- Sorting Tasks
- Word problems
- Formative Assessment Lessons
- Real-world tasks
- Open Middle Tasks
  (Open beginning & Open ended tasks too!)

<table>
<thead>
<tr>
<th>Expectations for students</th>
<th>Teacher actions to support students</th>
<th>Classroom-based indicators of success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most tasks that promote reasoning and problem solving take time to solve, and frustration may occur, but perseverance in the face of initial difficulty is important.</td>
<td>Use tasks that promote reasoning and problem solving; explicitly encourage students to persevere; find ways to support students without removing all the challenges in a task.</td>
<td>Students are engaged in the tasks and do not give up. The teacher supports students when they are “stuck” but does so in a way that keeps the thinking and reasoning at a high level.</td>
</tr>
<tr>
<td>Correct solutions are important, but so is being able to explain and discuss how one thought about and solved particular tasks.</td>
<td>Ask students to explain and justify how they solved a task. Value the quality of the explanation as much as the final solution.</td>
<td>Students explain how they solved a task and provide mathematical justifications for their reasoning.</td>
</tr>
<tr>
<td>Everyone has a responsibility and an obligation to make sense of mathematics by asking questions of peers and the teacher when he or she does not understand.</td>
<td>Give students the opportunity to discuss and determine the validity and appropriateness of strategies and solutions.</td>
<td>Students question and critique the reasoning of their peers and reflect on their own understanding.</td>
</tr>
<tr>
<td>Diagrams, sketches, and hands-on materials are important tools to use in making sense of tasks.</td>
<td>Give students access to tools that will support their thinking processes.</td>
<td>Students are able to use tools to solve tasks that they cannot solve without them.</td>
</tr>
<tr>
<td>Communicating about one’s thinking during a task makes it possible for others to help that person make progress on the task.</td>
<td>Ask students to explain their thinking and pose questions that are based on students’ reasoning, rather than on the way that the teacher is thinking about the task.</td>
<td>Students explain their thinking about a task to their peers and the teacher. The teacher asks probing questions based on the students’ thinking.</td>
</tr>
</tbody>
</table>
Productive Struggle

• Revisit your definition of productive struggle.
• Add to, revise, or adjust your definition based on what you have learned.

Next Steps

• Think about 1-2 next steps for mapping out tasks to engage your students in productive struggle.
• Write these down, then share them with a partner.
Session Outcomes

- Redefine the role that effort and struggle play in learning mathematics in your classroom.
- Develop strategies to help students build perseverance as they make sense of and solve problems.
- Explore ways to select and structure tasks to engage your students in productive struggle.

Celebrating Mistakes

https://www.youcubed.org/think-it-up/mistakes-grow-brain/
Resources

• NCTM’s Principles to Actions: Ensuring Mathematical Success for All
• YouCubed Tasks, http://youcubed.org/teachers/category/low-floor-high-ceiling/
• Robert Kaplinsky, “Productive Struggle” CMC South Ignite 2015
• Andrew Stadel, http://mr-stadel.blogspot.com/2015/12/productive-struggle-part-1.html
• “My Favorite No,” https://www.teachingchannel.org/videos/class-warm-up-routine
• Celebrating Mistakes, https://www.youcubed.org/think-it-up/mistakes-grow-brain/

Session Evaluation

• Please take the time to provide feedback on my session, it helps my planning for future sessions and it helps the conference committee determine your needs and wants.
• Use the ERMobile app by downloading it.
• Go to this session and go to Complete Session Survey.

Thank you for your feedback!
Thank you!

Enjoy the rest of your day.

Christine Roberts

christine.roberts@tcoe.org
@mathschristine

Resources: http://ccss.tcoe.org/math/presentations