

Tulare County  
Office of Education

*Jim Vidak, County Superintendent of Schools*

**Mapping Out Tasks to Engage Students  
in Productive Struggle**  
*Grades 3 – 5*

*Christine Roberts*



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[@mathschristine](https://twitter.com/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!*

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- 1:15 PM - 2:45 PM**
- 746. Mapping Out Tasks to Engage Students in Productive Struggle**
- Date:** Saturday, October 28th, 2017
- Time:** 1:15 PM - 2:45 PM
- Room:** Hard Rock Fillmore
- Track:** 3-5
- Strategies:** Acc&Eq Asmt

Below the session details is a paragraph of text: "Turn hazards and pitfalls into powerful learning by structuring tasks to engage students in productive struggle. Explore teacher moves that build student perseverance and build a classroom that values effort and struggle in learning mathematics." Underneath this text is the name "Christine Roberts" and "Tulare COE". At the bottom of the screen is a button labeled "Complete Session Survey". A large blue arrow points from the right side of the screen towards this button.

## 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.*

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## 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.

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## 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?



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## 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.

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## 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 should do . . .

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

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## What is productive struggle?

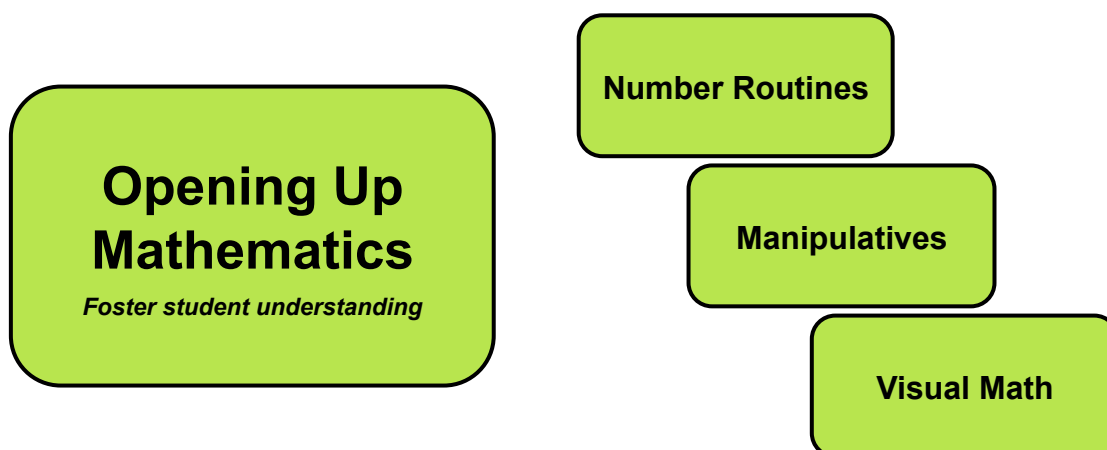
How does our view of struggle impact our instruction?

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.

NCTM's Principles to Actions: Ensuring Mathematical Success for All p. 48 11

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## Creating a Classroom that Supports Productive Struggle



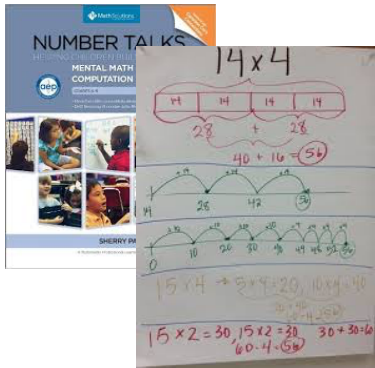
Structuring Mathematical Tasks to Engage Students in Productive Struggle, NCTM – Nick Lopez, DUSD & Christine Roberts, TCOE

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# How can we make math accessible again?

**Number Routines**



Nick Lopez, DUSD

**Manipulatives**



**Visual Math**



# Creating a Classroom that Supports Productive Struggle

**Teacher Steps**

*Foster growth mindsets*

**Messaging**

**Feedback**

**Norms & Expectations**

Nick Lopez, DUSD

## Classroom Norms

Everyone can learn math to the highest levels

Mistakes are valuable



Questions are really important

Math is about creativity and making sense

Math is about connections and communicating

Math class is about learning not performing

Depth is more important than speed

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## Creating a Classroom that Supports Productive Struggle


### Student Actions

*Foster student ownership*

Evidence of Learning

Goal setting

Reflection  
Self-Assessment

Nick Lopez, DUSD 16 

# Number Puzzles Card Sort

**A - This number has 2 factors and can be used to make a rectangle with whole number side lengths.**

**B - This number has exactly 8 factors.**

**C - 1 factor of this number is 1.**

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

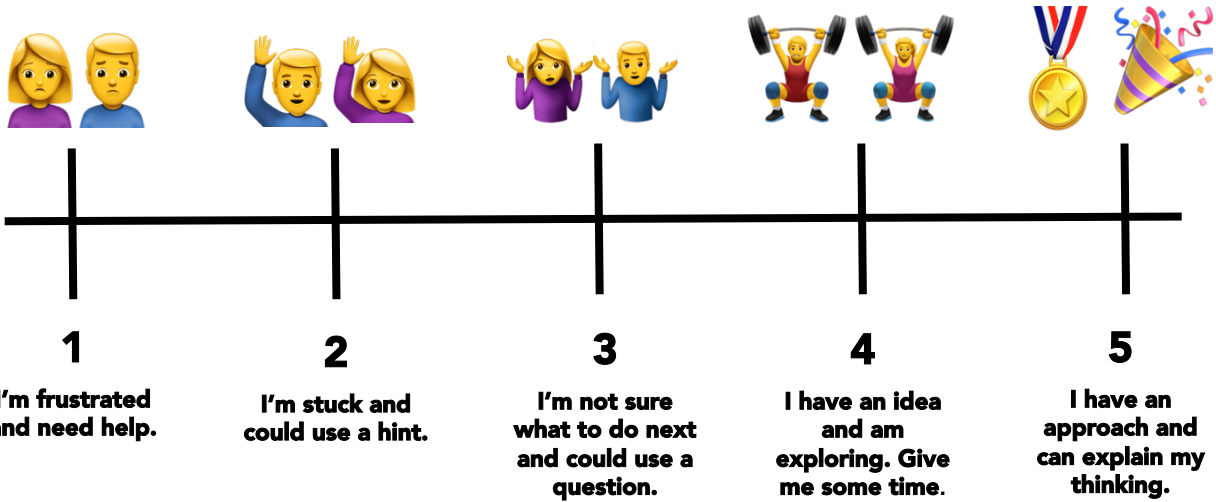
**NUMBER PUZZLE 1:**

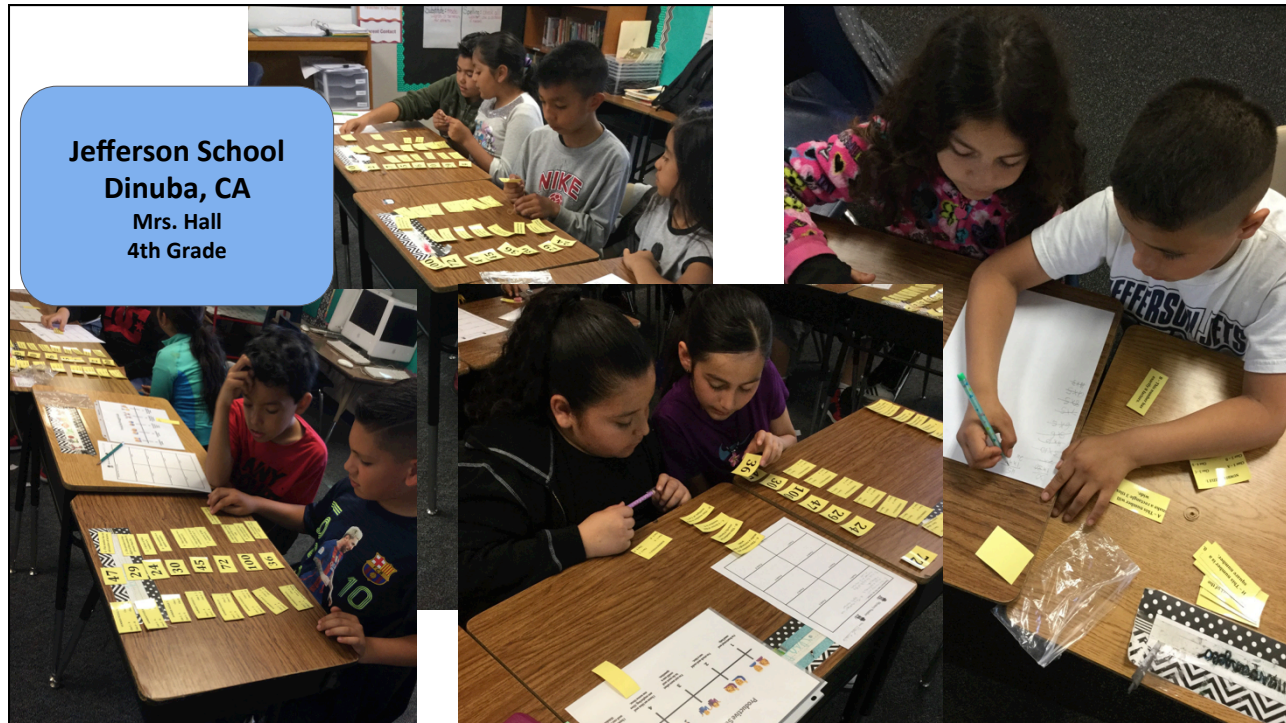
Clue 1 - A	Clue 3 - C
Clue 2 - B	Clue 4 - D

<http://teresaemmert.weebly.com/4th-grade-fals.html> 17

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## Productive Struggle Scale





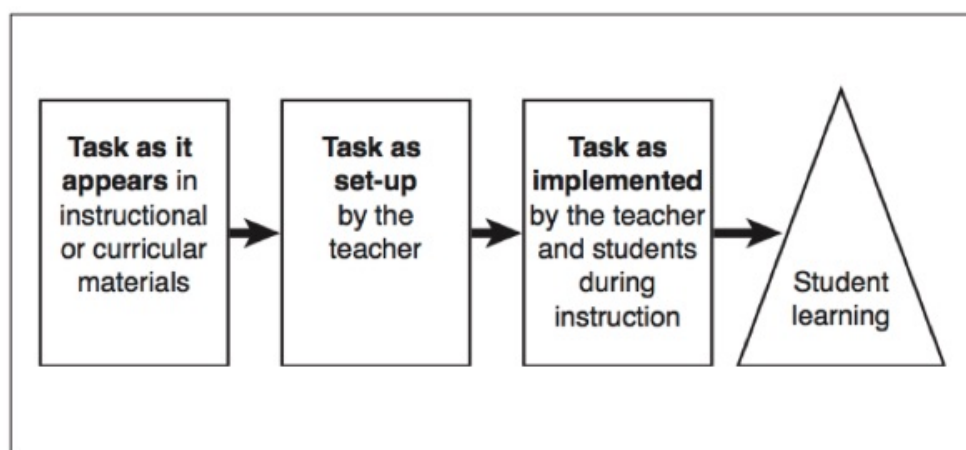
## Reflection: Number Puzzles Card Sort

- 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

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# Low Floor High Ceiling Task:

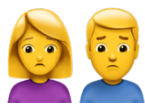
What's the Secret Code?  
Green Group

- 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.
- What code numbers fit these clues?

<http://youcubed.org/teachers/category/low-floor-high-ceiling/> 23

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## 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?

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## Student Support

### Beginning of the Task

Read and Flip

Individual  
Think/Work  
Time

Group Huddle

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## Student Support

### During the Task

**Spy**

**Collaborative  
Structures**

**Teacher  
Questioning**

**Student  
Questioning**

**Just in time  
support**

Nick Lopez, DUSD

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## 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>

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# Teacher Responses to Student Struggle

**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 immediately at a loss, upset, 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 fifth grade and plan their lessons collaboratively. Their current instructional unit focuses on fractions. They have selected the Shopping Trip task shown below because they think it will be accessible to their students yet provoke some struggle and challenge, since a solution pathway is not straightforward. The mathematics goal for students is to draw on and apply their understanding of how to build non-unit fractions from unit fractions and to use visual representations 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 \$24 remaining. He had spent  $\frac{3}{5}$  of his birthday money at the mall on video games and food. 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 see students struggling to get started. Some students in both classrooms immediately raise their hands, saying, "I don't get it," or "I don't know what to do."

Ms. Flahive is very directive in her response to her students. She tells them to draw a rectangle and shows them how to divide it into fifths to represent what Joseph had spent and what he had left. She then guides her students step by step until they have labeled each one-fifth of the rectangle as worth \$12, as shown below. Finally, she tells the students to use the information in the diagram to figure out the answers to the questions.

Ms. Ramirez approaches her students' struggles very differently. After she sees them struggling, she has them stop working on the problem and asks all the students to write down two things that they know about the problem and one thing that they wish they knew because it would help them make progress in solving the problem. Then Ms. Ramirez initiates a short class discussion in which several ideas are offered for what to do next. Suggestions include drawing a tape diagram or number line showing fifths, or just picking a number, such as \$50 and proceeding through trial and error. Ms. Ramirez encourages the students to consider the various ideas that have been shared as they continue working on the task.

Fig. 21. Two teachers' responses to students' struggles to solve a multi-step word problem involving fractions

- 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?

*NCTM's Principles to Actions: Ensuring Mathematical Success for All*

# Teacher and Student Actions

Support productive struggle in learning mathematics Teacher and student actions	
What are teachers doing?	What are students doing?

# Mindset, Effort, & Feedback

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

## Reframing Struggle as Expending Effort



<https://flic.kr/p/8GnE1X>



<https://i.ytimg.com/vi/ST7DhwKdkC0/maxresdefault.jpg>

Matt Larson, "Seeking Equilibrium" CMC South 2015 Ignite 32

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## Fixed Mindset vs. Growth Mindset

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

## 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 Ingnite 2015 34


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Expectations for students	Teacher actions to support students	Classroom-based indicators of success
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.	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.	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.
Correct solutions are important, but so is being able to explain and discuss how one thought about and solved particular tasks.	Ask students to explain and justify how they solved a task. Value the quality of the explanation as much as the final solution.	Students explain how they solved a task and provide mathematical justifications for their reasoning.
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.	Give students the opportunity to discuss and determine the validity and appropriateness of strategies and solutions.	Students question and critique the reasoning of their peers and reflect on their own understanding.
Diagrams, sketches, and hands-on materials are important tools to use in making sense of tasks.	Give students access to tools that will support their thinking processes.	Students are able to use tools to solve tasks that they cannot solve without them.
Communicating about one’s thinking during a task makes it possible for others to help that person make progress on the task.	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.	Students explain their thinking about a task to their peers and the teacher. The teacher asks probing questions based on the students’ thinking.

NCTM’s Principles to Actions: Ensuring Mathematical Success for All

## 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!)



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## Productive Struggle

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



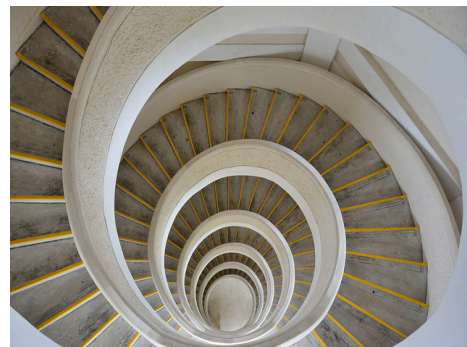
<https://flic.kr/p/dfUbRZ>

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## 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.



<https://flic.kr/p/bpULh5>

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## 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.

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## Celebrating Mistakes



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

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## 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>
- Teresa Emmert, <http://teresaemmert.weebly.com/4th-grade-fals.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/>

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# Thank you!

Enjoy the rest of your day.

Christine Roberts



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@mathschristine

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