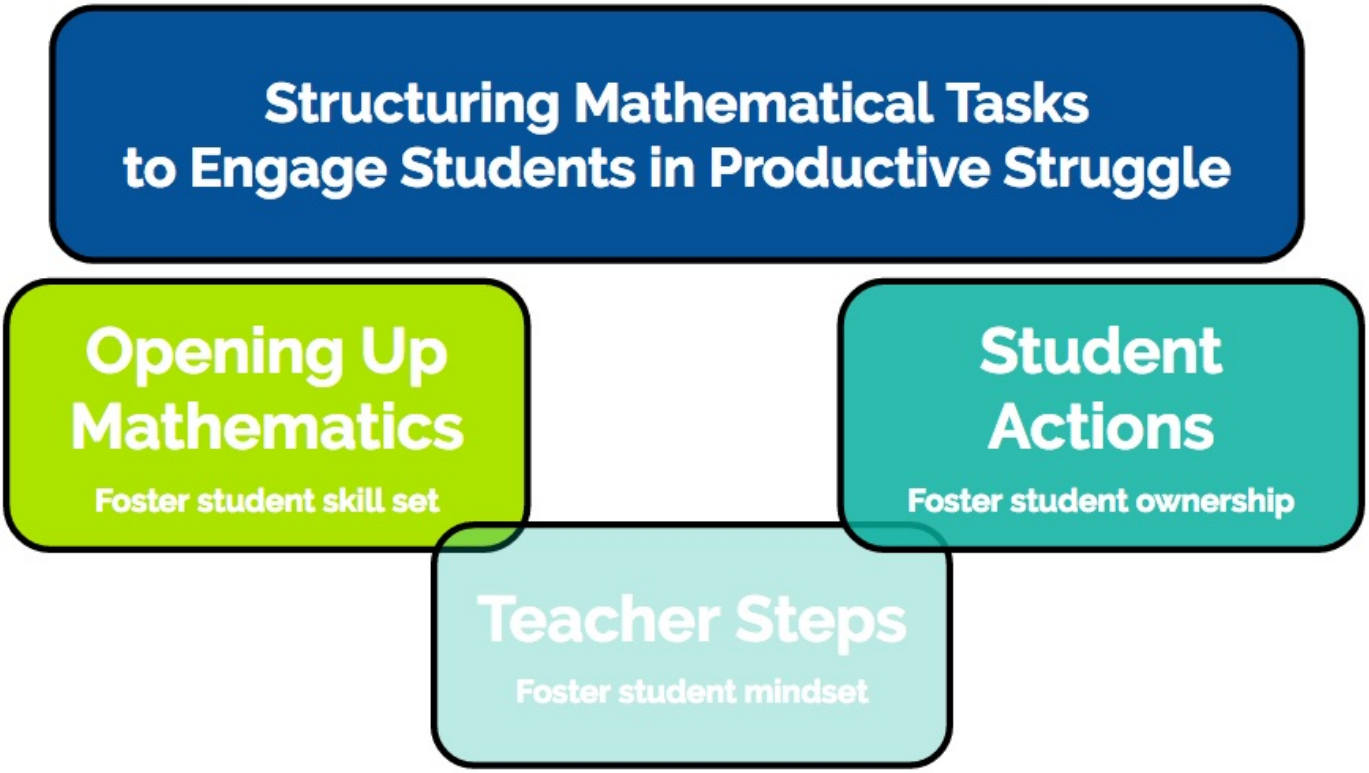

What is productive struggle?

Initial Definition	Revised Definition

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arise. Thinking about these in advance allows teachers to plan ways to support students productively without removing the opportunities for students to develop deeper understanding of the mathematics.

Mathematics classrooms that embrace productive struggle necessitate rethinking on the part of both students and teachers. Students must rethink what it means to be a successful learner of mathematics, and teachers must rethink what it means to be an effective teacher of mathematics. Figure 20 summarizes one such effort to redefine success in the mathematics classroom (Smith 2000), including expectations for students in regard to what it means to know and do mathematics, and actions for teachers with respect to what they can do to support students' learning, including acknowledging and using struggles as opportunities to learn.

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.

Fig. 20. Redefining student and teacher success. Adapted from Smith (2000, p. 382).

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?

3. Explain how you used all of these clues to find these possibilities.

4. Write one more clue so that there is only one possible code number.

From *Math for All: Differentiating Instruction, Grades 6-8* by Linda Dacey & Karen Gartland (Sausalito, CA: Math Solutions), pp. 257. Reprinted with permission.

Structure for Supporting Student Understanding and Solving of a Task/Word Problem

1. Introduce the task to the students.
2. Read the problem – Have students read the task/word problem independently without marking the text and turn over the task/word problem when they are done reading.
3. Group Share – The teacher will ask all students to turn over the task and share something they remember about the task in partners or in small groups.
4. Read the problem – Have students reread the task/word problem independently and mark the text without beginning the problem.
5. Group Share – The teacher will ask all students to turn over the task and share something they remember about the task in partners or in small groups.
6. Independent Work Time – Ask the students to begin solving the problem independently. Tell them that they will have a group check in time after x number of minutes.
7. Group Check In – Ask students to take turns sharing something that they tried that worked or did not work and what they learned from it. They may not share a solution at this point.
8. Independent Work Time – Ask students to continue solving the problem independently. Tell them that they will have another group check in time after x number of minutes.
9. Group Check In – Ask students to share possible solutions and how they determined their possible solutions. They may work together collaboratively at this point to help all students in the group reach a solution.
10. Group Share Out – Have 1 person from each group list a possible solution on the board.
11. Teacher asks students to look at the possible solutions and share with their table groups to determine if they agree or disagree with the solutions posted.
12. Group Share Out – Have groups share out a solution that they agree or disagree with and why.
13. Class Conversation – The teacher facilitates a whole class conversation based on what he/she noticed during group discussions and group share outs.

Read and flip over structure adapted from Max Ray's NCSM 2014 Presentation: *Does That Make Sense in the Story? Front-loading Formative Assessment During Problem Solving*, http://mathforum.org/nctm/2014/ncsmpresent.html