
# Learning from Students' Productive Struggle

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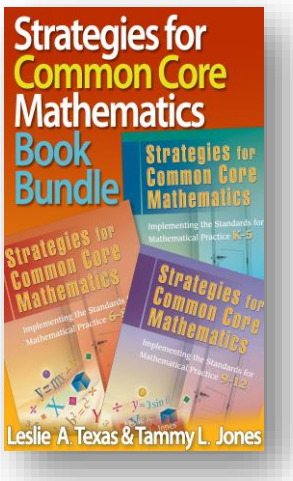


K-5

6-8

9-12


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# A Toolkit for Successful Implementation of: *The CCSSM: A Closer Look at the Standards for Mathematical Practice in the Classroom*



**SMP Questions & Look Fors:**

1. **Make sense of problems and persevere in solving them.**
   Questions:

   - What is the problem asking?
   - What is known?
   - What does a "solution to the problem look like?
   - What's a reasonable strategy to use?
   - What if I get stuck?
   - Is my solution reasonable?

   Look Fors: **Students:**
   - Actively engaged in authentic problem solving vs. simply solving problems.
   - Reading and comprehending texts across a range of types and disciplines.
   - Actively engaged in scientific inquiry by defining the problem to be solved.

   Look Fors: **Teachers:**
   - choosing and planning for opportunities for students to be engaged in authentic, rigorous, and rich experiences that meet the needs of a diverse population.
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   - preparing by first engaging in the student experience themselves to determine where students might encounter difficulties and by developing questions that will help move both the learner and the learning forward.
   - providing time for and facilitating discourse around the reading and understanding needed to identify the problem, question or dilemma.
   - Provide time for and facilitate mathematical discourse around strategies and solutions.
2. **Reason abstractly and quantitatively.**
   Questions:

   - How do I interpret this quantitative relationship?
   - What is the abstract relationship between the specific quantities?
   - How can I decontextualize the numbers to find a mathematical relationship?
   - Are the relationships between the quantities represented correctly?
   - Which operations and equivalences will simplify and help me solve the problem?
   - Does my abstract representation of the quantities make sense in context?

   Look Fors: **Students:**
   - Understands the context of the problem and the quantities involved as well as how to work with the quantities.
   - can discern pertinent information from that which is not.
   - Uses multiple representations and approaches when solving problems.

   Look Fors: **Teachers:**
   - Provides a range of representations of mathematical ideas and problem situations and encourages varied solution paths.
   - provide opportunities that create a need for students to develop a plan or strategy.
3. **Construct viable arguments and critique the reasoning of others.**
   Questions:

   - How did I think about this?
   - Is my answer reasonable and/or mathematically sound?
   - Does this argument make sense?
   - Have I sufficiently supported my answer and shown my work?
   - How might my peers critique my reasoning?
   - How could I demonstrate a counter-example?

   Look Fors: **Students:**
   - Understand and use prior learning in constructing arguments. Can justify their reasoning.
   - identify the specific types of evidence required by different disciplines.
   - are designing solutions/conclusions to problems, questions, and/or dilemmas.
   - "… convey intricate or multifaceted information." (ELA 1)

- "... refine and share their knowledge through writing and speaking." (ELA 2)
- "…adapt their communication in relation to audience, task, purpose, and discipline. (ELA 3)

Look Fors: **Teachers:**

- allow students opportunities to engage in the process of argumentation.
- provide time for students to engage in planning and creation of an analysis.
- create situations that call for students to communicate information, evidence, and ideas in multiple ways. (NGSS 8)

**4. Model with mathematics.**

Questions:

- Does this problem arise from everyday life, society, or the workplace?
- How can you write an expression or equation to describe this situation?
- What assumption and/or approximation can be made to simplify this situation?
- What important quantities are there?
- Would it be helpful to create one of the following: diagram; table; graph; flowchart; or formula?
- What mathematical relationship(s) did you use to draw your conclusions?
- Is there a need to improve your model? If so how will you improve it?

Look Fors: **Students:**

- Apply mathematics learned to problems they solve and reflect on the results.
- use pattern(s)/relationship(s) to create a model (using various representations).
- extend known patterns and/or relationships and structures to refine the strategy/plan.
- refine their model as needed.

Look Fors: **Teachers:**

- Provide a variety of contexts for students to apply the mathematics learned.
- provide opportunities that create a need for students to develop a plan, strategy, or analysis.

**5. Use appropriate tools strategically.**

Questions:

- What tools should I use to be most efficient and effective?
- What are the strengths and weaknesses of the tools at hand, and might there be better ones for the task?
- Where might I find more helpful resources when needed?

Look Fors: **Students:**

- are choosing and using appropriate tools strategically.
- Know when to use tools and which tools to use to deepen their understanding.

Look Fors: **Teachers:** Strategically implements various technologies at the point of instruction to make mathematics accessible to all students.

**6. Attend to precision.**

Questions:

- What are the terms that clearly need to be understood?
- What units should be used with this problem?
- To what degree of precision should my answer reflect?
- Is my answer reasonable?
- Have I answered the question posed?

Look Fors: **Students:** Students recognize terms that need to be clearly defined, apply the appropriate degree of precision for the data in the problem, understand and use appropriate units of measurement, and check for the reasonableness of their thinking & work.

Look Fors: **Teachers:**

- Emphasizes the importance of mathematical vocabulary, models precise communication, and facilitates mathematical discourse.
- plan deliberately and intentionally to include critical skills needed in creating a valid report.

7. **Look for and make use of structure.**
Questions:

- Is there an underlying pattern? If so, what is it?
- Can the pattern be extended? If so, how is one way?
- To what structure can the pattern be tied?
- How might a shift in perspective reveal more about the pattern?

Look Fors: **Students:** Look for, develop, and generalize patterns. Students formalize the structures they discover.
Look Fors: **Teachers:** Provides opportunities for "pattern sniffing," as well as time to be "conjecturers." (Habits of Mind, Costa & Kallick) Also provides time for students to apply and discuss properties.

8. **Look for and express regularity in repeated reasoning.**
Questions:
- What is a summary way to discuss the patterns you found?
- What predictions or generalizations can this pattern support?
- Will the same strategy work in other situations?

Look Fors: **Students:**
- Use repeated applications to generalize properties.
- extend known patterns and/or relationships and structures to refine the strategy/plan.

Look Fors: **Teachers:**
- Models and encourages students to look for and discuss general methods and shortcuts.

**In general teachers:**
- provide a wide range of subject matter from multiple sources that are of "quality and substance" for students to read.
- support students with specific feedback that will move the learner and learning forward. (*5 Strategies* Thompson & Wiliam)
- provide access to necessary resources.
- monitor student work to provide feedback to make sure students are on track toward the outcome.