# Procedural Fluency from Conceptual Understanding

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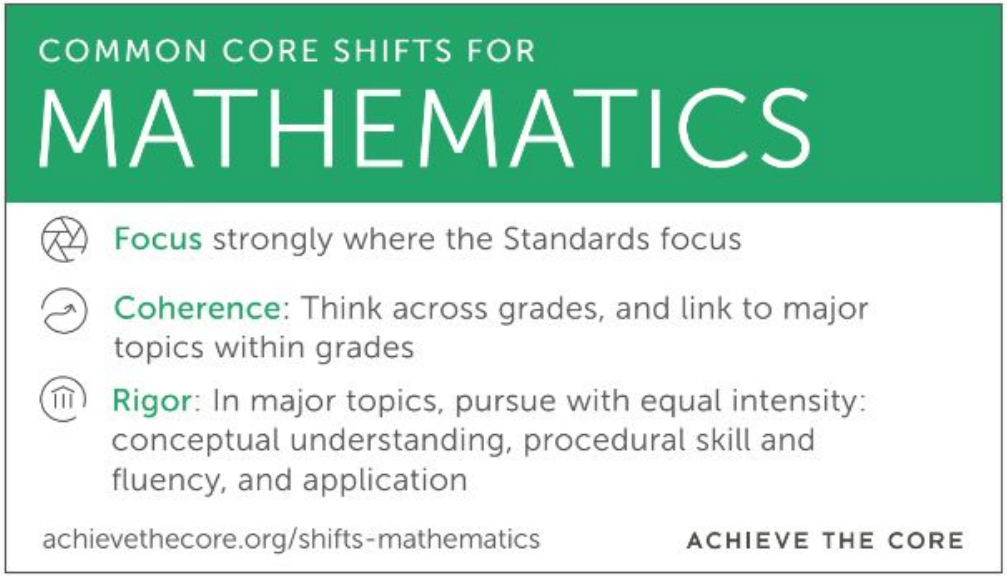
https://todaysmeet.com/TQRP_CCSSMath

# Agenda

- Revisit the Math Shifts
- Discussion on responses to pre-reading
- What is procedural fluency & how do you build it?
- Analyze a problem
- Teacher & Student Actions
- Questions & Closing

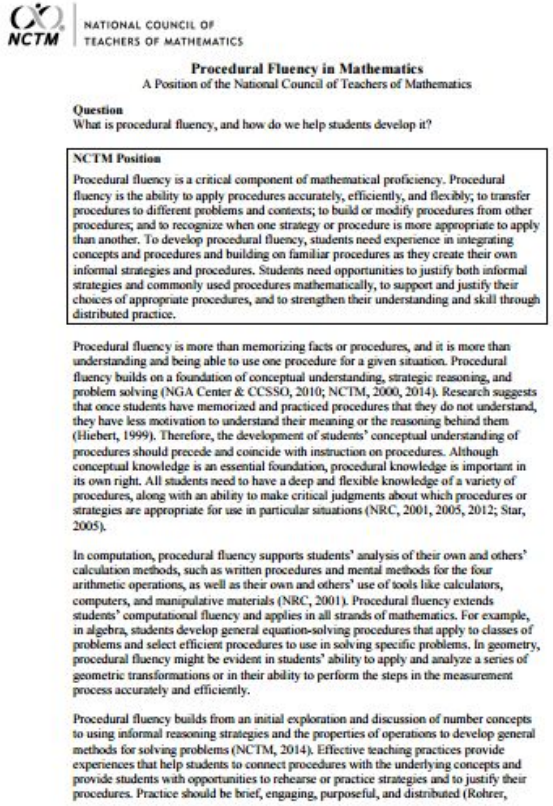
# Key Shifts in Mathematics

Since the summer experience, how have you attended to the shifts in your classroom or in your teacher preparation courses?



# Procedural Fluency in Mathematics

- What **A**ssumptions does the author of the text hold?
- What do you **A**gree with in the text?
- What do you want to **A**rgue with in the text?
- What parts of the text do you want to **A**spire to (or Act upon)?



NCTM NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

**Procedural Fluency in Mathematics**
A Position of the National Council of Teachers of Mathematics

**Question**
What is procedural fluency, and how do we help students develop it?

**NCTM Position**

Procedural fluency is a critical component of mathematical proficiency. Procedural fluency is the ability to apply procedures accurately, efficiently, and flexibly; to transfer procedures to different problems and contexts; to build or modify procedures from other procedures; and to recognize when one strategy or procedure is more appropriate to apply than another. To develop procedural fluency, students need experience in integrating concepts and procedures and building on familiar procedures as they create their own informal strategies and procedures. Students need opportunities to justify both informal strategies and commonly used procedures mathematically, to support and justify their choices of appropriate procedures, and to strengthen their understanding and skill through distributed practice.

Procedural fluency is more than memorizing facts or procedures, and it is more than understanding and being able to use one procedure for a given situation. Procedural fluency builds on a foundation of conceptual understanding, strategic reasoning, and problem solving (NGA Center & CCSSO, 2010; NCTM, 2000, 2014). Research suggests that once students have memorized and practiced procedures that they do not understand, they have less motivation to understand their meaning or the reasoning behind them (Hiebert, 1999). Therefore, the development of students' conceptual understanding of procedures should precede and coincide with instruction on procedures. Although conceptual knowledge is an essential foundation, procedural knowledge is important in its own right. All students need to have a deep and flexible knowledge of a variety of procedures, along with an ability to make critical judgments about which procedures or strategies are appropriate for use in particular situations (NRC, 2001, 2005, 2012; Star, 2005).

In computation, procedural fluency supports students' analysis of their own and others' calculation methods, such as written procedures and mental methods for the four arithmetic operations, as well as their own and others' use of tools like calculators, computers, and manipulative materials (NRC, 2001). Procedural fluency extends students' computational fluency and applies in all strands of mathematics. For example, in algebra, students develop general equation-solving procedures that apply to classes of problems and select efficient procedures to use in solving specific problems. In geometry, procedural fluency might be evident in students' ability to apply and analyze a series of geometric transformations or in their ability to perform the steps in the measurement process accurately and efficiently.

Procedural fluency builds from an initial exploration and discussion of number concepts to using informal reasoning strategies and the properties of operations to develop general methods for solving problems (NCTM, 2014). Effective teaching practices provide experiences that help students to connect procedures with the underlying concepts and provide students with opportunities to rehearse or practice strategies and to justify their procedures. Practice should be brief, engaging, purposeful, and distributed (Rohrer,

# Learning Target

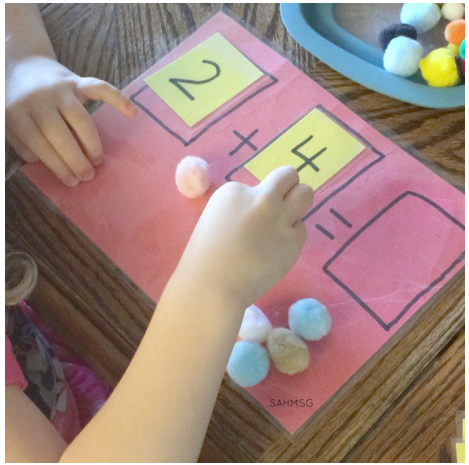
I can incorporate the teaching practice of building procedural fluency from conceptual understanding.

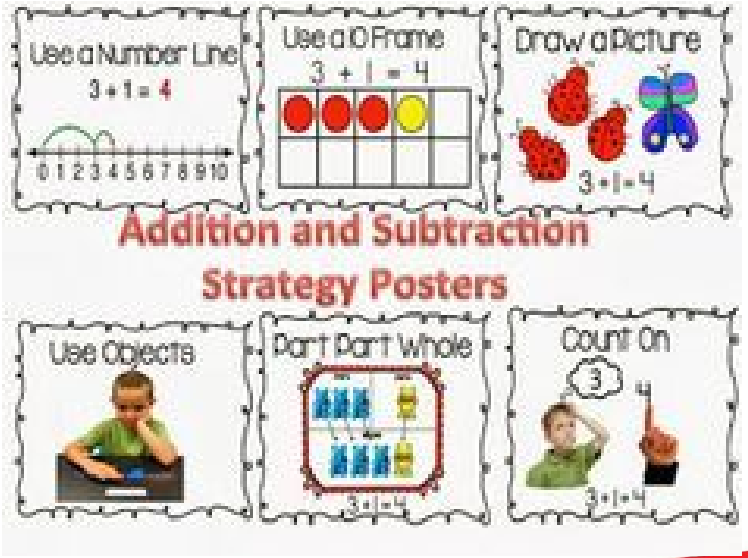
## What does fluency mean?

- Students are able to choose flexibly among methods and strategies to solve contextual and mathematical problems.
- Students understand and are able to explain their approaches.
- Students are able to produce accurate answers efficiently.

# How does fluency build?

**Exploration And Discussion** → **Informal Reasoning Strategies** → **Develop & Use General Methods**




$3 + 4 =$

$6 + 5 =$

$9 + 7 =$

# How does fluency build?

**Exploration And Discussion** → **Informal Reasoning Strategies** → **Develop & Use General Methods**

8+4

8+ 


(8+2)+2
10+2
12

8+4=12

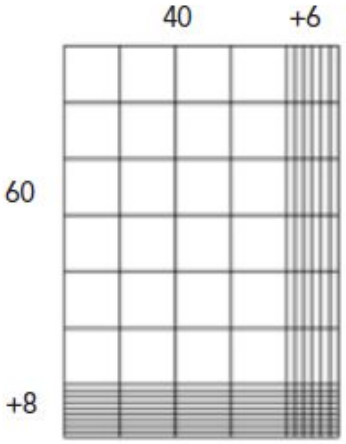
## Compute 46 x 68

Solve this problem in at least two ways.

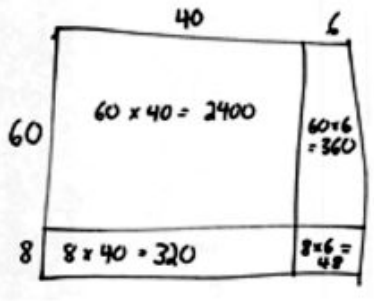
What does a student need to understand to answer this problem?

Describe how the models and algorithms relate to key understandings about multiplying multi-digit numbers.

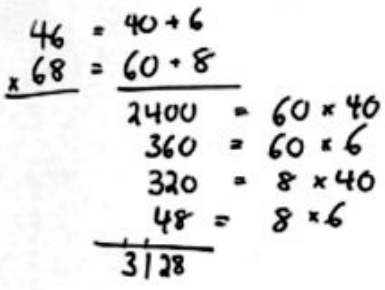
## Array model



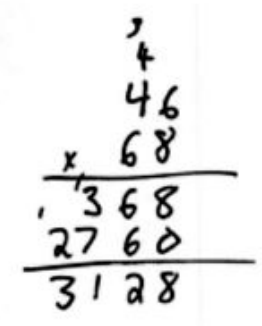

## Open array model




## Accessible algorithm




## Conventional algorithm



| What are teachers doing? | What are students doing? |
| --- | --- |
| A) Providing students with opportunities to use their own reasoning strategies and methods for solving problems. | A) Making sure that they understand and can explain the mathematical basis for the procedures that they are using. |
| B) Asking students to discuss and explain why the procedures that they are using work to solve particular problems. | B) Demonstrating flexible use of strategies and methods while reflecting on which procedures seem to work best for specific types of problems. |
| C) Connecting student-generated strategies and methods to more efficient procedures as appropriate. | C) Determining whether specific approaches generalize to a broad class of problems. |
| D) Using visual models to support students' understanding of general methods. | D) Striving to use procedures appropriately and efficiently. |
| E) Providing students with opportunities for distributed practice of procedures. | |

## What are teachers doing?

A) Providing students with opportunities to use their own reasoning strategies and methods for solving problems.

B) Asking students to discuss and explain why the procedures that they are using work to solve particular problems.

C) Connecting student-generated strategies and methods to more efficient procedures as appropriate.

D) Using visual models to support students' understanding of general methods.

E) Providing students with opportunities for distributed practice of procedures.

**Which action would you like to work on or know more about?**

**What are the challenges in taking that action?**

**How can you prepare to incorporate this action into your teaching?**

# Post Webinar Assignment

Choose one of the teacher actions and focus on it through a series of lessons.

Be prepared to share your experience next time.


## What are teachers doing?

A) Providing students with opportunities to use their own reasoning strategies and methods for solving problems.

B) Asking students to discuss and explain why the procedures that they are using work to solve particular problems.

C) Connecting student-generated strategies and methods to more efficient procedures as appropriate.

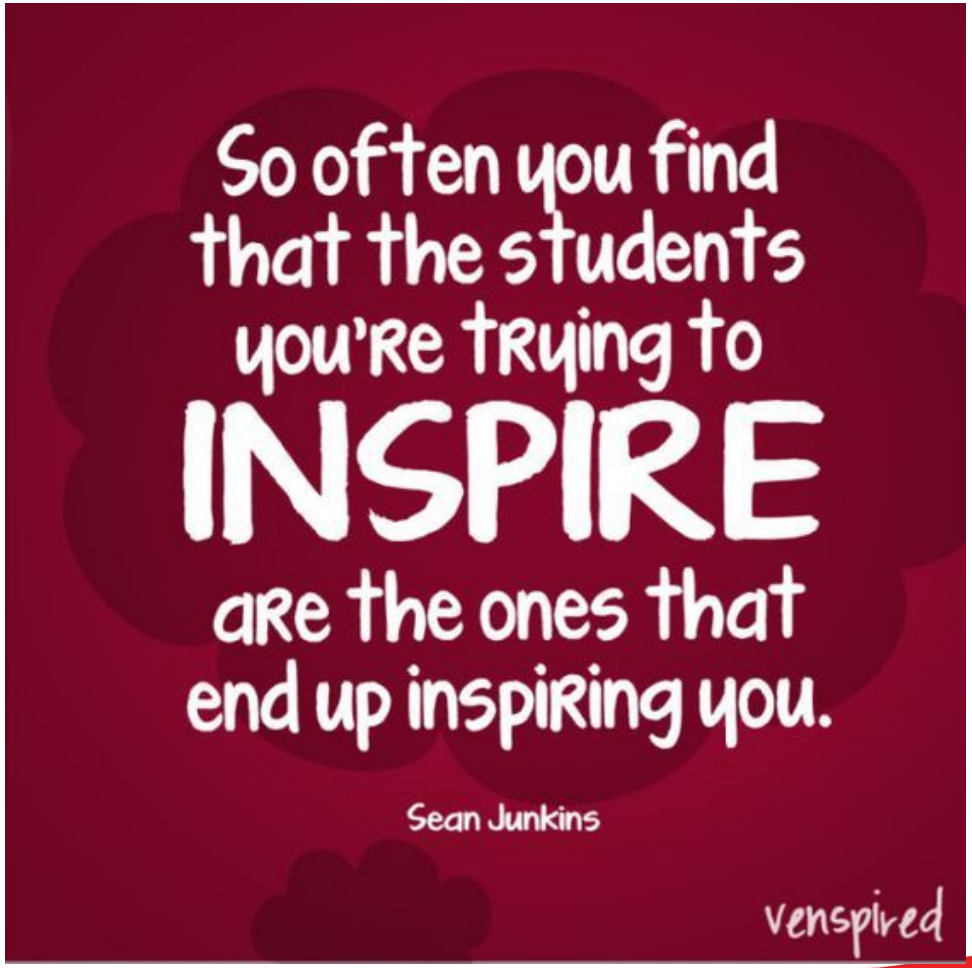
D) Using visual models to support students' understanding of general methods.

E) Providing students with opportunities for distributed practice of procedures.


Questions

# Reference


Principles to Actions : Ensuring Mathematical Success for All. Reston, VA :NCTM, National Council of Teachers of Mathematics, 2014.


So often you find
that the students
you're trying to
INSPIRE
are the ones that
end up inspiring you.
Sean Junkins
venspired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