NCTM Virtual 2021 ANNUAL MEETING April 21-May 1

#NCTMAnnual

Relating the NCTM Mathematics Teaching Practices to Support Learning Difficult Math Topics

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Paper presented at the Annual Conference of the National Council of Teachers of Mathematics, 2021.

For more details about all CCSS domains, please see the 22 hours of audio-visual Teaching Progressions I have made. You can find links to these, to classroom videos, and to papers and other presentations at

karenfusonmath.com

This presentation is also posted there.

Sharing ideas

I wish that we could have an in-person discussion of what you see about the NCTM practices when we watch each video and what you want to share about your own teaching of these two difficult topics. Instead I will ask you to type into the chat your thoughts about these. I will collect the chat and make it available to those who want to see it. If you want to see all of the comments, please send me an email to

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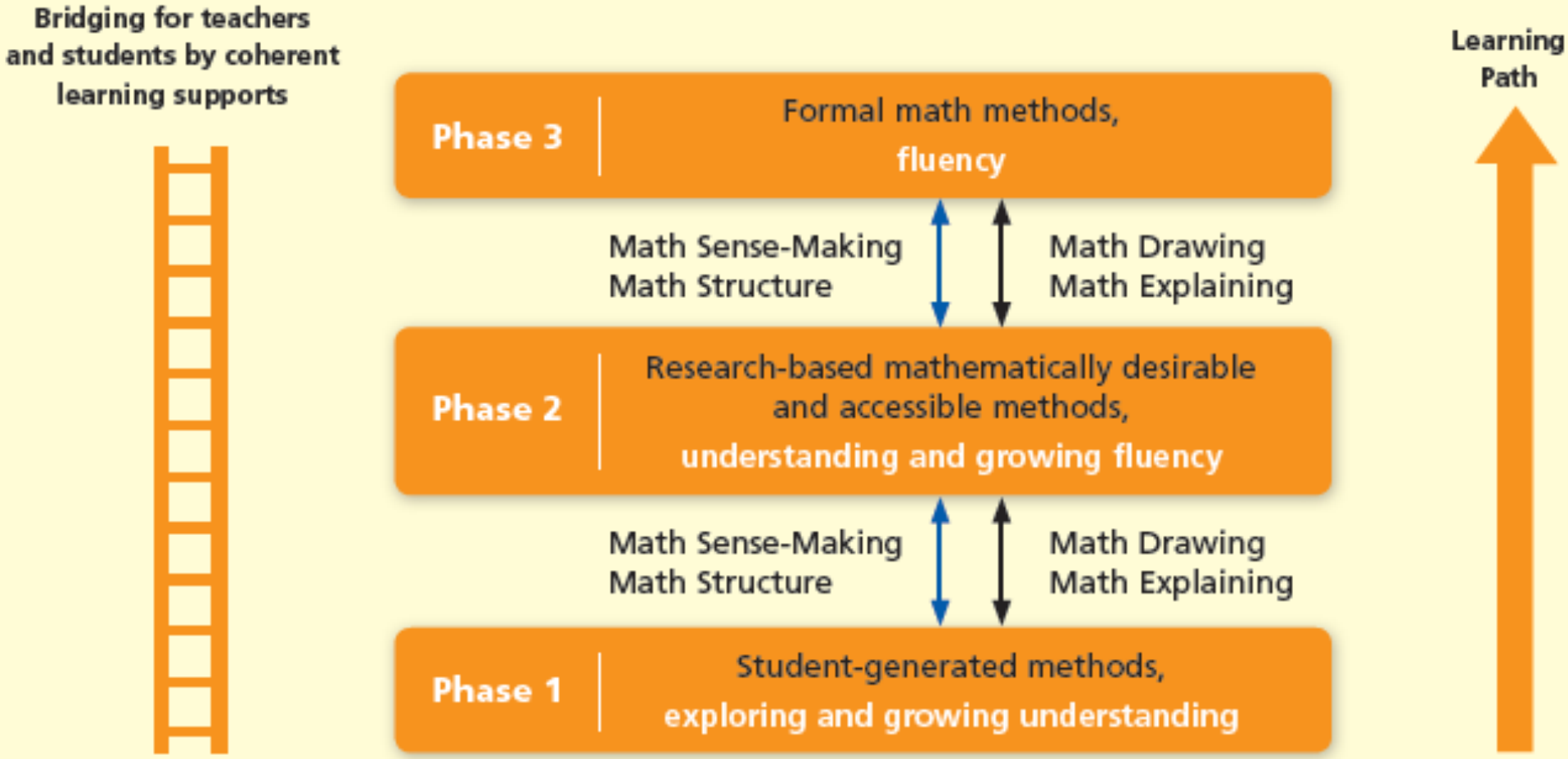
with NCTM chat as the subject line. People watching after April 23 are welcome to email me questions or comments, and I will gather these and send out another summary in early July.

Inquiry Learning Path

in the Math Talk Community



Balanced Inquiry Learning Path teaching requires

mathematically desirable and accessible situational diagrams,

mathematically desirable and accessible drawings of numbers,

mathematically desirable and accessible computational methods.

My many years of classroom research focused on finding, developing, and testing these in varied classrooms of students.

They all involve learning paths to bring students from where they start to fluency with advanced enough methods.

You can find details of all of these on my website in the Teaching Progressions and in the classroom videos. karenfusonmath.com

The Common Core State Standards support schools to teach using learning paths of students because the math standards progress and build sensibly.

Standards for Mathematical Practice

Math Sense-Making	Math Structure	Math Drawings	Math Explaining
Make sense and use of appropriate precision.	**See structure and generalize.**	**Model and use tools.**	**Reason, explain, and question.**
MP1 Make sense of problems and persevere in solving them. **MP6** Attend to precision.	**MP7** Look for and make use of structure. **MP8** Look for and express regularity in repeated reasoning.	**MP4** Model with mathematics. **MP5** Use appropriate tools strategically.	**MP2** Reason abstractly and quantitatively. **MP3** Construct viable arguments and critique the reasoning of others.
Teachers continually assist students to do math sense-making about math structure using math drawings to support math explaining.			

Teachers continually assist students to do **math sense-making** about **math structure** using **math drawings** to support **math explaining**.

NCTM Mathematics Teaching Practices

Three teaching practices are about learning progressions:

Build procedural fluency from conceptual understanding.

Establish mathematics goals to focus learning.

And situate goals within learning progressions.

Support productive struggle in learning mathematics.

NCTM Mathematics Teaching Practices

Six teaching practices are about moment-to-moment teaching:

Implement tasks that promote reasoning and problem solving.

Use and connect mathematical representations.

Facilitate meaningful mathematical discourse.

Elicit and use evidence of student thinking.

Pose purposeful questions.

Support productive struggle in learning mathematics.

NCTM Mathematics Teaching Practices

Implement tasks that promote reasoning and problem solving.

It is NOT THE TASKS that promote reasoning and problem solving.

It is using the Mathematical Teaching Practices:

Teachers continually assist students to do **math sense-making** about **math structure** using **math drawings** to support **math explaining**.

A nurturing meaning-making visual Math Talk Community:

is an inquiry-based teaching/learning environment and has a continual focus on sense-making by all participants.

Students are expected:

- to understand what they are doing,
- come to be able to explain their thinking,
- understand the thinking of other students,
- learn to seek help when they need it, and
- help others who need it.

Subtraction with ungrouping

Mathematically desirable and accessible drawings of numbers

Mathematically desirable and accessible computational methods

What is the very typical error made in multidigit subtracting?

$$\begin{array}{r} 346 \\ -\ 189 \\ \hline \end{array}$$

Subtraction with ungrouping

Mathematically desirable and accessible drawings of numbers

Mathematically desirable and accessible computational methods

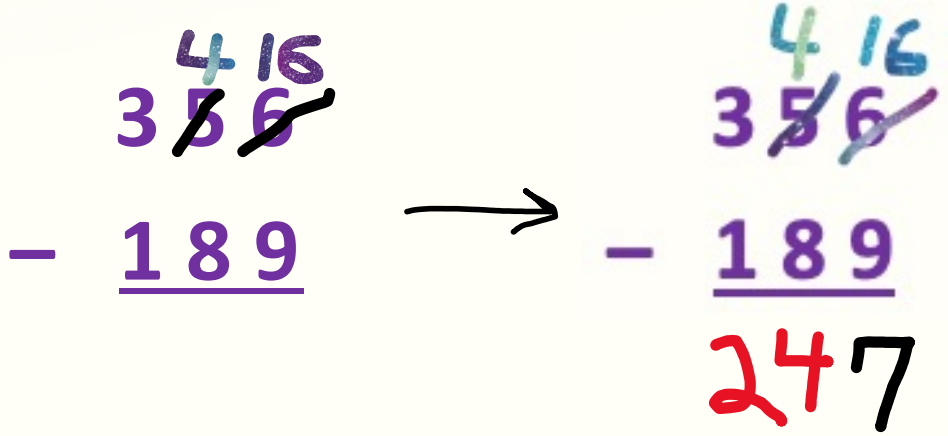
What is the very typical error made in multidigit subtracting?

$$\begin{array}{r} 356 \\ -\ 189 \\ \hline 233 \end{array}$$

So we need a method and concepts that inhibit this error.

Subtraction with ungrouping

What is another frequent error made in multidigit subtracting in the usual alternating method?



So we need a non-alternating method to reduce this error.

There is no one "standard algorithm." There are variations in ways to record efficient, accurate, and generalizable methods that form the collection of standard algorithms.

Some methods are better than others; my research is about these. These are in classroom videos, papers, and Teaching Progressions on my website.

Most taken to be "standard algorithms" are difficult or misleading.

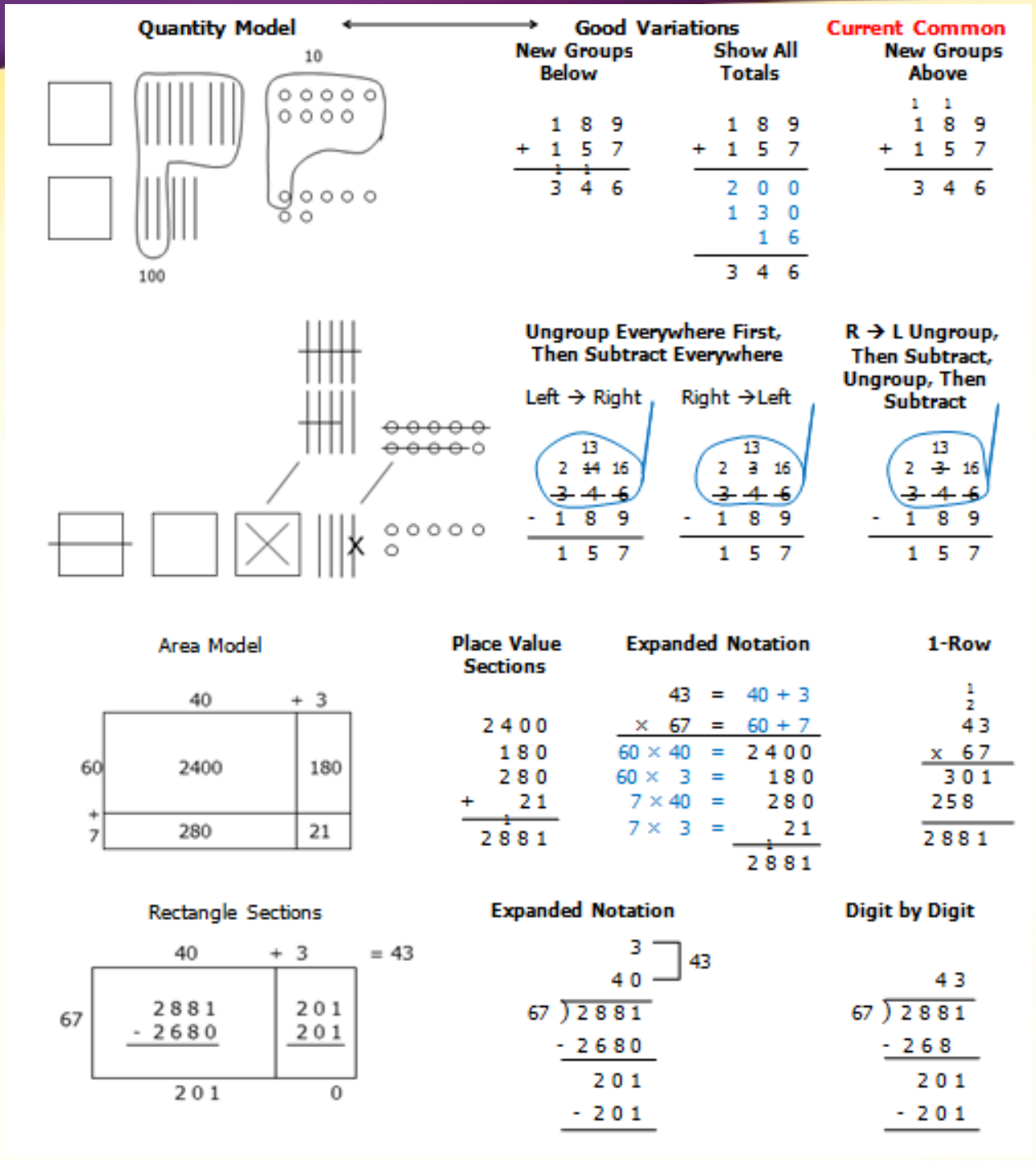
The CCSS say in the critical area for the first year of a given computation: "Students develop, discuss, and use efficient, accurate, and generalizable methods."

They do not say to wait until Grade 4 to do "standard algorithms."

More details are in the paper below (it is on my website under publications).

Fuson, K. C. & Beckmann, S. (Fall/Winter, 2012-2013). Standard algorithms in the Common Core State Standards. *National Council of Supervisors of Mathematics Journal of Mathematics Education Leadership, 14 (2)*, 14-30.

Drawings and Written Variations of Standard Algorithms



NCTM Mathematics Teaching Practices

As you watch this video of English language learners in a high poverty school explain 3-digit subtraction by ungrouping from the left and then subtracting from the left, think about these teaching practices:

Build procedural fluency from conceptual understanding.

Use and connect mathematical representations.

Facilitate meaningful mathematical discourse.

NCTM Mathematics Teaching Practices

After the video we will pause for a couple of minutes while you type into the chat your thoughts about any of the three NCTM teaching practices and the video. I will collect the chat and make it available to those who want to see it and respond to questions. If you want to see all of the comments, please send me an email to

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Equivalent Fractions

What is confusing about equivalent fractions?

$$\frac{2}{7} = \frac{6}{21}$$

Equivalent Fractions

What is confusing about equivalent fractions?

$$\frac{2}{7} = \frac{6}{21}$$

There are many more pieces in 6/21.

How can 6/21 be equivalent to 2/7?

Think about this and the practices while we watch the video.

NCTM Mathematics Teaching Practices

Please type into the chat your thoughts about any of the three NCTM teaching practices for the fraction video or about teaching approaches you use for equivalent fractions. I will collect the chat and make it available to those who want to see it. If you want to see all of the comments, please send me an email to

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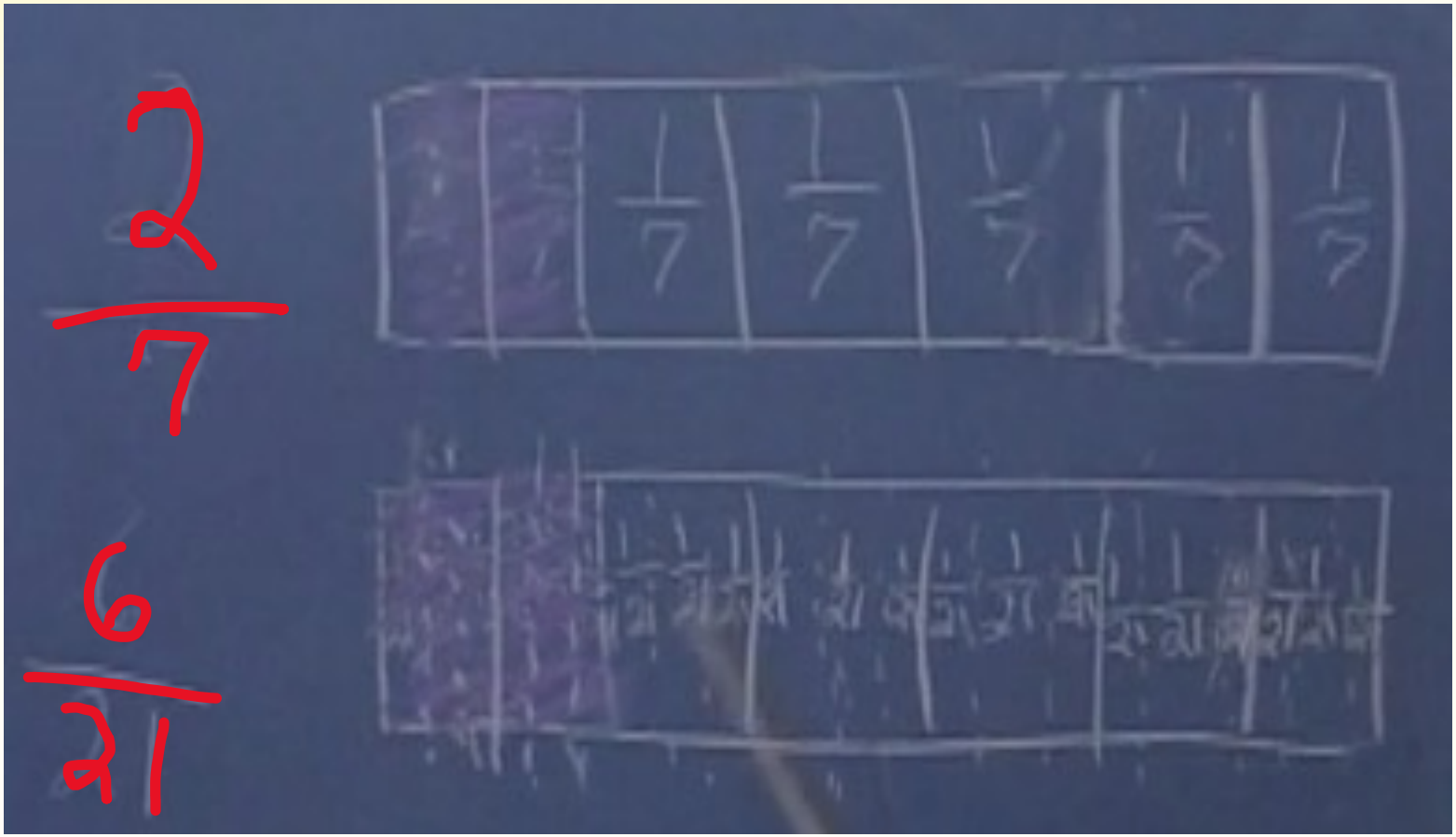
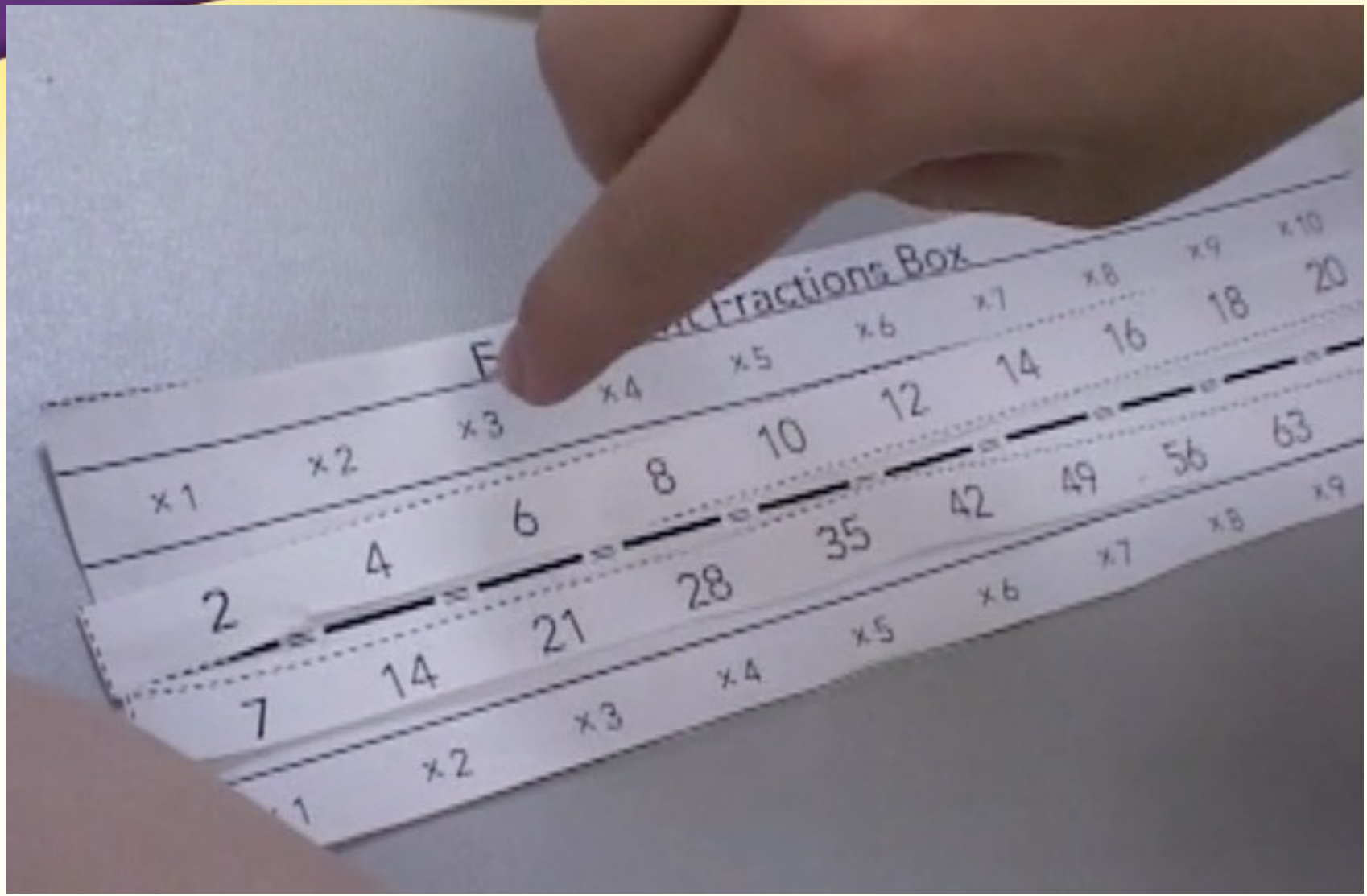
The fraction symbols 2/7 and 6/21 only show the

number of unit fractions not the **size** of the unit fractions.

You need a drawing to see that the unit fractions get smaller.



Equivalent fractions in multiplication table rows



NCTM Mathematics Teaching Practices

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Teachers continually assist students to do **math sense-making** about **math structure** using **math drawings** to support **math explaining**.

Roundtable Discussion after this talk

Find Roundtables in the Conference platform.

Find the title of my talk and click on it:

Relating the NCTM Mathematics Teaching Practices to Support Learning Difficult Math Topics

Your turn to ask questions and share.

See you there!!!

More about Balanced Teaching

An overview about Balanced Teaching and more about accessible methods and drawings is in a zoom talk I gave on March 6 at the Math Department at UCLA. This talk is available here:

https://ucla.box.com/s/urp1ljrclvm1xs8ovr9r82sna70wj5ks

Open the Karen Fuson folder and play the zoom.

It has a rough beginning because they were not going to record it, but it settles down quickly.

I made free Digital Learning Environments for PK to G6 that are available on my website karenfusonmath.com by clicking in the top right menu choice Remote Teaching Materials.

These were made in collaboration with

Shannon Kiebler: www.empowerlearngrow.com

Robyn Decker: ultramathpd@gmail.com

We built google slide decks with manipulatives and visual representations that students can move to show their thinking.

We used jamboards (a google app) to allow students to write and also move manipulatives around to show thinking.

There also are Quick Practices for grades K to 6 and Daily Routines for grades K to 2 that help to build and practice vital grade level knowledge.

You can use all of these digital materials with any math program.

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