Engaging Families in Math Fact Fluency

April 27, 2020

Jennifer Bay-Williams
University of Louisville
OUR PLAN

- Big Picture
- Fundamentals & Families
- Messaging to Families
- Family Messaging
- Family Face to Face Activities
- Summing Up
Big Picture

From This

@JBayWilliams  #mathfactfluency  #NCTM100
Big Picture

To This

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Big Picture

To This

Addition Facts Mastery Chart
Flexible Learning Progression

+/- 0, 1, 2

Doubles
Near Doubles

Combos of 10
Making 10

10+

Pretend-a-10

Foundational Fact Sets
Derived Fact Strategies

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#NCTM100
Big Picture

The Bottom Line

1. What do families most value about their child’s learning of mathematics?
2. What expectations do they have about how math is taught?
3. What were their experiences in learning the basic facts?
It is not sufficient nor effective to justify a change in math because of...

- Standards
- Assessments
- District policies
- "Research says"

It must be because the change will better serve the needs of their child.
5 Fundamentals of Math Fact Fluency

#1: Mastery must focus on fluency!
#2: Fluency develops in three phases.
#3: Knowing foundational facts must precede derived facts.
#4: Timed tests do not assess fluency
#5: Students need substantial and enjoyable practice.


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How can we best help families understand and embrace these fundamentals of fact fluency?
<p>| #1: Mastery must focus on fluency. | Families must understand that while we do want every child to master their facts for life, the way to reach this goal is through a focus on fluency, not rote memorization. |</p>
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<td>Families need opportunities to learn strategies (Phase 2), why the strategies matter, and questions to ask to help their children progress through the phases.</td>
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The four components (bolded) are interrelated. Appropriate strategy selection is required for efficiency and flexibility.
Learning Progression

Phase 1: Counting
Counts with objects or mentally

Phase 2: Deriving
Uses reasoning strategies based on known facts

Phase 3: Mastery
Efficient production of answers

Based on Baroody, 2006
Addition Fact Fluency Flexible Learning Progression

**Doubles**
- Use a double to find the sum.
  \[ 6 + 8 = 6 + 6 + 2 \]

**Combos of 10**
- Move some from one addend to the other to make a 10.
  \[ 6 + 8 = 10 + 4 = 14 \]

**10+**
- Think of an 8 or 9 as a 10, and adjust answer.
  \[ 6 + 8 \rightarrow 6 + 10 = 16 \]
  \[ \rightarrow 16 - 2 = 14 \]

**Near Doubles**
- Move some from one addend to the other to make a 10.
  \[ 6 + 8 = 10 + 4 = 14 \]

**Making 10**
- Think of an 8 or 9 as a 10, and adjust answer.
  \[ 6 + 8 \rightarrow 6 + 10 = 16 \]
  \[ \rightarrow 16 - 2 = 14 \]

**Derived Fact Strategies**

**Foundational Fact Sets**

*Also called Compensation and Use 10; we have found that young learners remember the strategy and distinguish it from Making 10 when we use this name. Research indicates that this strategy is more accessible than Making 10, and therefore should be explicitly taught (Baroody, Eiland, Reid, & Paliwal, 2016).*


*We acknowledge that all the derived fact strategies are break apart (distributive property) strategies. We focus on specific ways to break apart (e.g., adding a group) and move towards generalizing the Break Apart strategy.*
QUIZ 1

1. 5 + 7 =
2. 9 + 6 =
3. 4 × 7 =
4. 6 × 3 =
5. 5 × 9 =
Quiz 2

1. 95 + 7 = 
2. 90 + 60 = 
3. 4 × 15 = 
4. 35 × 3 = 
5. 5 × 49 =
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<td>#5: Students need substantial and enjoyable practice</td>
<td>Practice at home is critical, but it also needs to be meaningful and stress-free! Games, strategy talk, and self-assessing progress are important “home work.”</td>
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Game: Lucky 13

Pick a color: blue, green, or purple

Game: 
Lucky 13
Game: Lucky 13
Game: Lucky 13
Game: Factor War

Player 1: Five 8s is the same as ten 4s. I have 40.

Player 2: I doubled 9 to get 18, then doubled 18 to get 36.

Strategy Games...

**DO...**
- Focus on fact sets and strategies children are ready to practice
- Lend to students TALKING about the strategies selected.

**DO NOT...**
- Include a speed component.
- Have students solving the same fact.

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Questions to Ask for Fact Fluency Games

- How did you solve that fact?
- Why did you choose that strategy?
- Are there other ways you could solve for that fact?
- What other facts might be solved with that* strategy?
- When do you like to use that* strategy (when is that strategy a good idea)?

*you can replace ‘that’ with the name of a strategy, like ‘When do you use the doubling strategy?’
5 Fundamentals of Math Fact Fluency

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How can we best help families understand and embrace these fundamentals of fact fluency?
“We are not going to be doing timed tests this year.”

“To do a better job determining which facts each child has learned and which ones they need to work on, we are going to be using several different assessment tools.”

“Is she saying speed doesn’t matter? Are they not working on mastering facts?”

From Math Fact Fluency, p. 162
"We are not going to be memorizing facts. Instead, we need to focus on strategies. For students to be able to say all the facts within seconds, we are going to be focusing on strategies. This will eventually lead to automaticity, and this way your child won’t forget the facts they learned."

"Why aren’t they just memorizing the facts? They have to have them memorized eventually, so why waste time with strategies."

From Math Fact Fluency, p. 162
“We are gonna take all year.

“Our goal is not just to master the facts this year, but also develop fluency. This takes extra time but has big pay-offs for working with bigger numbers, fractions, decimals and even algebra!”

“All year? What about other topics? My child knows their facts, will she be challenged?”

From Math Fact Fluency, p. 162
LETTERS

Math Fact Fluency

Three KEYS to Helping Your Child Learn Basic Facts for Life AND Like Math

Learn
Focus on Real Math Fluency... use STRATEGIES (rather than just memorize the facts with worksheets or flash cards)

Why?
- Your child is much more likely to remember facts later on
- Your child is much less likely to have stress and anxiety
- The strategies will be used with greater numbers, fractions, and higher-level mathematics to support your child as a confident mathematician.

Life
Help your child ‘see’ the reasoning STRATEGIES that generalize to numbers beyond basic facts.

Developing fluency involves children building understandings of within and taking an active part in constructing number sense. Essential to this development is children deriving strategies to approach problems and recognizing that they are capable of reasoning and finding relationships.

To get to that point, though, a child needs multiple opportunities to interact with number sense ideas, use number sense, and discuss number sense ideas and strategies.

Like
Make practice enjoyable and meaningful.

- Play games.
- Talk through STRATEGIES.
- Focus on strategy selection, not speed. Speed will come with strategy practice.

Addition Strategies

Making 10
Example

9 + 6 = 10 + 5
= 15

Talk
Pretend the biggest number is 10. Add. Adjust your answer to remove the extra you added.

Ten Frames
9 + 6 = 10 + 5

Numbers
9 + 6 = 10 + 5

10 + 6 = 16

9 + 6 = 15

Home Made Ten Frame for Hands-On Learning
Cut off two cups of an egg carton so that you have ten cups. Use any [safe] household objects as counters (e.g., erasers, Lego, coins, game pieces, candies, etc.).

Why Strategies Matter:
Addition Strategies Extended to 3-digit Addition and Subtraction
A child with math fluency looks to see when these strategies can save them from doing more time-consuming standard algorithms.

“Making 10”
198 + 237 =
+2
+2
200 + 235 = 435

“Pretend-a-10”
198 + 237 =
-2
-2
200 + 237 = 437

“Pretend-a-10”
504 – 98 =
-2
-2
504 – 100 = 404
+2
+2
406
Why Strategies Matter:
Addition Strategies Extended to 3-digit Addition and Subtraction

A child with math fluency looks to see when these strategies can save them from doing the more time-consuming standard algorithms.

“Making 10”

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200 + 237 = 437
-2
435

“Pretend-a-10”

504 – 98 =  
-2
504 – 100 = 404
+2
406
**Multiplication Strategies**

**Doubling (and Halving)**

With any even factor, I can use half that number to multiply and then double my answer.

\[ 4 \times 7 \]

Think:

\[ 2 \times 7 = 14 \]
\[ + \]
\[ 2 \times 7 = 14 \]

So, \( 4 \times 7 = 28 \)

If both factors are even – pick either one to halve, then double!

\[ 6 \times 8 \]

Think:

\[ 3 \times 8 = 24 \]
\[ + \]
\[ 3 \times 8 = 24 \]

So, \( 6 \times 8 = 48 \)

**Break Apart [Distributive Property]**

I can take either factor and break it into two ‘friendly’ numbers, find the product of each part, and then join the parts together to find the product.

\[ 6 \times 8 \]

Think: Which 8 facts do I know?

\[ 5 \times 8 = 40 \]
\[ + \]
\[ 1 \times 8 = 8 \]

So, \( 6 \times 8 = 48 \)

**Homemade Materials for Hands-On Learning**

- **Egg Carton Ten Frames**: (see above). Use small objects (jelly beans) as counters. For \( 4 \times 7 \), fill 4 cups with 7 beans each.
- **Cupcake Cups (or Bowls)**: Start with counters, then eventually place numbers in each cup (using post-its). See how you can arrange the cups to show doubling.

**Games**

**Lucky 13**

1. Deal 4 cards to each player.
2. Players use 2 of their cards to get a sum as close to 13 as they can.
3. Your score matches how far you are from 13 (e.g., if your two cards add to 15, your score is 2. If you get lucky and get 13, your score is 0!).
4. Play 5 rounds. Lowest score wins!

More ways to play: Deal 5 cards, or play Lucky 10 or Lucky 15.

**Factor War**

[Think classic game of war.]

1. Share the cards equally among the players.
2. Each player flips over 2 cards and announces their product.
3. The greatest [correct] product wins those cards.
5. Winner has most cards when time is up!

More ways to play: Fixed Factor War. You pick a number (e.g., 9 if you are working on your 9 facts). Place it in center for reference. Players only flip one card and multiply their card by the fixed factor. The greatest [correct] product wins. Play Sum (or Fixed Addend) War to practice addition facts.

**Questions to Ask for Fact Fluency**

- How do you solve that fact?
- Why did you choose that strategy?
- Are there other ways you could solve for that fact?
- What other facts might be solved with that strategy?
- When do you like to use that strategy? (when is that strategy a good idea?)
- **You can replace 'that' with the name of a strategy like: When do you use the doubling strategy?**
Success with MATH FACT FLUENCY

ONE-STRATEGY LETTERS

Making 10 Strategy

What does Making 10 look like?

Story: Eight red tulips and six blue tulips bloomed in the garden. How many tulips in the garden?

Visual: 8 + 6 →

Home Made Ten Frame for Hands-On Learning

Cut off two cups of an egg carton so that you have ten cups. Use any [safe] household objects as counters (e.g., erasers, Lego, coins, game pieces, candies, etc.).

When is Making 10 useful?

This is a great question to ask your child! For basic facts, it is used adding two numbers that have a sum greater than 10.

Making 10s

29 + 15

Making 100s

278 + 496

Making 1s

\[ \frac{3}{4} + \frac{5}{4} \]

Making Decimals

21.56 + 42.9

Extending Making 10: Beyond Basic Facts

Making 10 might be the most useful reasoning strategy beyond the basic facts. Using Making 10 can eliminate the need to regroup or use other error-prone and more time-consuming steps. Compare the before and after of these four examples to see how the strategy creates an easier-to-solve problem.

Making 10s

30 + 14

Making 100s

274 + 500

Making 1s

\[ \frac{3}{4} + \frac{5}{4} \]

Making Decimals

21.46 + 43

Addition Strategy Brief

1. Students start learning addition by counting all, then learn more efficient strategies such as counting on. For facts with + 1 or + 2, counting on continues to be efficient; however, for facts like 8 + 6, counting is not efficient.

2. Students who discover and learn reasoning strategies remember, retain, and outperform their peers who simply memorize their facts. Additionally, students who apply strategies develop confidence, not anxiety!

3. Instruction should begin with stories and visuals to help students make sense of a reasoning strategy.

4. Learning and using reasoning strategies initially takes more time than counting, but with sufficient, meaningful practice, it is eventually more efficient.

5. When we focus on “fast” (memorization), we are encouraging students to not reason and not think, but rather just recall. Watch them revert to counting. That’s why the games below have no speed component!

6. Reasoning strategies themselves are important to learn because they generalize to larger numbers. Learning the strategies builds stronger math skills for life!

7. Playing purposeful math games is a great way for students to practice their reasoning strategies and learn their facts (see pages 3 and 4)!
Game: **Lucky 13** (Game 11 in Math Fact Fluency)

**Materials:**
- Deck of cards, with Kings and Jacks removed; Queens = 0; Aces = 1

**How to Play:**
1. One player is the dealer. The dealer gives each player 5 cards face up (see fig. 1).
2. Each player selects 2 cards which, when added together, produce a sum as close to 13 as possible (see fig. 2).
3. Players find how far their total is from ‘Lucky’ 13 and record that difference.

   **Examples:**
   - Cards add to 9: Score is 4 (9 is 4 away from 13)
   - Cards add to 15: Score is 2 (15 is 2 away from 13)
   - Cards add to 13: Score is 0 (13 is 0 away from 13) (see fig. 2)

4. Players discard the two cards that were used and draw two new cards.
5. Repeat for 5 rounds. Lowest score wins!

**More ways to play:** Deal only 4 cards; change the limit (e.g., 10); find a Lucky Difference (lucky number can be specified separately).

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**Game: Sum War** (Game 12 in Math Fact Fluency)

**(2 players)**

**Materials:**
- Deck of cards, with Kings and Jacks removed. Queens = 0; Aces = 1.

**How to Play:**
1. Split the deck in half so that each person has about the same number of cards.
2. At the same time, partners turn up their top two cards and say the sum.
3. Each player takes turns saying their answer, and sharing their thinking strategy. Both players decide if sums are correct:
4. The player with the larger (correct) sum gets the cards.
5. If there is a tie, it is a “war” and partners repeat steps 2 - 4.
6. Optional: Play for a set time; player with the most cards wins.

**More ways to play:** Play **Fixed Addend War** (see variation of Game 32 in Math Fact Fluency). Identify a “fixed addend” card and place face up between two players (e.g., use 9 as your fixed addend if working on the strategy Making 10). Players divide the remaining cards equally, how they found it. The larger sum wins the round.

Adapted from Parent Letters from the Williamsville Central School District, Williamsville, NY and Math Fact Fluency: 60+ Games and Assessment Tools to Support Learning and Retention
FAMILIES MESSAGING TO THEIR CHILDREN

This Photo by Unknown Author is licensed under CC BY-ND
“Math is Hard”

“I was never good at math.”

“I don’t like math.”
When adults say things to their child like “I am not good at math”, it can impede their child’s success in mathematics.

In fact, a parent’s emotions are connected to the student’s emotions, and positive emotions are connected to better performance.

(Else-Quest et al., 2008)
Be positive!
MATH IN OUR DAILY LIVES

What ideas fit your families in your setting?

- As socks are folded, ask: How many socks did we wash? [doubles] How did you figure that out? [counting, skip counting, grouping]
- At dinner, there may be 12 dinner rolls. Ask: How might we share these rolls?
- As bedtime or other event is approaching, ask: How many more minutes until _____?
- For chores, ask how long will it take to [clean each bathroom, bake all the cookies] if there are x number of [bathrooms, batches of cookies].

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Today’s Date. Ask child to take the day (e.g., 12) and think of different addition (or multiplication) facts that have that number as an answer (e.g., 10 + 2 = 12, 3 x 4 = 12).

In the car, ask: *Do you see a basic fact on that license plate?* or *Can you add the numbers on that license plate?*

In the car, select a target number (e.g., 20 for younger children or 100 for older) and ask the child to use the numbers on a license plate to reach that target number (Hildebrandt, Biglan, & Budd, 2013)
FAMILY FACE-TO-FACE EVENTS

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Kindergarten Orientation

The Bottom Line

What do parents do to get their child academically ready for Kindergarten?
Numeracy is as important as literacy!
Numeracy is as important as literacy!

✓ Counting word
✓ 7 is a number,
✓ 7 is a quantity
✓ 7 comes after six in counting
✓ 7 is one more than 6
✓ If you have 6 bears and get one one, you will have 7.
✓ 7 is before 8
✓ 7 is one less than 8
✓ 7 is 5 and 2
✓ 7 can be shown with fingers
Sleeping Bears
Sleeping Bears
Sleeping Bears
Version 1: Bears Race to 10
Label the sides of a die +0, +0, +1, +1, +2, and +2. Students start their bears at 0. They then take turns rolling the die and moving their bear the appropriate number of spaces. The first bear to 10 wins the race.
FAMILY FACE-TO-FACE EVENTS

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Back to School Nights

For your most important topic!

Procedural fluency includes:

1. Flexibility
2. Accuracy
3. Efficiency and
4. Appropriate strategy selection

Back to School Nights

For your most important topic!

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Fluency

• Solve this problem any way you choose

306 − 298 =
Fluency

• Solve this problem any way you choose

48 + 39 =
Fluency

- Solve this problem any way you choose

4.8 + 3.9 =
Fluency

- Solve these problems any way you choose

12 \times 15 = \\
17 \times 29 =
Debrief with the #4fluency list, an illustration or just chat about being ‘fluent’.

The four components (bolded) are interrelated. Appropriate strategy selection is required for efficiency and flexibility.
FAMILY FACE-TO-FACE EVENTS

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Family Math Night Plan

1. Have parents share what fluency means to them and/or engage in Truth or Myth activity, facts sort, or other activity.
2. Engage parents in a parent “quiz” or show a video of a classroom where children are demonstrating fluency (for example, using or sharing strategies during class discussion or game play).
3. Develop a robust definition of fluency (flexibility, accuracy, efficiency, and appropriate strategy use) and share the three phases of fact mastery.
4. Demonstrate fluency-building activities, such as Quick Looks and facts games.
5. Close with sharing the implications of this for assessment (timed testing doesn’t align with fluency) and/or revisiting the myths/facts sort.
<table>
<thead>
<tr>
<th>Truth</th>
<th>Myth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

Fluency is the same thing as Mastery.

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Truth or Myth?

Children eventually need to be automatic with their facts (coming up with an answer in about 3 seconds).

Timed tests help students master their facts.

Games are not adequate substitutes for fact drill.

Calculators can support students in learning their facts.

The order in which the basic facts are learned matters.

Basic fact fluency is essential to operations with fractions.

Memorization is the best technique to master the basic facts.
Truth or Myth?

Children eventually need to be automatic with their facts (coming up with an answer in about 3 seconds).

Timed tests help students master their facts.

Calculators can help students in learning math facts.

Basic fact fluency is essential to operations with fractions.

Memorization is the best technique to master the basic facts.

More ideas (myth or fact)?

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ENGAGE FAMILIES IN ASSESSMENT DISCUSSION
Quiz 1

1. $5 + 7 =$
2. $5 \times 9 =$
3. $9 + 6 =$
4. $6 \times 8 =$
5. $7 \times 3 =$
Quiz 2

1. $95 + 7 =$

2. $5 \times 49 =$

3. $90 + 60 =$

4. $8 \times 15 =$

5. $35 \times 3 =$
Timed Test: Multiplication
# Share a Fluency Rubric

<table>
<thead>
<tr>
<th>Beginning</th>
<th>Fluency Developing</th>
<th>Fluency Emerging</th>
<th>Mastery Accomplished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knows some foundational facts but counts or skip counts for derived facts.</td>
<td>Demonstrates automaticity with all foundational fact sets and uses at least one of the derived fact strategies for other facts.</td>
<td>Demonstrates automaticity with all foundational fact sets and uses several derived fact strategies for most or all other facts, though may require processing time to implement some strategies.</td>
<td>Demonstrates automaticity with all or most facts, selects efficient strategies and implements them easily, or just knows the facts.</td>
</tr>
</tbody>
</table>


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FACT SORT

Skip Counted

Used a Strategy

Just Knew


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FACT SORT

Skip Counted

Used a Strategy

Just Knew
LET'S SUM IT UP
5 Fundamentals of Math Fact Fluency

#1: Mastery must focus on fluency!
#2: Fluency develops in three phases.
#3: Knowing foundational facts must precede derived facts.
#4: Timed tests do not assess fluency.
#5: Students need substantial and enjoyable practice.

How can we best help families understand and embrace these fundamentals of fact fluency?

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In what ways do these ideas and others address family values, expectations and experiences?

1. What do families most value about their child’s learning of mathematics?
2. What expectations do they have about how math is taught?
3. What were their experiences in learning the basic facts?

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Engaging Families in Math Fact Fluency

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Thank You

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