
Is Math Having Its *Science of Reading* Moment?

*How Children Really Learn Math & What It Means for
Educators*

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Contents

01	Executive summary	4
02	What happened in reading	6
03	The shared root: constructivism	6
04	How children really learn math	8
05	Reading and math, side by side	12
06	Where the parallel has limits	13
07	Is math's moment arriving?	13
08	A key difference: in math, teachers are leading the call	14
09	What it means for educators	17
10	One research-informed path: from counting to fact automaticity	18
11	Responding to common objections	24
12	A call for evidence	25
	About the author	27
	Appendix: About the comment analysis	28
	References	29

This paper draws on research in cognitive science and mathematics education, current national data, and an analysis of 1,130 educator comments. It introduces the C.R.A.F.T.™ framework (Counting, Reasoning, Automaticity, Fluency, Tenacity) as one research-informed path from counting to fact automaticity.

SECTION 1

Executive summary

Math has been repeating reading's mistakes for decades, and the test scores reveal the cost. On the 2024 National Assessment of Educational Progress, 61% of fourth graders scored below the Proficient benchmark in math, and nearly one in four scored below Basic ([NAEP, 2024](#)). Internationally, the picture is no better. On PISA 2025, released in September 2026, U.S. 15-year-olds posted the lowest U.S. math score on record, and about a third fell below the baseline level of proficiency ([Center for American Progress, 2026](#); [Chalkbeat, 2026](#)).

Figure 1. Where U.S. math achievement stands

61%

of U.S. fourth graders scored below Proficient in math on NAEP 2024

1 in 4

scored below Basic, the lowest achievement level

Record low

U.S. 15-year-olds posted the lowest U.S. math score on record on PISA 2025

Source: NAEP 2024, grade 4; PISA 2025.

Behind these numbers is a mismatch between how we teach math and how children learn it. Math's dominant theories of learning are widely used but weakly supported. The research points instead toward explicit instruction, early fluency, and daily practice of foundational skills, starting with counting.

In reading, recognizing the gap between research and practice sparked a movement. Since 2022, at least 26 states have passed laws aligning reading instruction with research, and at least 18 restrict the discredited "three-cueing" method. Math is now following the same path: between 2022 and 2025, 18 states passed laws pushing math instruction toward more structured approaches. As the debate heats up, educators need a clear view of what the research says.

One difference stands out. When reading instruction shifted, most early-grade teachers had to be convinced to abandon methods they trusted. In math, the push for change is coming from teachers themselves. In our analysis of 1,130 comments on our social media posts, 93% of self-identified teachers supported prioritizing explicit instruction and practice in fact fluency, and many described being discouraged from teaching it.

93% of self-identified teachers in our analysis of 1,130 comments supported prioritizing explicit instruction and practice in fact fluency.

This paper makes five points:

- 1 Failed reading reforms and today's math reforms share a root.**
 The reading reforms of the late 20th and early 21st centuries grew from the same idea as reform math: constructivism, a sound theory of learning that was turned into a flawed theory of teaching: that children will develop foundational skills on their own through rich activities.
- 2 Concepts do not have to come first.**
 Research shows conceptual understanding and fluency build each other. No study we know of shows students must understand before they practice.
- 3 Counting is math's foundational skill.**
 Counting practice builds the mental number line, and fluent counting by the units behind the facts is a direct path to fact automaticity, as decoding is to word recognition.
- 4 Automaticity is math's word recognition.**
 Instant recall of basic facts frees working memory for higher-level math, as automatic word recognition frees readers for comprehension. If elementary school accomplishes nothing else in math, every student should leave it with full automaticity in all four operations.
- 5 The parallel has limits.**
 Math research is thinner and less settled than reading research. That argues for testing current practices, not keeping them on faith. The burden of proof belongs on the practices already in classrooms, not on the students who have been failed by them.

We close with recommendations for educators and a call for research that tests these ideas directly.

SECTION 2

What happened in reading

Reading instruction changed because the gap between classroom practice and research became impossible to ignore.

For two decades, programs built on the work of Lucy Calkins and of Irene Fountas and Gay Su Pinnell shaped reading instruction in thousands of schools. They taught children to identify words from pictures, context, and the first letter, a method known as three-cueing. They assumed children would absorb decoding through exposure to good books.

Meanwhile, decades of research had established a different picture:

- **Skilled reading depends on automatic word recognition.** Readers have limited attention; effortful decoding leaves little for comprehension (LaBerge & Samuels, 1974; Perfetti, 1985).
- **Words become instant through decoding, not memorization.** A "sight word" is any word a reader recognizes instantly because decoding has mapped its spelling into memory (Ehri, 2014).
- **Comprehension requires two things.** Under the Simple View of Reading, comprehension is the product of word recognition and language comprehension (Gough & Tunmer, 1986). Neither is enough alone.

When journalism brought this research to parents and policymakers, most prominently the 2022 podcast *Sold a Story*, the response was swift. At least 26 states have since passed laws aligning reading instruction with research, and at least 18 ban or restrict three-cueing ([APM Reports, 2025](#)).

The lesson for math is not that one program was bad. It is that an entire field adopted a theory of learning before testing it against how children actually learn, and kept it for decades. Math, unfortunately, is repeating that mistake.

SECTION 3

The shared root: constructivism

Balanced literacy and reform math grew from the same idea, and made the same mistake with it.

Constructivism holds that learners build their own understanding; knowledge is not simply transferred into their heads. As a description of learning, this is sound. The error came in turning it into a rule for teaching: if children construct knowledge, teachers should not tell them things, and foundational skills will emerge on their own through rich experiences.

One idea, two subjects. That same error shaped both reading and math, and the two followed strikingly similar paths, from a defining statement to a set-aside skill to a backlash:

Table 1. One idea, two subjects: how reading and math reform followed the same path

	Reading	Math
The movement	Whole language, then balanced literacy	Reform math
Defining statement	Goodman (1967) called reading a "psycholinguistic guessing game"	NCTM's 1989 <i>Curriculum and Evaluation Standards</i> called for less attention to rote practice and paper-and-pencil computation
Core assumption	Children learn to read as they learn to talk: through immersion	Children build skills by inventing strategies and exploring with manipulatives
Foundational skill set aside	Systematic phonics	Fact practice and standard algorithms; Kamii and Dominick (1998) argued teaching algorithms harms children's thinking
Backlash	The reading wars; later, the science of reading movement	The math wars of the 1990s; now, the science of math movement

Goodman's theory was eventually tested, and it did not hold up. Eye-movement research showed that skilled readers process nearly every letter of nearly every word. Stanovich (1980) found that relying on context to guess words is a mark of weak readers, not strong ones; good readers decode so quickly they have no need to guess. The assumptions behind reform math deserve the same scrutiny. Like the belief that children would learn to read by guessing, the belief that they will become fluent in math through discovery reached classrooms before it was rigorously tested, and when it was tested, it came up short (Alfieri et al., 2011).

The psychologist Richard Mayer named the underlying error in 2004. Constructivism is a theory of learning, not a method of teaching. Students can build understanding from clear explanation, worked examples, and practice as well as from exploration. For novices, guided instruction consistently outperforms discovery (Kirschner, Sweller & Clark, 2006; Alfieri et al., 2011).

NCTM's 2000 standards took a more balanced tone, and the math wars cooled. But the core assumption remained in classrooms: students need concepts before fluency, and rich activities will produce the foundation. Reading has confronted that assumption. Math has yet to catch up.

SECTION 4

How children really learn math

Five findings from the research on math learning challenge the assumptions behind much of today's elementary instruction.

1. Understanding and fluency build each other

Many programs assume students must understand a concept before practicing it to fluency. The research does not support that order. Conceptual and procedural knowledge develop iteratively, each strengthening the other (Rittle-Johnson, Siegler & Alibali, 2001). A later review summed it up in its title: *Not a one-way street* (Rittle-Johnson, Schneider & Star, 2015). The National Mathematics Advisory Panel (2008) called conceptual understanding, computational fluency, and problem solving "mutually reinforcing" and called debates over which comes first misguided.

Yet several widely used K–2 programs are built around a concepts-first sequence:

Table 2. How four widely used K–2 programs structure a lesson

Program	How a lesson is built	Where fluency fits
enVision Mathematics	Every lesson opens with "Solve & Share": students work a problem before instruction	Practice comes last, after the visual lesson
Illustrative Mathematics	Problem-based; students discuss and justify their thinking	Embedded within lessons rather than practiced directly
Everyday Mathematics	A spiral: skills recur across the year	Fact games, fact triangles, and daily review, but not practice to mastery before moving on
Eureka Math ²	Fluency, Launch, Learn, Land	Every lesson opens with a dedicated fluency segment

Source: Publisher materials; EdReports; Massachusetts DESE CURATE reviews.

Independent reviewers, including EdReports and Massachusetts's CURATE, rate the current editions of all four programs as balancing conceptual understanding and procedural fluency. But those reviews check whether fluency is present, not whether students get enough practice to reach automaticity, or whether practice comes early enough to support new learning. One of the four programs takes a different approach. Eureka Math² opens every lesson with fluency practice, showing that a different design is possible within the same standards: fluency first, every day.

The research is clear that fluency does not have to wait for understanding. Yet in many classrooms, the curriculum's design makes it wait: exploration comes first, practice comes last, and practice is the first thing cut when time runs short. Putting fluency at the start of the lesson, rather than the end, is one of the simplest changes a school can make.

2. Novices learn best from explicit, systematic instruction

Unguided discovery produces weaker learning than explicit instruction (Alfieri et al., 2011). Beginners benefit most from clear explanation and worked examples (Kirschner, Sweller & Clark, 2006). For students who struggle, explicit and systematic teaching is among the most effective approaches (Gersten et al., 2009).

The federal practice guide on elementary math intervention makes six recommendations: systematic instruction, clear mathematical language, well-chosen concrete and semi-concrete representations, the number line, deliberate instruction on word problems, and regular timed activities to build fluency (Fuchs et al., 2021). None of these asks students to discover the foundation on their own.

3. Counting comes first and builds number sense

Before children understand much about numbers, they count: reciting numbers aloud, touching objects one at a time, moving a game piece space by space, chanting by ones, twos, fives, and tens. This practice does not wait for understanding. It builds understanding.

Children can recite the count sequence months before they grasp that the last number counted tells how many (Wynn, 1990; Sarnecka & Carey, 2008). Susan Carey argues that the memorized count list is what allows children to construct the concept of number in the first place: a structure learned first and filled with meaning later (Carey, 2009).

Counting along a line builds the mental number line. Preschoolers who played a linear numbered board game, counting aloud as they moved, improved in number line estimation, magnitude comparison, counting, and numeral recognition, with gains lasting weeks (Ramani & Siegler, 2008). A circular board did not produce the same gains (Siegler & Ramani, 2009), and counting on from the current square beat counting from 1 (Laski & Siegler, 2014). An accurate mental number line predicts later math achievement (Booth & Siegler, 2006).

Counting does one more thing. Counting by many different units stores a web of number relationships that makes pattern recognition possible. Children's awareness of mathematical pattern and structure is closely tied to their math achievement (Mulligan & Mitchelmore, 2009), and patterning skill at age 4 predicts math achievement in fifth grade (Rittle-Johnson et al., 2017). Research on expertise explains why: experts recognize patterns at a glance because extensive

practice has stored familiar patterns in memory (Chase & Simon, 1973). A student who has counted by 7s and 8s can see at once that 56 belongs to both; a student without those sequences has nothing to recognize.

4. Automaticity frees the mind for higher-level math

In reading, automatic word recognition frees attention for comprehension. Math works the same way. Gagné (1983) argued that basic computation must become automatic so working memory is free for problem solving. Hasselbring, Goin, and Bransford (1988) applied automaticity theory to math facts, and Tronsky and Royer (2003) reviewed the links between computational automaticity, working memory, and complex problem solving.

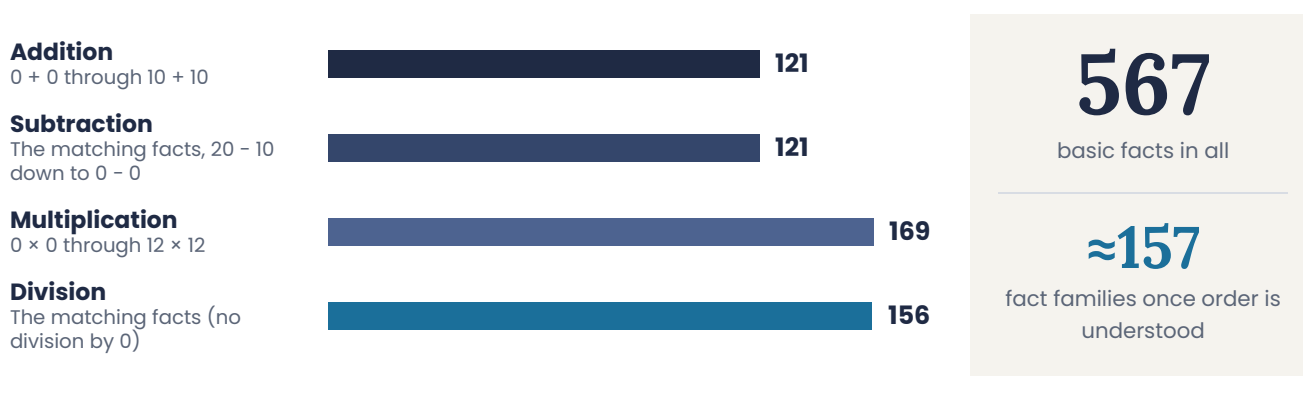
The evidence is consistent:

- Brain activity during single-digit arithmetic predicted high school math scores (Price, Mazzocco & Ansari, 2013).
- Growth in fact fluency predicts general math achievement in grades 4–8 (Nelson, Parker & Zaslofsky, 2016).
- Slow, effortful fact retrieval is a defining feature of students with math difficulties (Geary, 2004).

Automaticity is what frees students to reason. They cannot solve problems, use mathematical language, or build new concepts well while their working memory is consumed by basic calculation. That is why full automaticity in all four operations should be a non-negotiable goal of elementary math, not an optional extra.

One difference favors math. A fluent reader recognizes tens of thousands of words automatically. The complete set of basic facts is far smaller:

Figure 2. The complete set of basic facts is small and finite



Once students understand that order does not change a sum or product, these collapse to about 157 fact families. The target is small and clear, which makes full automaticity by the end of elementary school a realistic expectation for nearly every student.

Public discussion of fact fluency usually focuses on multiplication, but addition and subtraction come first. Slow addition retrieval is one of the earliest and most consistent markers of math difficulty (Geary, 2004), and multiplication fluency depends on it: skip counting by 7s is repeated addition. A student who counts on their fingers for $8 + 5$ cannot become fluent with 7×8 .

If elementary school accomplishes nothing else in math, every student should leave it with full automaticity in all four operations.

5. Struggling students lack a mental map for numbers

Students with weak math foundations often have no organized mental framework for numbers: no sense of where a number sits, how it relates to its neighbors, or what patterns connect them. In our years of interviewing students who struggle in math, this is the clearest throughline. They cannot picture numbers, patterns, or quantities in their heads.

The research points the same way:

- **Students with math learning disabilities have weaker mental number lines.** Their number line estimates are less accurate than their peers', and they take years longer to space numbers evenly (Geary et al., 2008).
- **Spatial thinking and math are linked.** A meta-analysis of 45 studies found a moderate relationship between spatial skills and math achievement across ages (Atit et al., 2022). Preschoolers' skill at copying block structures predicts their early math (Verdine et al., 2014).
- **Structure matters more than pictures.** Students who represent a problem's structure (relationships, positions, patterns) solve math problems better. Students who form vivid but irrelevant images do worse (Hegarty & Kozhevnikov, 1999).
- **The map can be built.** A meta-analysis found that spatial training improves math performance (Hawes et al., 2022), and counting along a linear board game builds the number line directly (Ramani & Siegler, 2008).

The map is also never finished. Children's number line estimates become accurate one range at a time: 0–100 around grade 2, 0–1,000 around grades 4–6 (Siegler & Opfer, 2003; Siegler & Booth, 2004). Yet counting, the practice that builds the number line, is usually dropped after grade 2, just as

students meet larger numbers. A strong whole-number map in the early grades is also the foundation students need when fractions and decimals arrive in grades 4–6.

The missing piece is not a talent some children lack. It is a structure that can be taught, and counting practice is one of the most direct ways to build it. A quick number line task, such as marking where 37 falls on a line from 0 to 100, gives teachers a simple way to see whether a student has that map.

SECTION 5

Reading and math, side by side

The core ideas of the science of reading have clear counterparts in math.

Table 3. The science of reading and its counterparts in math

Science of reading	Math counterpart	Research anchor
Phonics and decoding: the foundational skill, taught explicitly	Counting fluency: forward and backward, from any number, by the units behind the facts	Sarnecka & Carey, 2008; Laski & Siegler, 2014; Sherin & Fuson, 2005
Orthographic mapping: decoding turns words into instant recognition	Counting by a unit turns its multiples into retrievable facts	Ehri, 2014; Sherin & Fuson, 2005
Automatic word recognition frees attention for comprehension	Fact automaticity frees working memory for problem solving	LaBerge & Samuels, 1974; Gagné, 1983; Price et al., 2013
Vocabulary: knowing word meanings and relationships	Number relationships: knowing 24 is 3×8 , 4×6 , and 2×12	Nelson et al., 2016
Simple View: word recognition $\times$ language comprehension	Automaticity $\times$ understanding: both necessary, neither sufficient	Gough & Tunmer, 1986; Rittle-Johnson et al., 2015
Three-cueing: guessing from context in place of decoding	Relying on counting or strategies indefinitely in place of retrieval	Geary, 2004

The closest of these parallels is orthographic mapping. In the science of reading, a "sight word" is not a word memorized as a whole shape. Following Linnea Ehri's work, it is any word a reader recognizes instantly because decoding has mapped its spelling into memory. Decoding is the route to instant recognition.

Counting fluency does for facts what decoding does for words. Neither words nor facts are best learned as unconnected lists. A strong practice, repeated over time, becomes instant recall.

SECTION 6

Where the parallel has limits

The comparison to reading is powerful, and it should be made honestly. Three differences matter.

The math research is thinner. The case for systematic phonics rests on decades of converging evidence. Math has no equivalent consensus, and fewer large, rigorous studies of classroom practice. Much of the evidence on fact fluency shows that it *predicts* later achievement; less shows that building it *causes* gains.

Math's foundation includes concepts. In reading, decoding is fairly separate from comprehension. In math, early number sense, such as knowing which number is bigger or where it sits on a line, is itself partly conceptual. That is why counting practice works best when tied to a number line or physical sequence.

Counting research is concentrated in the early grades. Most studies of counting cover preschool through grade 2. Extending counting routines through grade 5 is well grounded in the number line research but has not been tested directly.

None of this justifies the status quo. Current practices rest on even less evidence. The right response is to test them, and the alternatives, directly.

SECTION 7

Is math's moment arriving?

The signs point to yes. Scores are stagnant, states are legislating, and the professional debate has become public.

The need is clear. On the 2024 National Assessment of Educational Progress, fourth-grade math scores rose 2 points from 2022 but remained below 2019 levels nationally. Eighth-grade scores were flat. Higher-performing students drove most of the gains, while lower performers stalled or declined, widening a gap that has grown for over a decade ([NAGB, 2025](#)).

States are acting. According to the Center on Reinventing Public Education, 18 states passed math legislation between 2022 and 2025 pushing instruction in a more structured, intervention-oriented direction ([Education Week, 2026](#)). Alabama's Numeracy Act of 2022 is the model most often cited. It

requires screening and intervention for struggling students, math coaches in elementary schools, and state-approved materials. Alabama was also the only state whose 2024 fourth-grade math scores surpassed pre-pandemic levels, though it is too early to attribute that to the law.

The debate is public. The "science of math" movement, led by special education researchers including Sarah Powell of the University of Texas at Austin, calls for explicit, systematic instruction in foundational skills. Professional organizations have pushed back. NCTM issued a statement in early 2025 criticizing an "overemphasis" on explicit instruction, and the National Council of Supervisors of Mathematics published a December 2025 position paper favoring guided inquiry ([Education Week, 2026](#)).

This is the same moment reading reached around 2019 to 2022: rising frustration, early legislation, and organized resistance from established voices. Educators who understand the research will be better prepared for what comes next.

So far, the debate is taking place mostly among researchers and professional organizations. Missing from it are the people who live with the consequences every day: classroom teachers, especially in upper elementary and middle school, who are expected to teach grade-level content to students who arrive without the foundations to learn it. A fifth-grade teacher cannot teach fraction multiplication to students who still count on their fingers to add. These teachers need to be part of the conversation, and as the next section shows, many are already speaking up.

SECTION 8

A key difference: in math, teachers are leading the call

In reading, the shift had to overcome teachers' own beliefs. In math, many teachers are already asking for it.

Before the reading reckoning, three-cueing was mainstream classroom practice. A 2019 Education Week Research Center survey found that 75% of K-2 and elementary special education teachers taught it ([Education Week, 2019](#)). Changing reading instruction meant persuading teachers that a method they trusted did not work.

Math looks different. We coded all 1,130 comments and replies left on 111 of our social media posts about fact fluency and foundational skills (collected September 2026). Of the 912 comments that take a position, 88% support building fact fluency and foundations, 7% are mixed, and 5% push back. Among the 187 commenters who identify themselves as K-12 teachers, support rises to 93%.

The pushback is concentrated. Most of it argues for conceptual understanding first or defends teaching multiple strategies, and most of those commenters do not state their role. Meanwhile, 50 comments describe teachers being told by administrators, coaches, or the curriculum not to spend time on facts. The full breakdown by theme is available from the author on request; the method is described in the appendix.

Figure 3. Stance on fact fluency and foundations, by commenter’s stated role

Commenter's stated role		Support	Mixed	Push back	Comments
Elementary teacher		91%	7%	2%	137
Middle school teacher		100%	0%	0%	27
High school teacher		96%	0%	4%	23
Coach or specialist		83%	0%	17%	6
Parent or grandparent		97%	3%	0%	37
Other educator (tutor, substitute, para)		95%	5%	0%	20
Role not stated		86%	8%	6%	662
All comments with a position		88%	7%	5%	912

■ Support ■ Mixed ■ Push back

Source: Author’s analysis of 1,130 TikTok comments, September 2026. See appendix.

Five themes recur. (Quotes are anonymous and lightly edited for spelling.)

Teachers are told not to teach facts.

<i>I was scolded for working on math facts because 'we need to focus on conceptual understanding.' But at 4th grade, they understand the concept. They need the fluency.</i>	<i>I fought this the whole time I taught third grade. Every coach would tell me to stop making them memorize their facts.</i>
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Teachers work around the curriculum to fill the gap.

<i>I use every intervention time and extra time to hit multiplication. I get a lot of pushback from admin and coaches on why I'm not covering other standards. If I can fix multiplication, I fix area, volume, division, multiplying and dividing fractions, and so much more.</i>	<i>I'm on day 4 and just assessed math facts. I'm not starting curriculum until we get this down.</i>
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The gaps follow students into middle and high school.

I've personally watched 7th graders do 4×3 on their fingers and get 11.

I get high school students in Algebra 2 who have to use a calculator to do 7×6 .

Teachers see the working-memory cost.

Without being prompted, teachers describe the mechanism in this paper's research section.

If students have to stop in the middle of a multi-step math problem to figure out what 4×8 is, they lose the thread of where they were in the problem. It takes them longer, and leads to errors.

This is akin to sending 3rd grade kids on to 4th grade not knowing any sight words or being fluent readers.
— 8th grade math teacher

Teachers link fluency to outcomes.

I could determine their state test by doing one times-table sprint.
— middle school teacher

These comments are not a representative survey. They come from teachers who follow and respond to our posts, and they describe experiences rather than measured results. But they point to something important. In reading, reform required changing teachers' minds. In math, the resistance appears to sit higher up. Teachers describe being told by administrators, coaches, and district leaders not to spend time on facts, and national organizations such as NCTM have pushed back against explicit instruction. Reform in math will require changing the minds of the instructional leaders and organizations that shape what happens in classrooms, and giving teachers permission, and time, to do what many already believe works.

SECTION 9

What it means for educators

Educators do not need to wait for legislation to act on what the research already shows.

IN THE CLASSROOM

- 1. Teach foundational skills explicitly.** Model, explain, and practice. Do not expect students to discover the foundation through open-ended tasks.
- 2. Build fluency and understanding together.** Start fluency practice early, and connect it to meaning through clear explanation and representations.
- 3. Make counting a daily routine, K–5.** Five to ten minutes: forward and backward, from any number, by the units behind the facts, and later by 100s.
- 4. Move from counting to retrieval.** Once students count fluently by a unit, practice the matching facts to instant recall, including regular timed practice. Track each student's progress toward full automaticity.
- 5. Use the number line in every grade.** Anchor counting and whole numbers to a line.
- 6. Teach fact fluency at school; reinforce it at home.** Too often, schools say there is no time for fact practice and send it home instead, which leaves it to families with the time and knowledge to provide it. Fluency should be taught and practiced in class, where every student gets it. Families can then reinforce it with simple, low-effort routines, such as counting forward and backward together in the car or at dinner.

FOR SCHOOL AND DISTRICT LEADERS

- 1. Make full fact automaticity a non-negotiable goal.** Every student should leave elementary school with instant recall of addition, subtraction, multiplication, and division facts. Set grade-level milestones and track progress toward them. The Common Core expects students to know all sums of two one-digit numbers from memory by the end of grade 2, and all products by the end of grade 3. But its "know from memory" expectation stops there. Subtraction and division are listed only as skills to perform fluently, typically with strategies, not as facts to recall. That is like training the biceps and ignoring the triceps: the two operations work as a pair, and students need instant recall of both.
- 2. Screen and monitor.** Assess counting fluency and fact fluency regularly, as reading programs assess decoding. Use assessments that build in milestones from kindergarten onward, so gaps are caught early, not in fifth grade.
- 3. Evaluate curricula with hard questions.** Does it teach foundational skills explicitly? Does it build daily fluency practice into every grade? Does it use the number line? Does it continue counting after grade 2?
- 4. Protect time for practice.** Where curricula require many strategies and representations for each operation, make room for daily fluency routines.
- 5. Train teachers in the research.** Many teachers were prepared under constructivist assumptions. They deserve the same kind of professional learning reading teachers are now receiving.

SECTION 10

One research-informed path: from counting to fact automaticity

What does a science-of-math approach look like in practice? Here is the specific path we use at Trapezium to build math fact automaticity and mental math fluency.

The C.R.A.F.T.[™] framework

Trapezium Math's approach is organized around a proprietary framework, C.R.A.F.T.[™]: Counting, Reasoning, Automaticity, Fluency, and Tenacity.

C.R.A.F.T. is distinct from the Concrete–Representational–Abstract (CRA) sequence used in many math programs. CRA describes how materials move from objects to symbols; C.R.A.F.T. describes what students must master, and in what order, to reach full automaticity and the mathematical reasoning it makes possible.

Each element of C.R.A.F.T. draws on the research in this paper:

Figure 4. The C.R.A.F.T.™ framework

C	Counting Daily oral counting, forward and backward, by the units behind the basic facts, builds the mental number line and the recall that facts grow from <i>Ramani & Siegler, 2008; Roediger & Karpicke, 2006</i>
R	Reasoning Students use the number relationships that counting builds to recognize patterns, compose and decompose numbers, and solve problems <i>Mulligan & Mitchelmore, 2009; Rittle-Johnson, Schneider & Star, 2015</i>
A	Automaticity Instant recall of all basic facts in all four operations by the end of third grade <i>LaBerge & Samuels, 1974; Gagné, 1983; Price et al., 2013</i>
F	Fluency Flexible mental math: multi-step operations performed accurately and efficiently in the head <i>National Mathematics Advisory Panel, 2008</i>
T	Tenacity Students persist through daily practice and build confidence as they see their own growth <i>Bandura, 1997</i>

Evidence for the pathway

- **Skip counting is a recognized step toward multiplication facts.** Sherin and Fuson (2005) found that counting by a number is a standard stage in learning multiplication. With practice, the rhythm of the count sequence turns into known products.
- **Multiplication facts are stored largely as verbal sequences.** In Dehaene's triple-code model, multiplication facts are held in verbal memory (Dehaene & Cohen, 1995). Reciting count sequences builds the same kind of memory that fact retrieval uses.
- **Chinese students learn the multiplication table as a recited rhyme.** Chinese number words are also regular ("ten-one" for eleven), and Chinese-speaking children learn to count further earlier (Miller et al., 1995). This evidence is correlational: countries differ in many ways, so it cannot show

that recitation alone causes stronger math skills. But it is exactly what the path from counting to facts would predict.

Starting from the goal

In most schools, fact fluency lands on one grade. Third-grade teachers are expected to get students fully fluent, often with little groundwork laid in the grades before. By the time students arrive in third grade, the gaps are wide and the year is short.

Trapezium Math has spent years mapping backward from the end of third grade to the start of kindergarten, with a single goal: full automaticity in all four operations by the time students finish third grade. The result is a clear set of expectations for each grade band, so that the work is shared across the early grades rather than left to one teacher:

Table 4. Grade-band expectations, mapped backward from full automaticity at the end of grade 3

Grade band	Counting fluency (forward and backward, 30 seconds or less)	Fact automaticity (see it, know it)	Mental math fluency
Kindergarten–grade 1	Ones to 30, fives to 100, tens to 200, evens from 0 to 40, and odds from 1 to 41	All addition facts within 10 and the matching subtraction facts	Multi-step addition and subtraction within 10 (may begin with fingers)
Grade 2	All K–1 counts, plus 3s to 45, 4s to 60, 6s to 90, and 8s to 120	All addition facts to 10 + 10 and the matching subtraction facts	Multi-step addition and subtraction within 20
Grade 3	All earlier counts, plus 7s to 105, 9s to 135, 11s to 165, and 12s to 180	All earlier facts, plus multiplication through 12×12 and the matching division facts: full automaticity	Multi-step operations with all four operations within 50
Grades 4–5	Any number to any number, by any number; counting by halves and quarters	No grade-level assessment: students should arrive with full automaticity. Any student who has not reached it is flagged for intervention.	Composing and decomposing numbers, doubling and halving any whole number, operations with powers of 10, finding halves and quarters

Kindergarten and first grade form one band, giving students two years to meet the first set of expectations. At every grade, teachers know exactly what they own: *"by the time students leave my class, they will be able to count forward and backward by these units, and they will have mental math fluency for these facts."*

A sequence of assessments, beginning in kindergarten, measures counting fluency and fact fluency against those expectations. Teachers can see where each student stands and what comes next, and gaps are caught in the grade where they open, not two years later. The grade 3 goal is earlier than the end-of-elementary target this paper recommends for every school, because it is attainable for most students. Reaching it by the end of third grade frees grades 4 and 5 to focus on the students who need additional support or intervention, rather than reteaching facts to the whole class.

The counting sequence

In the C.R.A.F.T. model, students build counting fluency, forward and backward, in the order below. Each count is performed as one continuous sequence, up to the target number and back down again, and the entire round trip must be completed in 30 seconds or less. A student who is truly fluent finishes in under 15 seconds, so the extra time makes room for every learner, including students with slower processing speed, without lowering the bar for fluency.

Below is the order Trapezium Math has refined through years of classroom testing and observation:

Table 5. The C.R.A.F.T. counting sequence

Stage	Counting unit	What it builds
①	Ones	The base sequence; counting on and back from any number
②	Fives	Anchors to 5 and 10; the 5s facts
③	Tens	Place value; the 10s facts
④	Evens (2s from 0)	Doubles; the 2s facts
⑤	Odds (2s from 1)	Parity; the structure of the number sequence
⑥	3s, then 4s	The 3s and 4s facts (4s are double 2s)
⑦	6s, then 8s	The 6s and 8s facts (doubles of 3s and 4s)
⑧	7s, then 9s	The hardest facts, reached last (9s are one less than 10s)
⑨	11s, then 12s	Extended facts through 12×15

For stages 6 through 9, students count to 15 multiples, forward and backward. Counting backward sets up division. Going past 12 multiples covers the full fact range with room to spare.

The counting routine

Counting works like playing scales on the piano. Pianists never stop practicing scales, because daily repetition builds and maintains the technique that makes music possible.

In a C.R.A.F.T. classroom, students practice counting individually and orally, in front of their classmates, for the duration of their time in elementary school. By the time a child leaves elementary school, they should be able to count to any number, by any number, from any number.

The count sequence is projected on the board behind the student who is counting, visible to the class but not to the counter. This design does two things at once:

- **The counter practices retrieval.** With the sequence out of sight, the student must pull each number from memory rather than read it.
- **The class practices too.** Classmates hear each number while following it on the number line that is projected on the SMART board at the front of the class. In this model, the entire class is practicing retrieval as well. This is why the routine belongs in front of the whole class, not in a small group off to the side. Each classmate's turn is another full pass through the sequence, heard and seen at the same time, and every pass strengthens each listener's mental map of the numbers. A class of 25 hears the sequence many more times than any one student could count it alone. That includes students who are not yet ready to count that sequence themselves, who are building the map before their turn comes. When teachers pull students out to count separately, the counter still practices, but the rest of the class loses those repetitions.

The routine is also how teachers monitor each student's progress. Students work through a set sequence of counting units, forward and backward, starting from numbers other than zero. Each student moves to the next unit once the current one is fluent.

Individual counting also shows the teacher exactly where each student's fluency breaks down, which choral counting hides. The routine is meant to challenge students, including timed, speed-based counting challenges. Young athletes in track, swimming, or gymnastics build grit by pushing against the clock in practice, and the same is true here: students see their own times improve and learn that effort pays off. That is the Tenacity in C.R.A.F.T. The common worry that timed practice causes math anxiety rests on thin evidence, and avoiding challenge denies students the chance to experience their own growth.

Why the routine works. Learning science explains why this kind of practice works:

- **Recalling a sequence builds memory more than hearing it.** Pulling information from memory without cues strengthens retention more than rereading or re-hearing it (Roediger & Karpicke, 2006; Karpicke & Blunt, 2011). A student who counts aloud without looking at the sequence is practicing retrieval.
- **Silent recall counts too.** Recalling silently improves retention about as much as answering aloud (Smith, Roediger & Karpicke, 2013). Classmates who anticipate each number before it is spoken are practicing retrieval as well.
- **Hearing and seeing together builds the map.** Pairing spoken number words with their positions on a line is what built number sense in the board game studies, and learning generally improves when words and visuals are presented together (Mayer, 2009).
- **Repetition over time produces automaticity.** Automatic performance is the retrieval of memories built through repeated practice (Logan, 1988). Practice spread across many days outlasts cramming (Cepeda et al., 2006), and practicing past the point of first success improves long-term retention (Driskell, Willis & Copper, 1992).

The result resembles the lyrics of a song learned as a teenager and still remembered word for word decades later. Songs stick because of heavy repetition, spaced over time, carried by rhythm, and melody and rhythm measurably improve recall (Wallace, 1994). Count sequences, especially skip counting, share all three features.

Counting is the bridge, not the destination

A student who counts up to 7×8 every time is not yet automatic. The goal is instant retrieval. In our experience, students who reach this level of counting fluency gain fact automaticity readily. Counting fluency makes facts retrievable; it does not replace retrieval.

SECTION 11

Responding to common objections

The ideas in this paper challenge practices that many educators were trained in and care deeply about. The objections below come up again and again: in research debates, in professional development sessions, and in the comments we analyzed. Each deserves a direct answer.

Table 6. Common objections and how the research answers them

The objection	The response
<i>"Explicit instruction is a 'pedagogy of poverty.'"</i>	Explicit instruction is what research shows works best for novices and struggling students. Leaving foundational skills to discovery, or to families at home, widens gaps. The 2024 NAEP results show lower performers falling further behind.
<i>"Students need to understand before they practice."</i>	Research shows understanding and fluency build each other. No study we know of shows understanding must come first.
<i>"This is drill and kill."</i>	Daily fluency practice takes minutes, not whole lessons. Automaticity is a non-negotiable skill in elementary math, just as sight-word recognition is in reading. It does not replace reasoning; it makes reasoning possible.
<i>"Timed practice causes math anxiety."</i>	The causal evidence for this claim is thin. The federal practice guide recommends regular timed activities to build fluency. Practice comes first, and lots of it. Only then do students demonstrate mastery individually, against a clear time standard.
<i>"Counting becomes a crutch."</i>	Counting is the bridge to retrieval, not a way to compute. Counting fluency lays down a strong mental map for numbers, and that map lets students move naturally and seamlessly from counting to instant recall.
<i>"Counting is for young children."</i>	The mental number line is rebuilt for each new range of numbers, well beyond the early grades. By the end of elementary school, every student should be able to count to any number, from any number, by any number.
<i>"Math is not reading."</i>	Agreed. The research on math is thinner, and math's foundation includes concepts. The parallel is about a shared pattern: untested theories displacing foundational skills.
<i>"Where is the direct evidence?"</i>	Much of it exists for each step; the full pathway has not been tested in upper elementary. We call for that research below.

SECTION 12

A call for evidence

Reading changed when research reached the people making decisions. Math needs the same. Trapezium Math has been collecting evidence for the theory of action in this paper for years: including counting and fact-fluency assessment results, and interviews with hundreds of students who struggle in math. That evidence has shaped every part of the C.R.A.F.T.™ framework. What classroom evidence alone cannot do is show whether the pattern holds at scale.

Testing it at scale

7 K-8 SCHOOLS	1,100+ STUDENTS	2026-27 SCHOOL YEAR	PSSA OUTCOME MEASURE
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That is now changing. Through a pilot with the School District of Philadelphia, Trapezium Math will test the C.R.A.F.T. pathway in seven K-8 schools and over 1,100 students, for the 2026-2027 school year. The pilot is a correlational study of the theory of action behind this paper: if third graders reach grade-level mastery in Counting, Reasoning, Automaticity, and Fluency, they will score proficient on the state test. Each student's end-of-year C.R.A.F.T. results will be compared with their score on the Pennsylvania System of School Assessment (PSSA). A correlational design cannot prove that C.R.A.F.T. mastery causes proficiency, but a strong relationship across a large urban district would show that these foundational skills predict the outcome schools are held accountable for.

Alongside the PSSA analysis, the pilot tracks four impact indicators:

Table 7. Pilot impact indicators

85%

Predictive accuracy

85% of teachers accurately predict each student's placement on the end-of-year state assessment, within one proficiency level

Measured by: Correlation between real-time progress monitoring results and year-end state test results; success means high alignment between the two

Shift

Student agency

A measurable shift in students' math identity, from passive reception to self-directed level selection and problem-solving

Measured by: Student reflections showing they can self-correct and explain their choice of "just-right" levels based on their own sense of mastery

90%

Teacher efficacy

90% of teachers report greater diagnostic confidence, especially in moving students between challenge levels in real time

Measured by: Mid-year reflections and professional identity surveys

85%

Fidelity

85% of classrooms run the student-led 10-Minute Math routine with high fidelity (4 or more days per week)

Measured by: Digital implementation logs and classroom observations

The Philadelphia pilot is a first step. We invite other schools, districts, and researchers to join us in building the evidence base. The question in our title deserves an answer grounded in evidence, not ideology.

About the author

Angela McIver, PhD, is the founder and CEO of Trapezium Math, Inc. A practitioner-scholar, she has spent her career bridging the gap between cognitive research and the realities of schools. She earned her PhD at the University of Pennsylvania, where her dissertation, *Understanding the Numerical Reasoning of Middle School Students*, was awarded the Spencer Dissertation Fellowship. Her research draws from hundreds of clinical interviews with students from kindergarten through college. The interviews revealed a widespread lack of the foundations this paper describes: counting fluency, fact automaticity, and a strong mental map for numbers. They also convinced her that teachers needed a curriculum-agnostic framework applying science of reading principles to math foundations: the work that became C.R.A.F.T.™. She shares classroom-ready strategies with educators on TikTok at @mcivermathphd.

About Trapezium Math, Inc.



Trapezium Math brings a science of math approach to the foundations every student needs. Its C.R.A.F.T.™ framework (Counting, Reasoning, Automaticity, Fluency, Tenacity) gives schools a structured, research-based roadmap to foundational numeracy, with clear benchmarks from kindergarten through grade 5. Trapezium Math also provides remediation for students in grades 6–12 who are still missing these foundations. The framework is curriculum-agnostic and reaches classrooms through the 10-Minute Math Program, a structured daily routine that moves students away from isolated computer-based practice and into "out loud" learning, where students count, reason, and explain their thinking with their classmates. Teachers use one-click progress monitoring tools to capture each student's results in real time, and Trapezium's diagnostic assessments measure progress against each milestone. Trapezium Math is committed to analog learning. Students build math foundations by counting aloud, reasoning with classmates, and showing what they know, not by working alone on a screen. Technology plays a supporting role: its tools are built for the teacher, not the student, so that classrooms stay "heads up, hands up" while teachers track every student's progress in the moment. Learn more at www.trapeziummath.com.

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Appendix: About the comment analysis

The comment analysis in this paper is a systematic count of public responses, not a survey.

- **Source.** Every comment and reply on 111 posts from the author's TikTok account (@mcivermathphd), collected September 27, 2026: 1,130 comments from other users. The author's own replies were excluded. No usernames were recorded.
- **Stance.** Each comment was coded as supporting, mixed, or pushing back on the argument for fact fluency and foundations first. 218 comments with no position (emoji, off-topic remarks, requests for resources) were excluded, leaving 912.
- **Role.** Coded only when commenters named it themselves ("as a 5th grade teacher..."). 662 of the 912 did not.
- **Themes.** Twelve recurring themes, such as pressure not to teach facts, pace and number of standards, and gaps in older students. A comment could carry more than one theme.
- **Limits.** Commenters chose to respond to these posts, so the sample leans toward people who already agree. Coding was done in a single pass by one coder. The results describe what these educators report, not what a representative sample of teachers believes. A formal survey would be a valuable next step.

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Notes

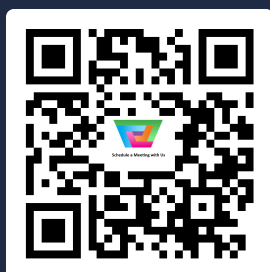


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