Math Myth Busters & The Science of Math

LEARNING & *the* BRAIN®

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Session Goals:

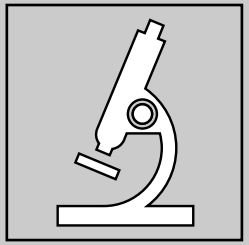
1. Identify common myths about math instruction & intervention.
2. Explain evidence to counter common myths to maximize students' learning.
3. Recommend best practices for supporting students' foundational math skills.
4. Recognize the difference between pseudoscientific claims and scientific evidence.

MYTH /mith/ a widely held but false belief

https://www.thescienceofmath.com/

THE SCIENCE OF MATH

The Science of Math is a movement focused on using objective evidence about how students learn math to make educational decisions and to inform policy and practice.



Science of Learning

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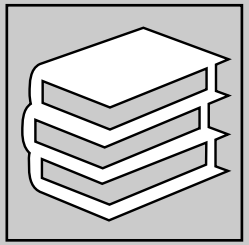
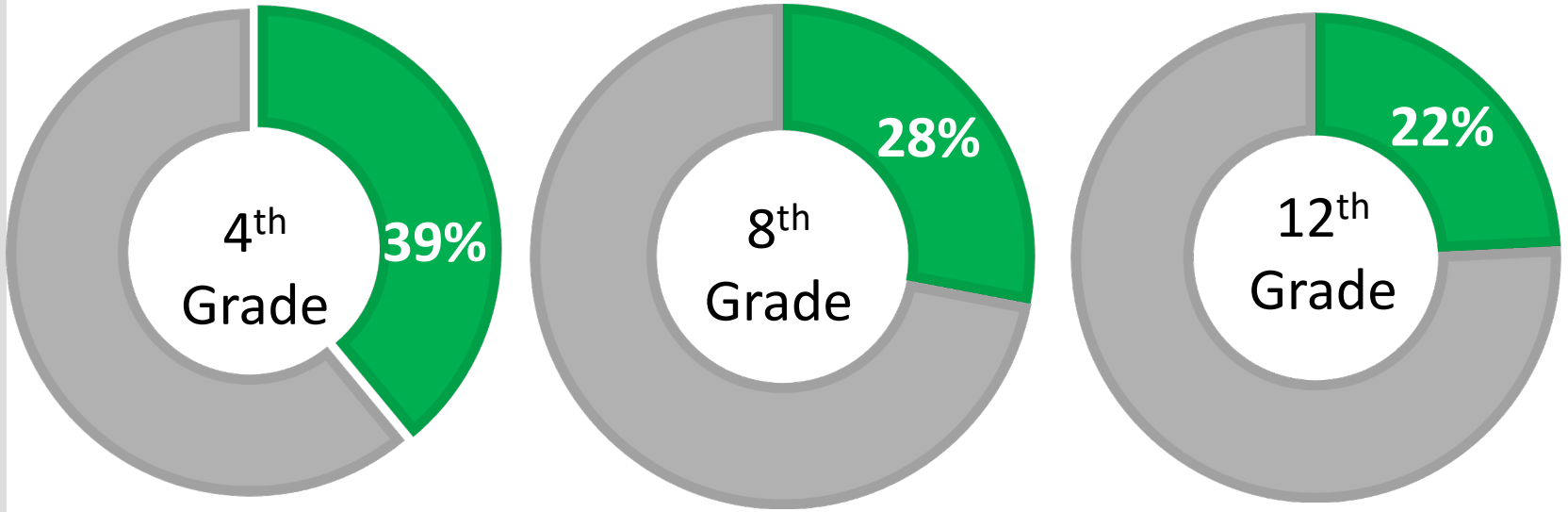


Research Base on Effective Mathematics Instruction

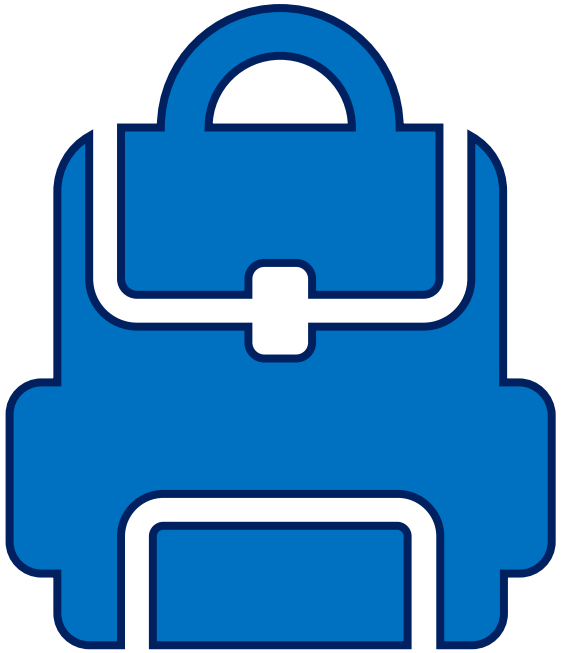
Math Proficiency in the United States

- Underachievement for more than a decade
- Mathematics is hierarchical
- Lack of foundational skills lead to a persistent pattern of poor proficiency



National Assessment of Educational Progress-Math (2024)

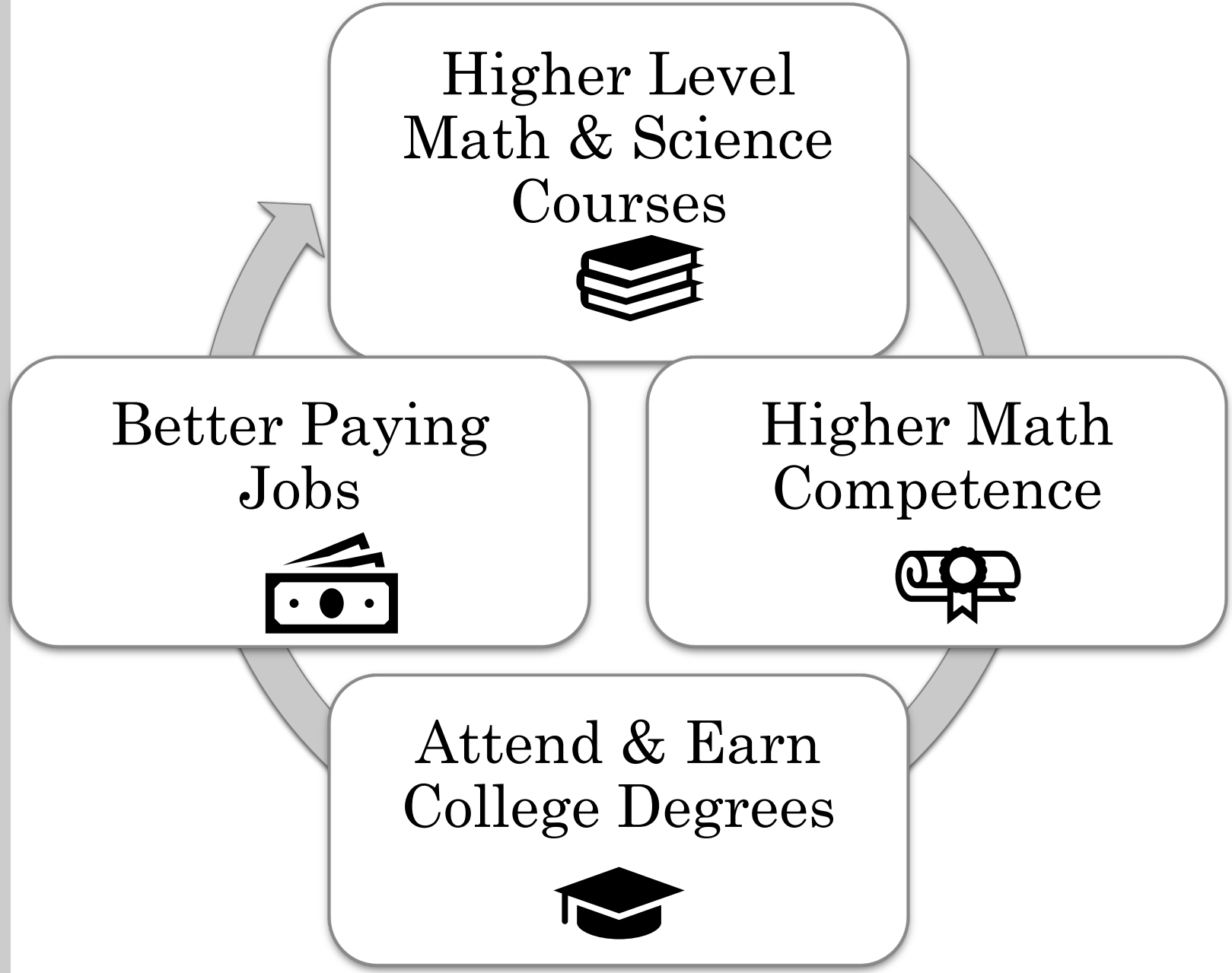
High Stakes: Early Math Problems Persist Over time



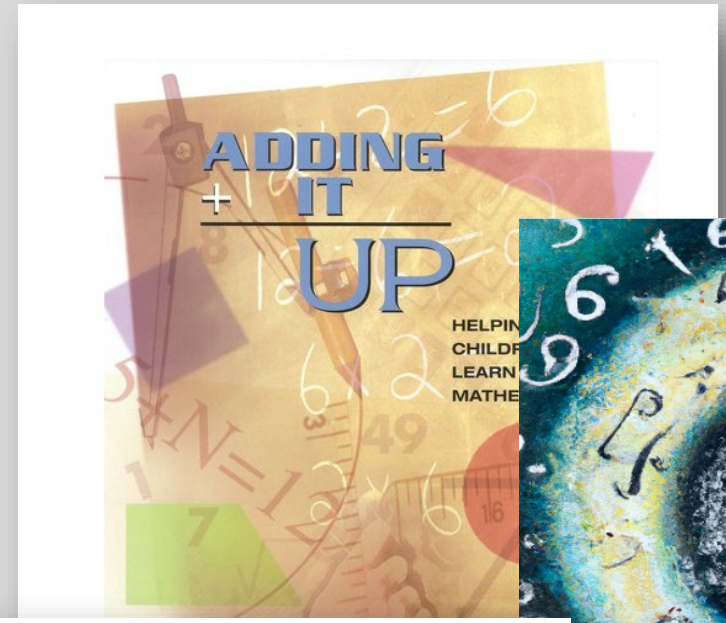
- Among school-entry reading, mathematics, & attention, the strongest predictor of later achievement is **EARLY MATHEMATICS SKILLS**
- Math difficulties begin as early as pre-school & continue without intervention

(Claessen et al., 2009; Davis-Kean et al., 2022; Duncan et al., 2007; Fyfe et al., 2019; Morgan et al., 2011; Watts et al., 2014)

High Stakes: College Ready



(Adelman, 2006; Atawell & Domina, 2008; Buyn et al., 2015; Dowker, 2005; Lee et al., 2012; Methe et al., 2011; Parsons & Bynner, 1997; Ritchie & Bates, 2013; You & Nguyen 2012)



Foundations for Success

The Final Report of the National Mathematics Advisory Panel

2008
U.S. Department of Education

IES WWC What Works Clearinghouse MENU Search Go

Assisting Students Struggling with Mathematics
This practice guide provides evidence-based practices that can help teachers tailor their instructional approaches and/or their mathematics intervention programs to meet the needs of their students.
Practice Guide | March 2021

Improving Algebra Knowledge & Strategies in Grades 6-12
This practice guide provides three recommendations for teaching algebra to students in middle school and high school. Each recommendation includes implementation steps and solutions for common roadblocks. The recommendations also...
Practice Guide | April 2015 (Revised January 2019)

Related Resource (2.7 MB)
This six-page practice guide summary provides an overview of the three recommendations for teaching algebra to students in middle school and high school. See the research evidence at a glance.
Practice Guide Summary | July 2015

Teaching Math to Young Children
This practice guide provides five recommendations for teaching math to children in preschool, prekindergarten, and kindergarten. Each recommendation includes implementation steps and solutions for common roadblocks. The recommendations...
Practice Guide | November 2013

Related Resource (883 KB)
This eight-page summary reviews expert recommendations from the field, along with tips on implementing them. See the research evidence at a glance.
Practice Guide Summary | February 2014

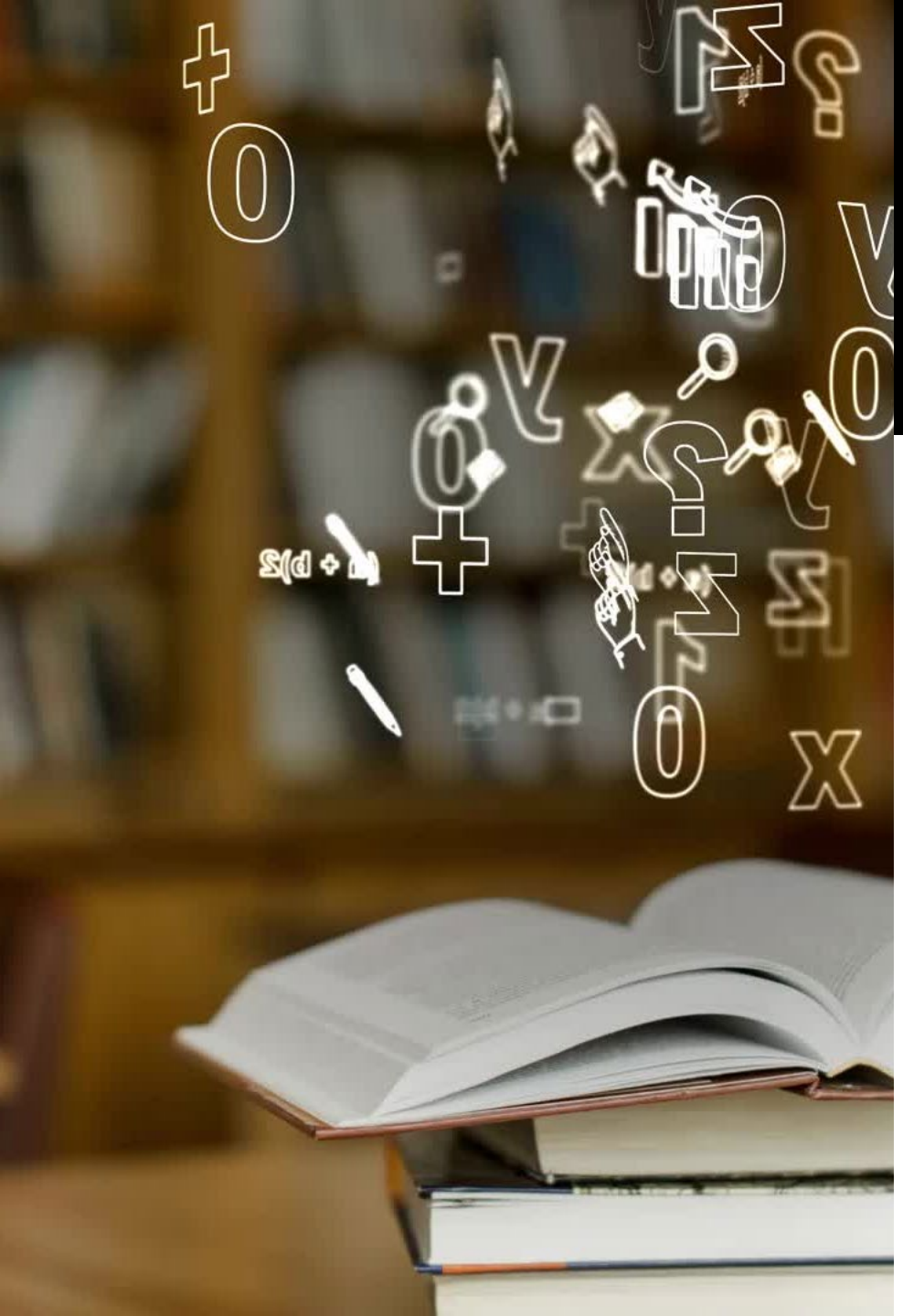
Improving Math Problem Solving in Grades 4-8
This practice guide provides five recommendations for improving students' mathematical problem solving in grades 4 through 8. This guide is geared toward teachers, math coaches, other educators, and curriculum developers who want to...
Practice Guide | May 2012 (Revised October 2018)

Related Resource (925 KB)
This eight-page set of instructional tips translates practice guide recommendations into actionable approaches that educators can try in their classrooms.
Instructional Tips | July 2017

Developing Fractions Instructions for K-8
This practice guide presents five recommendations intended to help educators improve students' understanding of fractions. Recommendations include strategies to develop young children's understanding of early fraction concepts...
Practice Guide | September 2010

Assisting Students K-8 in Mathematics
Taking early action may be key to helping students struggling with mathematics.
Practice Guide | April 2009

Encouraging Girls in Math and Science
The objective of this guide is to provide teachers with specific recommendations that can be carried out in the classroom without requiring systemic change.



WHAT MYTHS OPERATE IN YOUR SCHOOL/DISTRICT?

1. Teach Conceptual Knowledge 1st
2. Standard Algorithms are Harmful
3. Fact Fluency Doesn't Matter
4. Timed tests & Tasks Cause Math Anxiety
5. Productive Struggle Leads to Deeper Learning
6. Explicit Instruction is Only Helpful for Some Students
7. All Math Standards Are Created Equal
8. Executive Functioning Training Matters
9. Growth Mindset Increases Math Achievement

MYTH #1

TEACH CONCEPTUAL UNDERSTANDING FIRST

Estimate the closest whole number of $\frac{12}{13} + \frac{7}{8}$

- Understand and estimate magnitude

Decide whether 3 = 3 makes sense

- Evaluate examples of concepts

Place 28 on a number line

- Translate quantities between representational systems

Which is bigger: 5 or 8

- Compare quantities

Define the commutative property

- Generate or select definitions

Defining Terms: Conceptual

Comprehension of mathematical concepts, laws, principles, & relations
(NRC et al. 2001, p. 5)

8/10 + 6/10 = x

- Solve problems in a familiar format

2 ½ + ¼ = x

- Solve problem with a new surface or problem feature

5 + 4 =

- Quick and effortless recall of basic facts

58 + 62 =

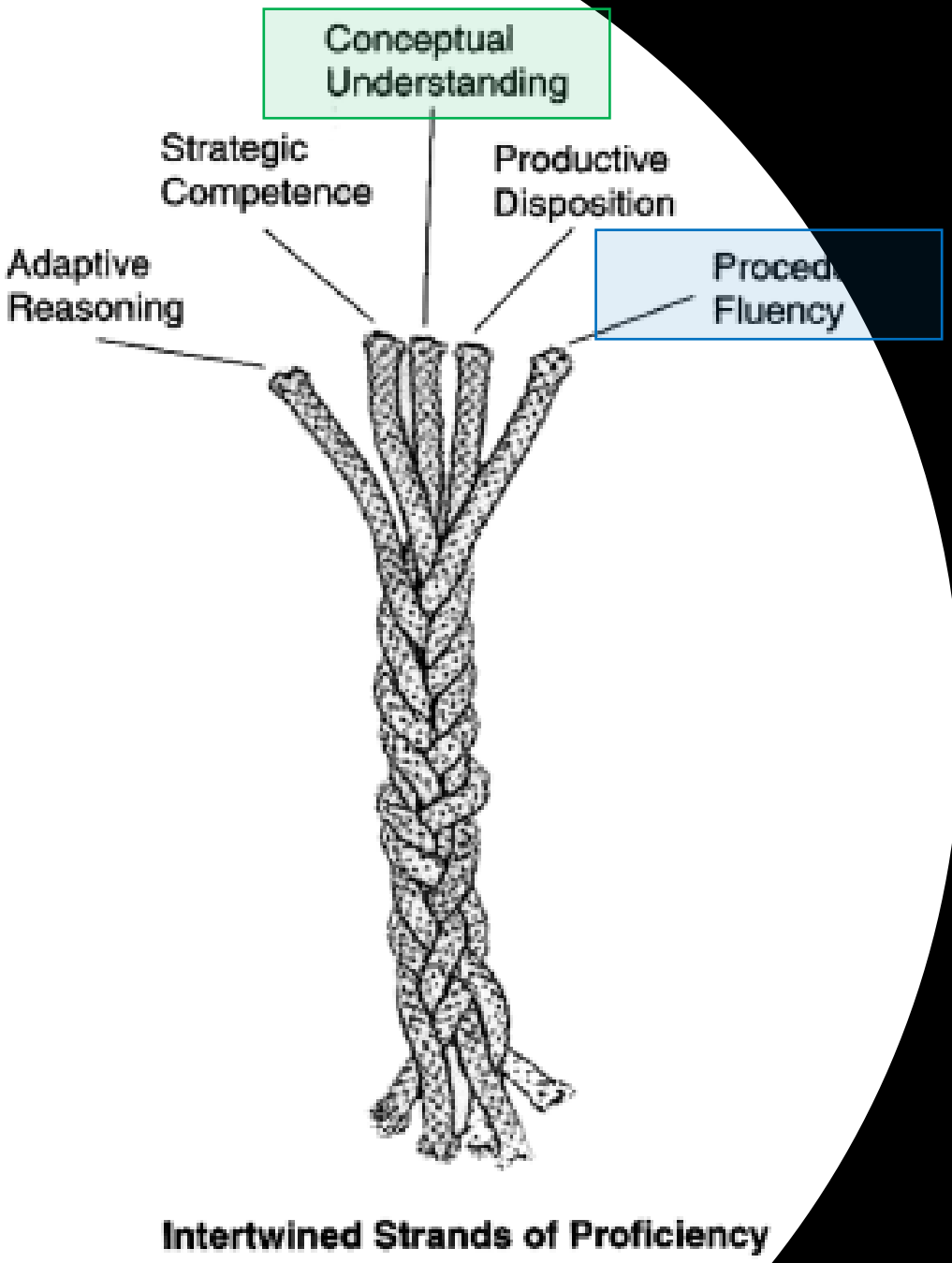
- Solve complex operations using algorithms, mental math, and other strategies as appropriate

Defining Terms:

Procedural

Knowledge of when & how to use procedures appropriately as well as skill in performing them flexibly, accurately & efficiently

(NRC et al., p. 121)



Truth

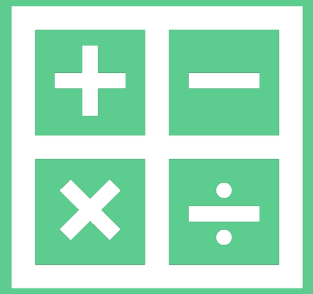
Pitting procedural fluency against conceptual understanding **creates a FALSE DICHOTOMY** (NRC, 2001, p. 100)

Conceptual understanding and procedural fluency (including quick & effortless recall of facts) are **MUTUALLY BENEFICIAL**

(NMAP, 2008, p. 11)

Procedural vs. Conceptual Debate seems only to apply to U.S.

Other countries recognize practice with procedures as a route to understanding



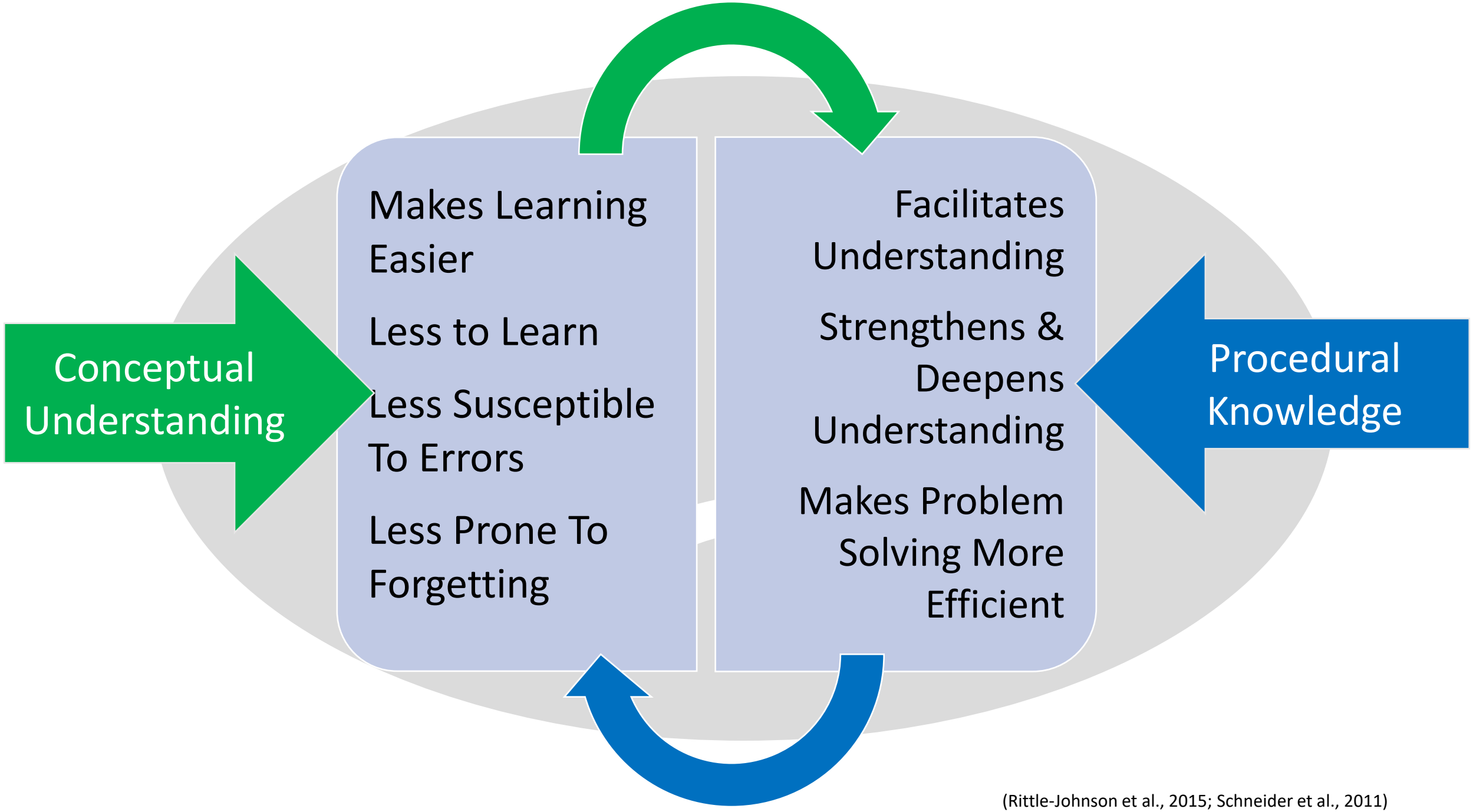
U.S. students cannot solve basic facts as quickly or efficiently as their international peers

Neither textbooks nor instruction provide enough opportunities for practice with procedural knowledge

U.S. Curricula

Gaps in BOTH Conceptual & Procedural Knowledge

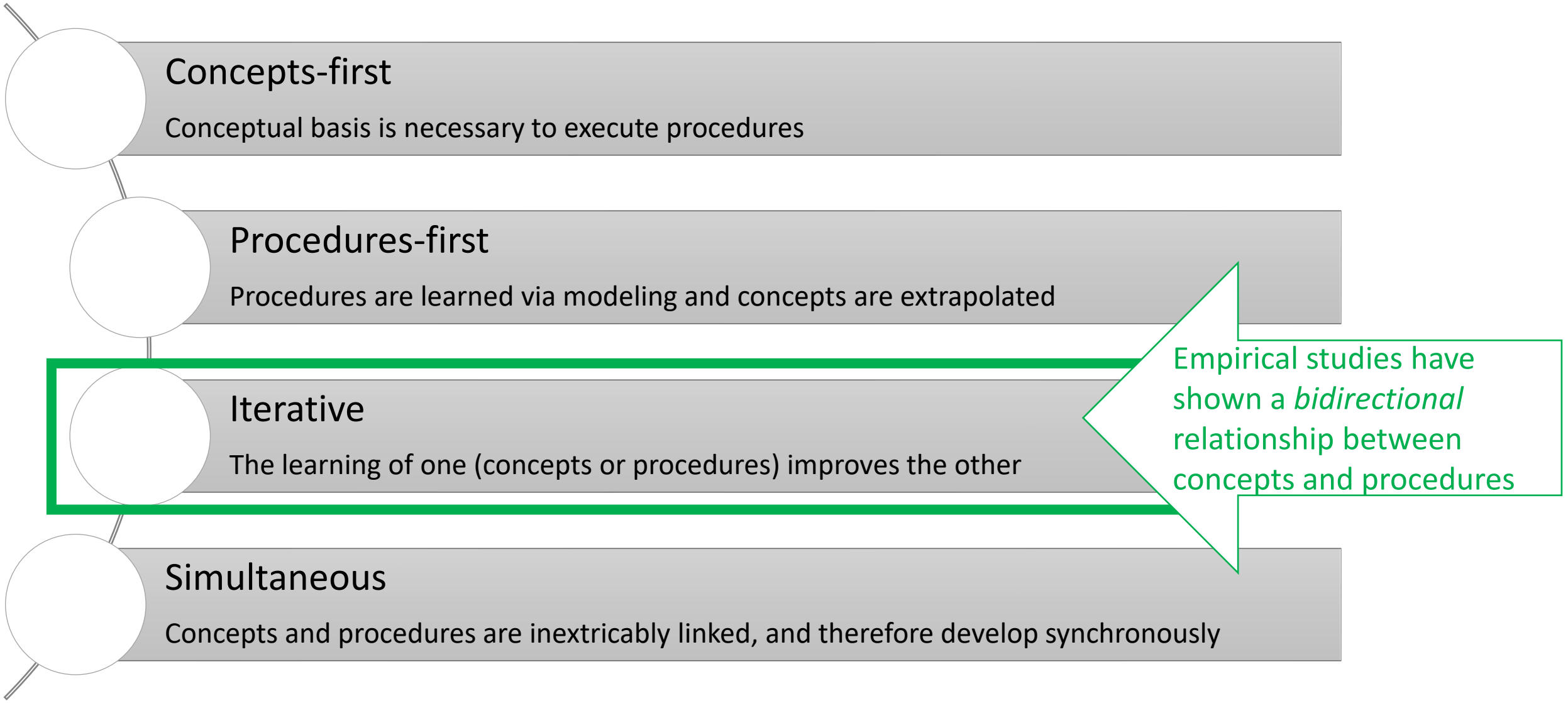
(Codding et al., 2017; NRC, 2001;NMAP, 2008)



(Rittle-Johnson et al., 2015; Schneider et al., 2011)

Commutative Property of Addition	5 + 3 = 3+ 5
Relationships among Numbers	6+ 7 = 6+ 6 + 1 = 13
Multiplicative Understanding + Estimation	9.83 x 7.65 ≠ 7519.95 Answer must be < 80 (10 x 8)
Understand Base-10 Place Value	199 + 67 = 200 + 66 4 + 26 = 20 + (6+4) = 30

Theories Regarding the Relationship Between Conceptual Understanding & Procedural Knowledge



EVIDENCE

Conceptual Understanding

Procedural Knowledge

- **Counting (preschoolers)**
- **Decimals (middle schoolers)**
- **Addition & Subtraction (primary schoolers)**
- **Equivalence (primary schoolers)**
- **Fractions (primary schoolers)**

(Canobi, 2009; Hectht & Vagi, 2010; Rittle-Johnson & Koedinger, 2009; Rittle-Johnson et al., 2001, 2015; Running, Codding et al., 2023; Schneider et al., 2011)

BEST PRACTICES

(e.g., Bouck et al., 2018; Flores, 2010; Gersten et al., 2009; Morano et al., 2020; Strickland & Maccini, 2013; Woodward et al., 2012)

Interleave conceptual and procedural content within lessons

Engage in think alouds to model and practice step-by-step procedures for problem-solving while describing conceptual understanding

Use a progression of concrete*representation (semi-concrete)*abstract phases & consider integrating each phase within the same lesson

MYTH #1 HAS LED TO THESE OTHER MYTHS:

Standard Algorithms are Harmful

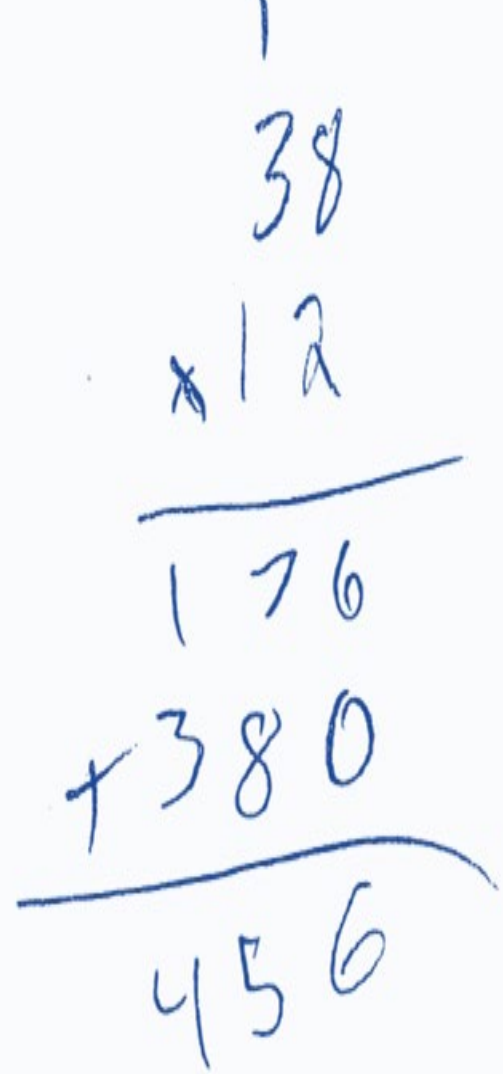
Fact Fluency Doesn’t Matter

MYTH #2

TEACHING THE STANDARD ALGORITHM IS HARMFUL

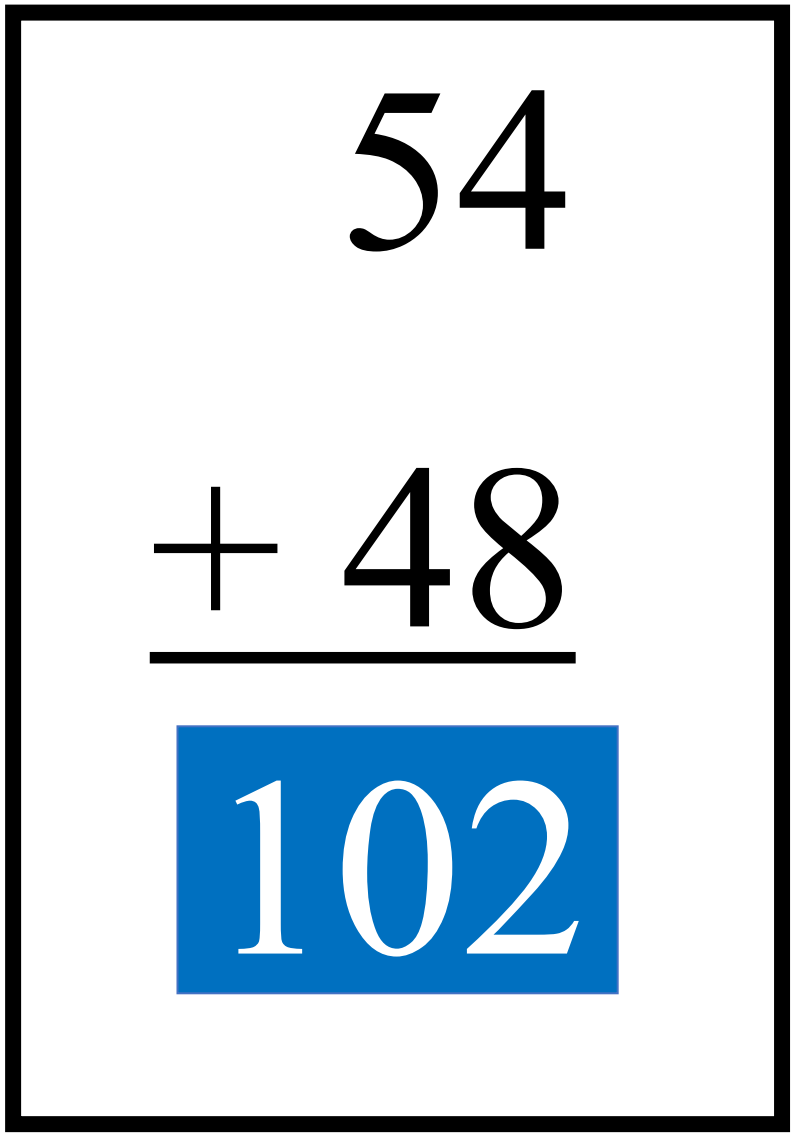
has 38 boxes of oranges in her delivery truck. Each box holds 12 oranges. How
ges does Julie have in her truck?

456



Linking Strands of Mathematical Proficiency to Number Combinations

Algorithm-only instruction is distinct from not teaching the standard algorithm at all



Logic of Standard Algorithm

1. Add digits in the one's column

   4+ 8 = 12

2. If the sum in the one's column is >10, regroup

	1
	54
+	48
10	2

3. Sum the digits in the ten's column

1. 54 = 5 10 & 4 ones
2. 48 = 4 10 & 8 ones
3. Add the ones
4. 4 + 8 = 12
5. 12 = 1 10 & 2 ones
   - We are left with 2 ones
6. Add the tens
   - 50 + 40 + 10 = 100
7. add the tens & ones
   - 100 + 2 = 102

(Wu, 2011; Zhang et al., 2014; Zhang et al., 2017)

Using Algorithms to Illustrate Place Value Understanding

Step 1: Add Ones
Step 2: Add Tens
Step 3: Add Hundreds

SpringMath Accelerate

	4	1 9
+	1	4 0
	5	5 9

→ 400 + 10 + 9

→ + 100 + 40 + 0

500 + 50 + 9 = 559

Using Algorithms to Illustrate Place Value Understanding Continued

Step 1: Add Ones
Step 2: Add Tens
Step 3: Add Hundreds

$$\begin{array}{r} 419 \\ +\ 140 \\ \hline 559 \end{array}$$

$$\begin{array}{r} 419 \\ +\ 140 \\ \hline 559 \end{array} \quad \rightarrow \quad \begin{array}{r} 420 - 1 \\ +\ 140 \\ \hline 560 - 1 = 559 \end{array}$$

SpringMath Accelerate
Amanda VanDerHeyden

The National Mathematics Advisory Panel (2008) defines **Proficiency** as…

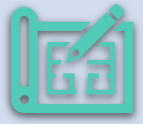
Understanding key concepts, achieve automaticity as appropriate, **DEVELOP FLEXIBLE ACCURATE, & AUTOMATIC EXECUTION OF STANDARD ALGORITHMS** & use these competencies to solve problems (p. 22)

Truth

Many Tasks In Every Day Life Require Algorithms

Algorithms…

Link conceptual understanding & procedural knowledge



Illustrate that mathematics is structured, predictable, organized & contains patterns

Provide a Tool For Completing Routine Tasks

Break Down More Complex Problems Into Simpler Subtasks

(Kilpatrick et al., 2001; Wu, 2011)

BEST PRACTICES

(Flores & Kaffar, 2018; Montague et al., 2011; Pfannenstiel et al., 2015 Pashler et al., 2007; Torbeyns & Verschaffel, 2016; Zhang et al., 2014; Zhang et al., 2017)

Teach the Standard Algorithm

- Help students understand when to use & why

Use Worked Examples When Students are First Learning to Solve Problems

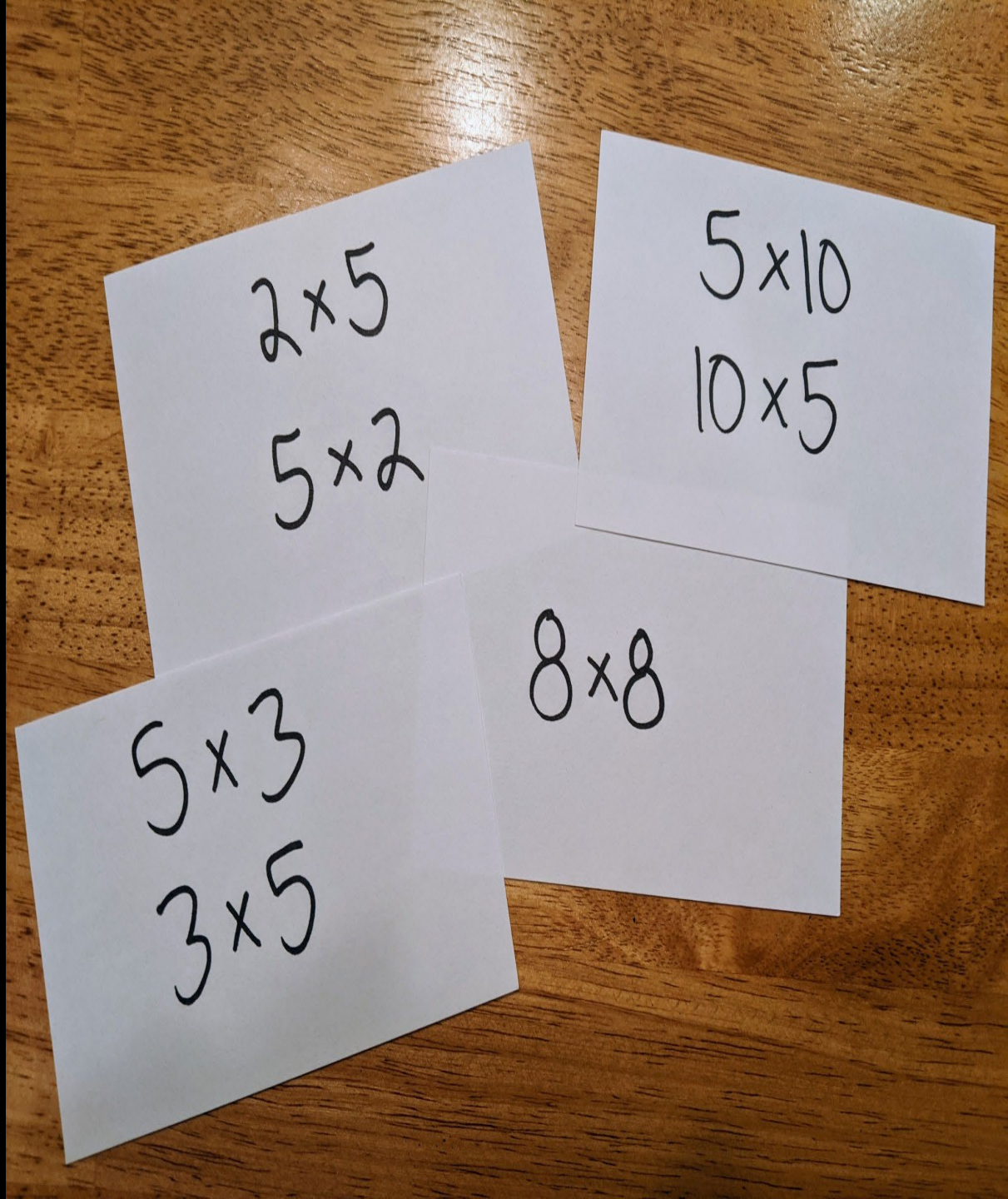
- Interleaving worked and/or partially worked examples with unworked problems → deeper learning

Use Mnemonics & Checklists to Support Step-by-Step Problem Solving

- RENAME

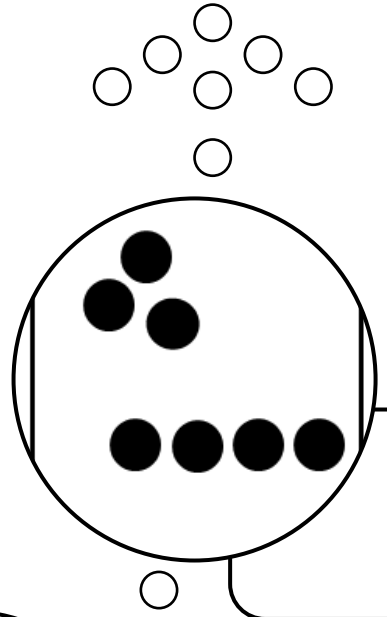
MYTH #3

FACT FLUENCY DOESN'T MATTER



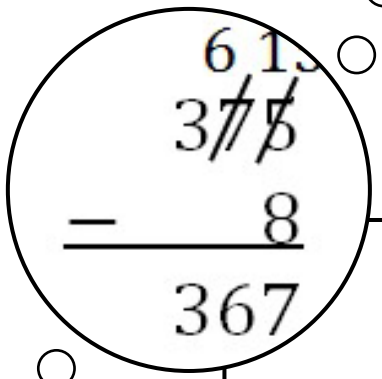
Computational Proficiency with Whole Number Operations

(National Mathematics Advisory Panel, 2008)



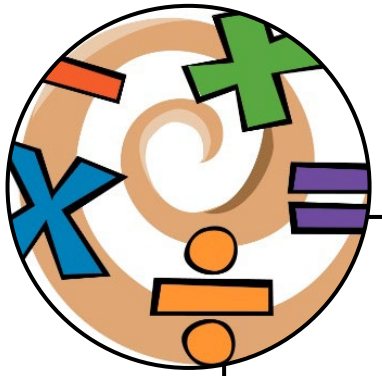
Sense of Number

Solid Sense of Number Concepts



Fluency

With Standard Algorithms for all Operations



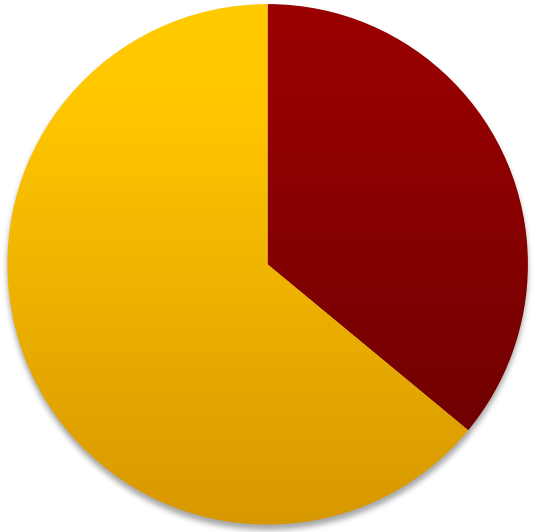
Facts

Automatic Recall

State of Affairs

Basic Addition

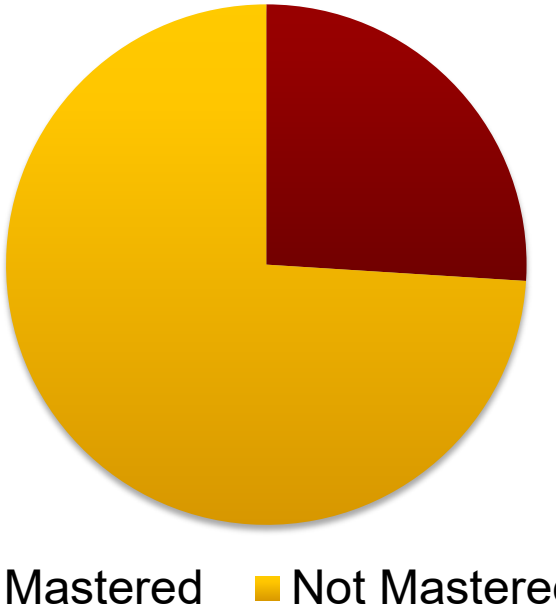
Second Graders



Third Graders

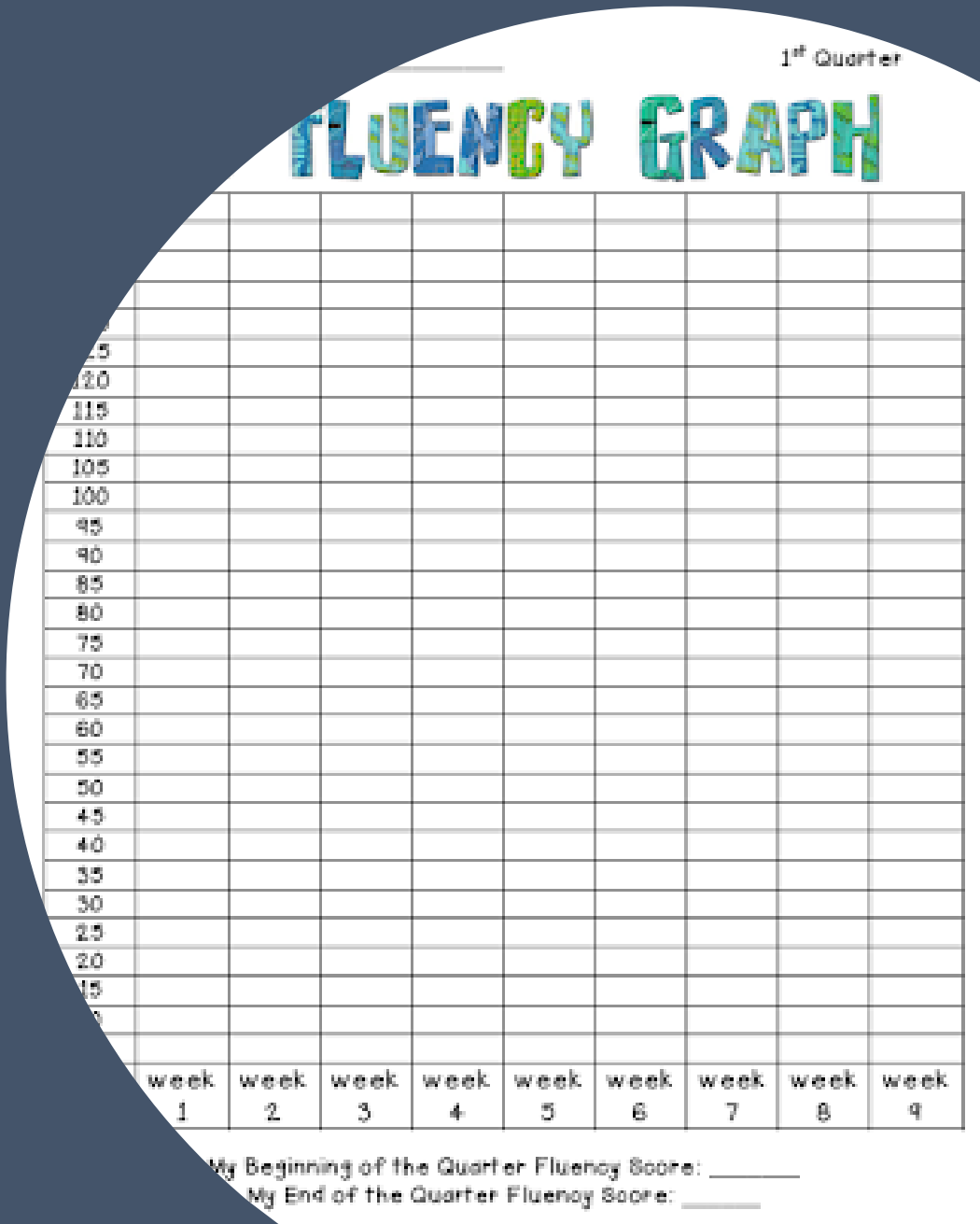
Basic Subtraction

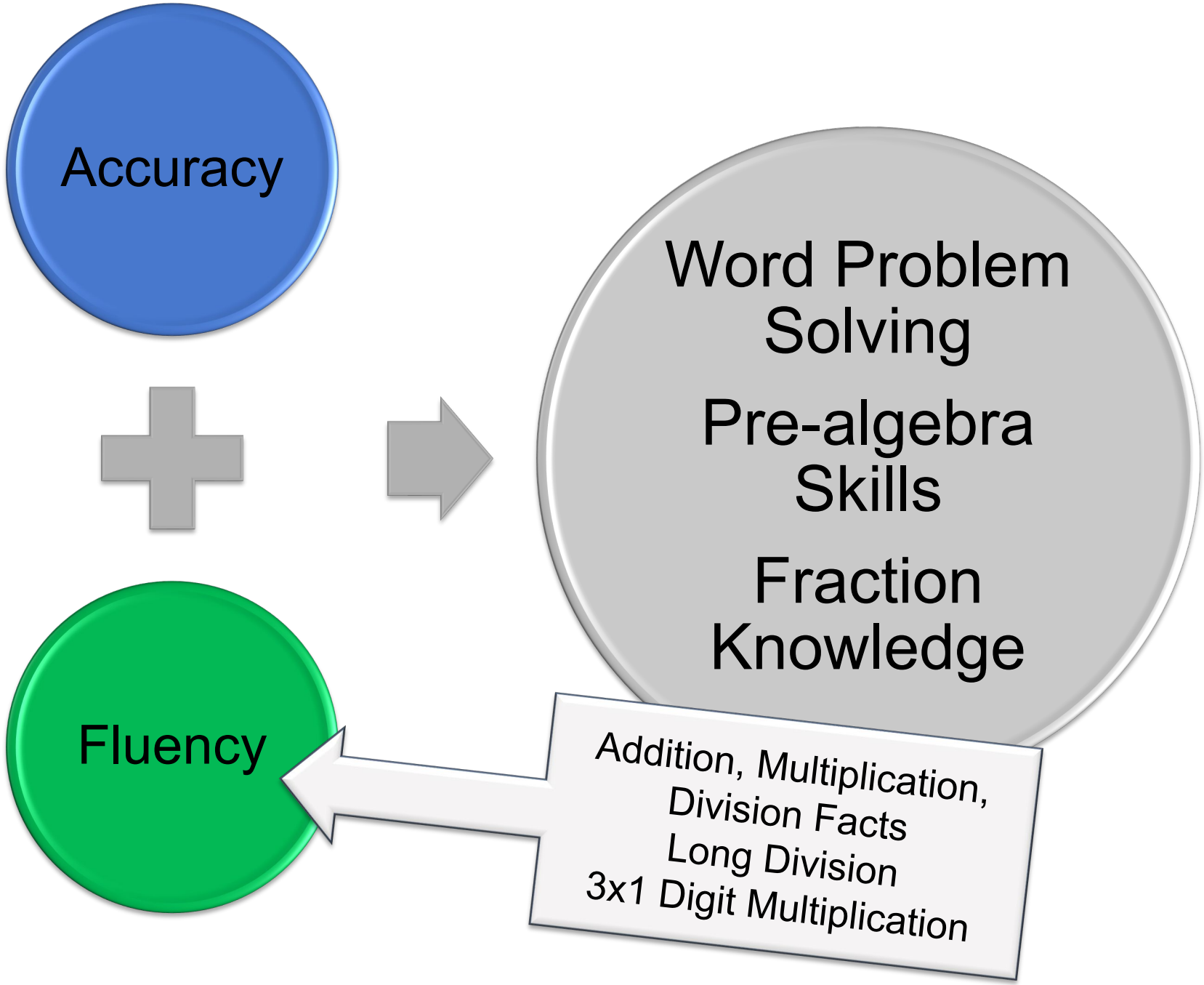
Third Graders



(Stickney, Sharp, & Keynon, 2012)

Accuracy or Fluency?





(Carr & Alexeev, 2011; Fuchs et al., 2016; Hansen, Jordan, & Rodrigues, 2017; Ilyse et al., 2016; Numkung et al., 2018; Resnick et al 2018; Ye et al., 2016)

Truth

If students automatically retrieve

3 + 4

they are more likely to access:

- 30 +40
- 53 + 24
- 321 + 452
- $1.30 + $1.40
- $^3/_9 + ^4/_9$

If students are not fluent, they:

- Direct more attention & working memory to retrieving the solution
- Experience greater **anxiety** for & **avoidance** of math tasks

(Dehaene, 2011; DeSmedt et al., 2011; Gersten et al., 2009; Hasselbring et al., 1988; Jordan et al., 2009; O'Connell & SanGiovanni, 2011; Powell & Fuchs 2013; Price et al., 2013; Stickney et al., 2012).

Fact Fluency Defined

What:

- Fast & accurate performance on 1-digit problems across all whole number operations

When:

- Should be mastered by the end of 5th grade

Why:

- Associated with higher mathematics achievement & more efficient completion of complex math tasks

(Hansen, Jordan, & Rodrigues, 2017; Jordan, Kaplan, Locuniak, & Ramineni, 2009; NGACBP/CCSSO, 2010; Numkung et al., 2018; Price, Mazzocco, & Ansari, 2013; Resnick et al., 2018)

Pathway to Automaticity

Counting All

LEAST EFFICIENT

Counting Up from First Addend

3 + 5

Counting on from Larger Addend

3 + **5**

COUNTING

REASONING

Decomposition

7+8 = 5+2+8 = 5+10

7+8 = 7+ 7 + 1

Mental Retrieval

MOST EFFICIENT

(Butterworth, 2005; Griffin, 2003)

BEST PRACTICES

(e.g., Baroody et al., 2009; Burns et al., 2006; Burns et al., 2015; Daly et al., 2007; Fuchs et al., 2008; Gersten et al., 2009)

10 min of daily fluency practice

Deliberate

Frequent

Materials are…

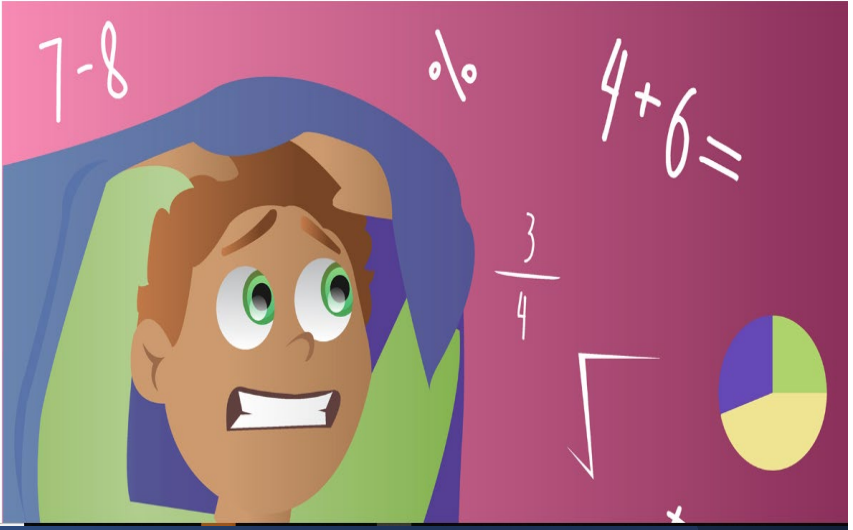
To solve simple multiplication facts, the **average**

- Matched to instructional level
- Sequenced into small sets
- Altered according to progress
- Integrated for cumulative review

- 3rd grader requires 7-8 repetitions
- 4th grader requires 5 repetitions

MYTH #4

TIMED TESTS CAUSE MATH ANXIETY



Defining Math Anxiety

(Ahmed, 2018; Ashcraft & Moore, 2009; Cargnelutti et al., 2017; Chinn, 2009; Gunderson et al., 2018; Hembree, 1990; Ho et al., 2000; Li et al., 2021; Luttenberger et al., 2018; OECD, 2013; Ramirez et al., 2013; Richardson & Suinn, 1972; ; Sawchuk & Sparks, 2020; Sorvo et al., 2017; Vukovic et al., 2013)

What is it?

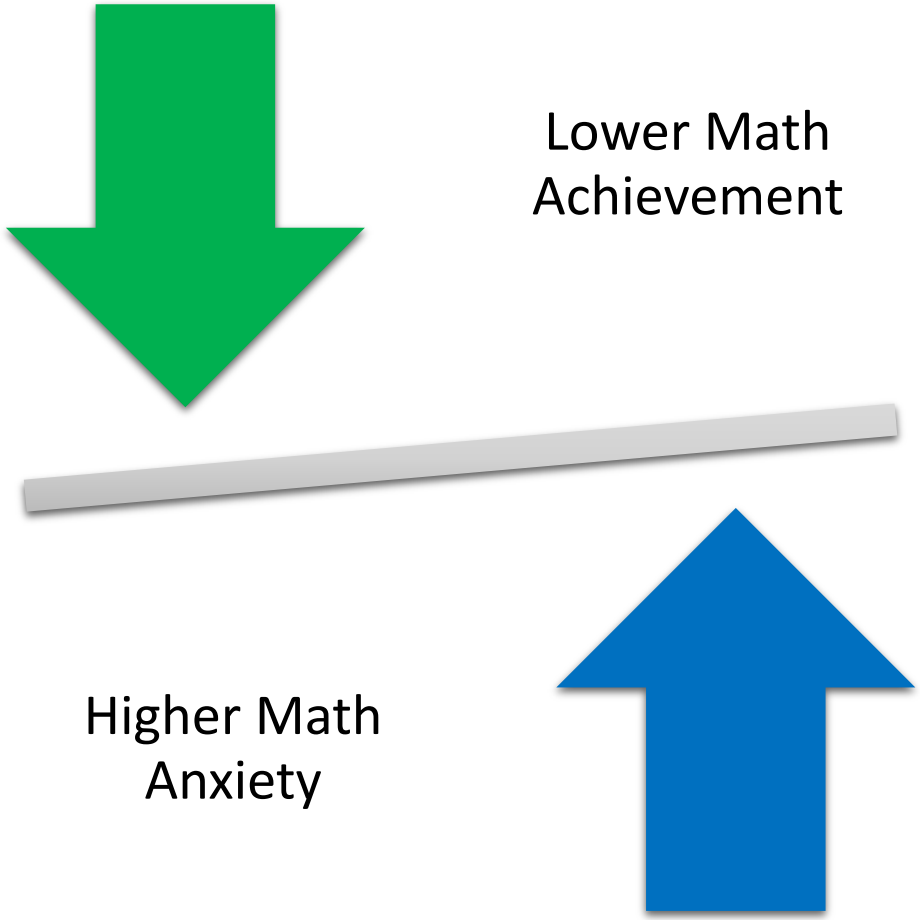
Tension, worry, physiological reaction & self-defeating thoughts about performance interfering w/completion of math tasks or the manipulation of numbers in ***academic and daily living***

Prevalence:

As many as 17% of the U.S. population experiences high levels of math anxiety	Children as young as 6 have experienced math anxiety	As many as 59% of adolescents around the world worry math class will be difficult

Relationship Between Math Achievement & Math Anxiety

- Small to Moderate Negative Relationship (r = -.25 to -.40)
- Relationship is Consistent Across
  - the Lifespan
  - Racially and Ethnically Diverse Samples within the U.S.
  - Continent of Origin



(Barroso et al., 2021; Hembree 1990; Ma 1999; Namkung et al., 2019; Zhang et al., 2019)

Why do We Assess with Timed Tests?

Superior Information In Knowing Whether Students Have Attained Mastery

Its Efficient And Wastes Less Instructional Time

Rate Measures are More Reliable & Valid than Accuracy Measures

(Burns, VanderHeyden, & Jiban , 2006)

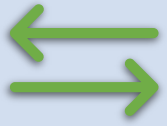
Theories Associated with Math Anxiety

Deficit Theory

Poor Math Performance → High Math Anxiety

Cognitive Interference Theory

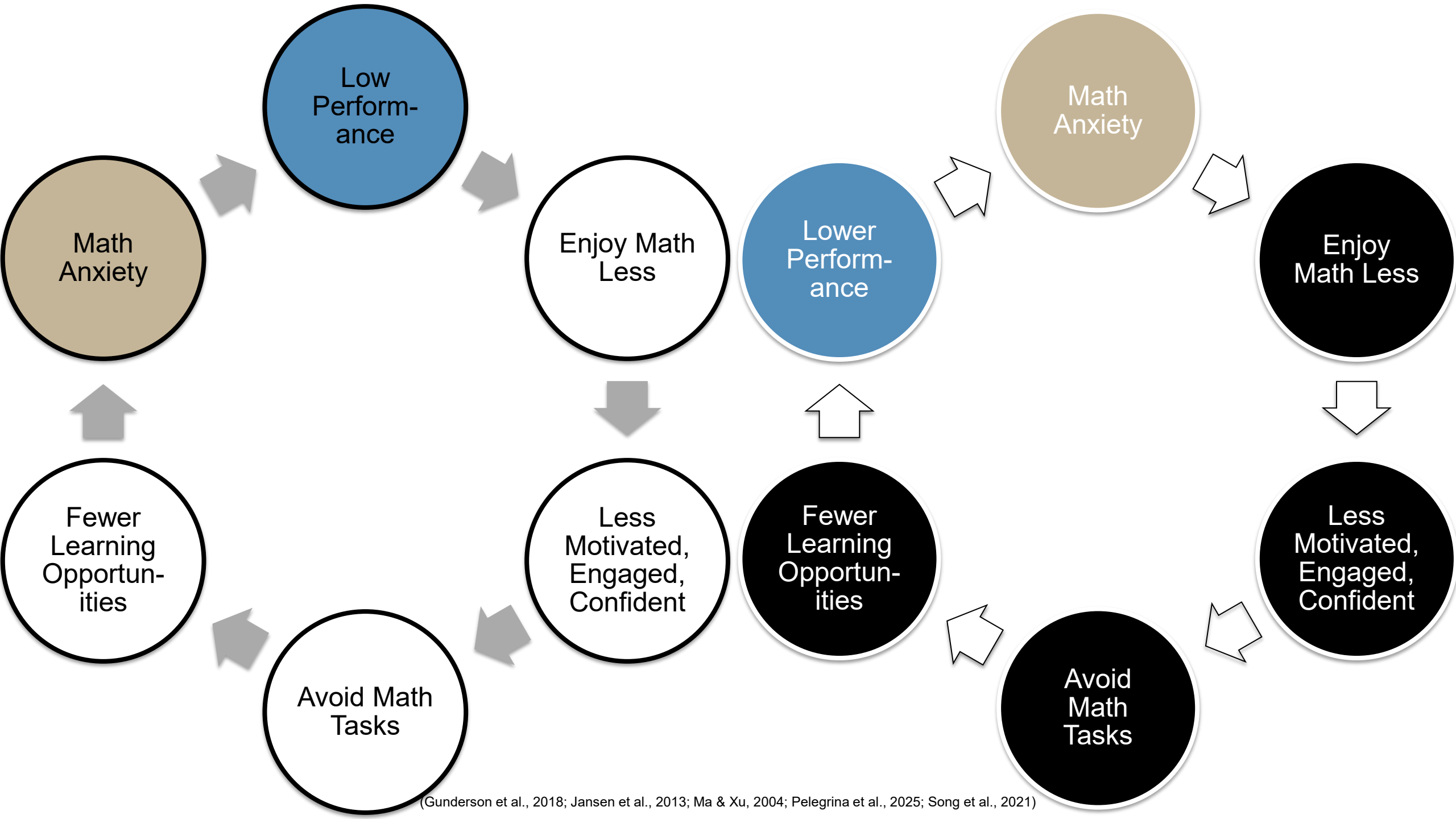
High Math Anxiety → Poor Math Performance



Reciprocal Theory

Poor Math Performance ↔ High Math Anxiety

(Ashcraft & Krause, 2007;Barroso et al., 2021; Carey et al., 2016; Eysenck & Calvo, 1992; Gunderson et al., 2018; Jansen et al., 2013; Ma & Xu, 2004; Namkung et al., 2019; Song et al., 2021; Shaw & Maloney, 2018; Wang et al., 2015)



(Gunderson et al., 2018; Jansen et al., 2013; Ma & Xu, 2004; Pelegrina et al., 2025; Song et al., 2021)

TRUTH

When students are given **difficult tasks** without adequate prior instruction or practice, they report higher math anxiety

Overt timing on practice tasks can **facilitate** math performance for all students

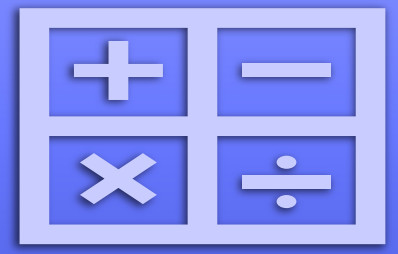
Math skill building interventions improve math performance and reduce math anxiety

Combining math skill building and therapeutic interventions is effective for reducing math anxiety but not improving math skills

(Codding, Goodridge et al., 2023; Codding , VanDerHeyden, et al., 2023; Grays et al., 2017; Liu et al., 2025; Maki, Codding et al., 2023; Maki et al., 2023; Namkung et al., 2019; Tsui & Mazzocco, 2006)

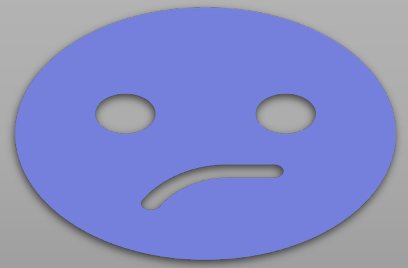
BEST PRACTICES

(**Cargnelutti et al., 2017**; Codding, Goodridge et al., 2023 **Grays et al., 2017**; **Gunderson et al., 2018**; ; Liu et al., 2025 **Sorvo et al., 2017**)



Address Students' Math Skill Gaps Directly & First

- Match instructional strategies to students' needs
- Check to make sure prerequisite skills are mastered

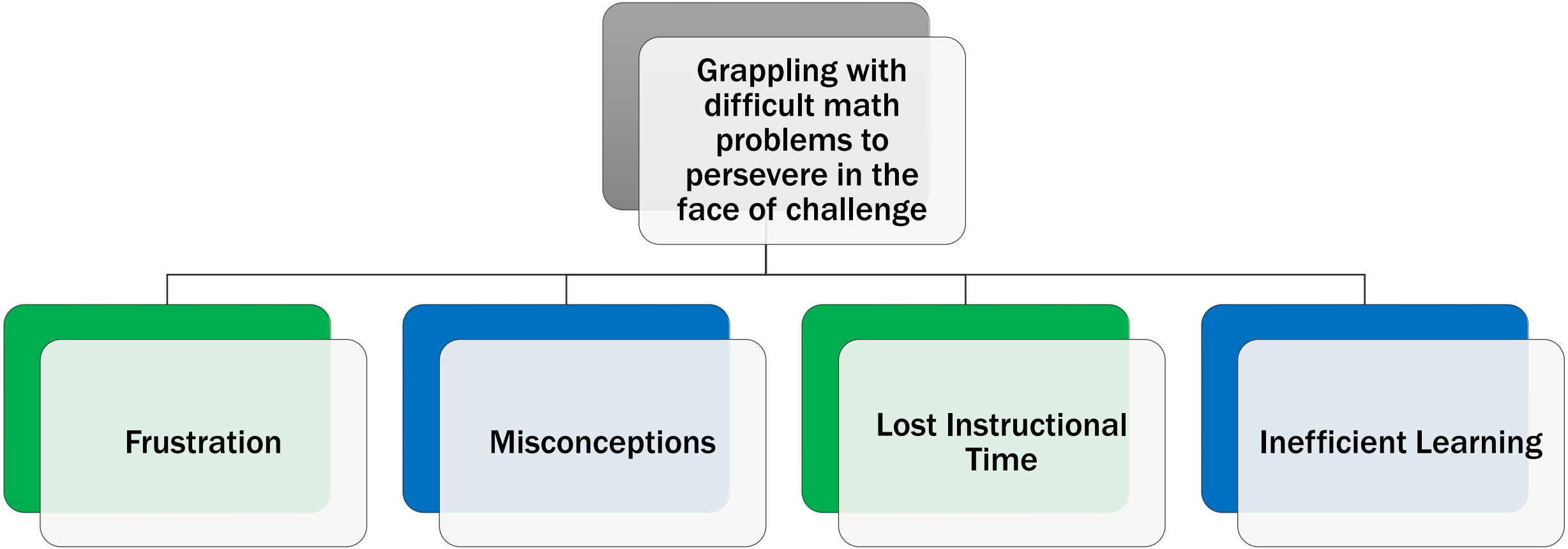


When Students Have High Math Anxiety Add Therapeutic Support

MYTH #5

PRODUCTIVE STRUGGLE LEADS TO DEEPER LEARNING

PRODUCTIVE STRUGGLE



(Ashman et al., 2020; Brown & Campione, 1994; Carlson et al., 1992; Kapur, 2014)

Students learning NEW skills need clear demonstration, modeling, & guided practice

Students' comprehension of NEW information is Improved by activating PRIOR KNOWLEDGE

No evidence that giving partial information for making connections leads to learning

Teacher guidance is required for learners to complete & learn from an activity

Explicit explanations are required to maximize student performance

(Iris Center: https://iris.peabody.vanderbilt.edu/module/sec-rdng/cresource/q3/p09/; Kirschner et al., 2010; Kirschner & Hendrick, 2020; Lazonder & Harmsen (2016)

Instructional Hierarchy

(Burns et al., 2010; Codding et al., 2017; Haring et al., 1978)

Acquisition

ESTABLISHING Skills & Concepts – Building Accuracy

Fluency

REMEMBERING & RETAINING Skills & Concepts – Building Efficiency & Accuracy

Generalization

ENDURING – Skills & Concepts Are Demonstrated Across Academic Tasks & Situations

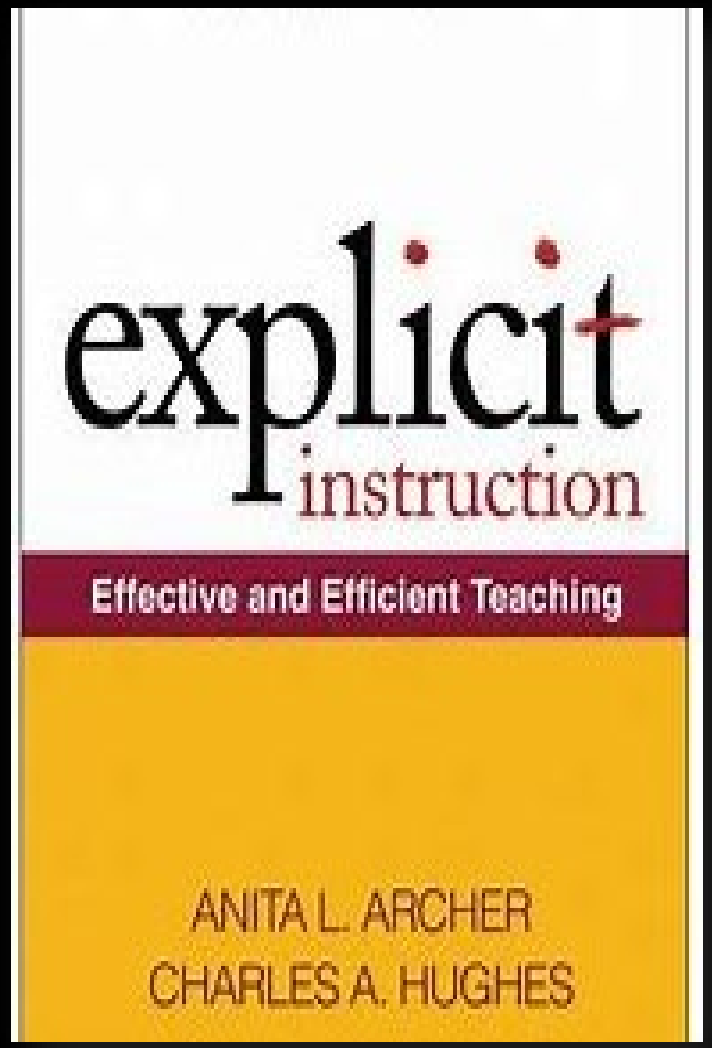
Adaptation

APPLYING – Skills & Concepts are Integrated and Applied to Novel Problems

Best Practices

(Ashman et al., 2020; Brown & Campione, 1994; Carlson et al., 1992; Kapur, 2014)

Scaffold	Learning According to the Instructional Hierarchy
Build on	Prior Knowledge
Provide	Challenging Problems After Students Demonstrate Accuracy, Fluency, & Generalization w/Required Skills & Concepts



MYTH #6

EXPLICIT INSTRUCTION IS ONLY HELPFUL FOR SOME STUDENTS

Systematic a
instr
and skills

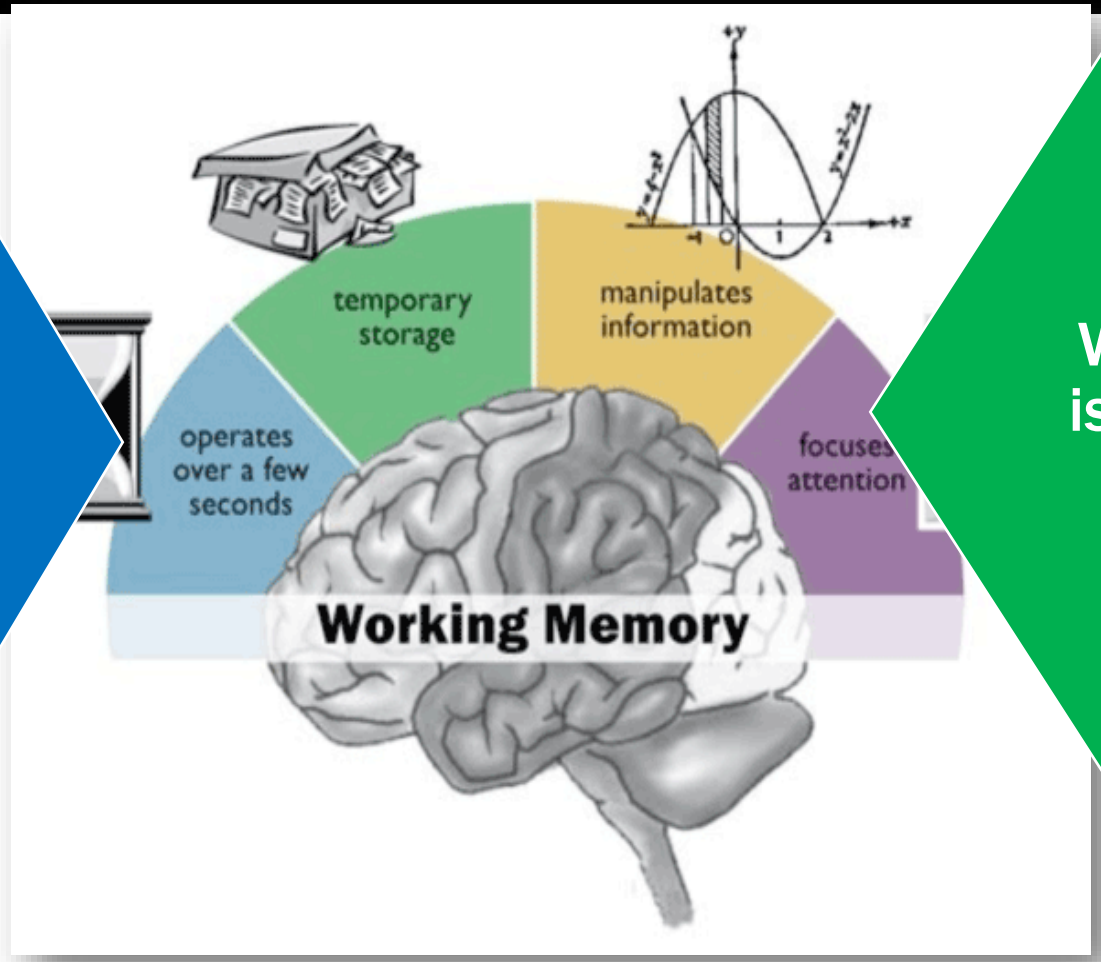
STATED CLEARLY AND IN DETAIL, LEAVING NO ROOM FOR CONFUSION OR DOUBT.
~Oxford Dictionary

(Doabler et al., 2014; Carnine et al., 2004; Rosenshine, 2012)

SCIENCE OF LEARNING

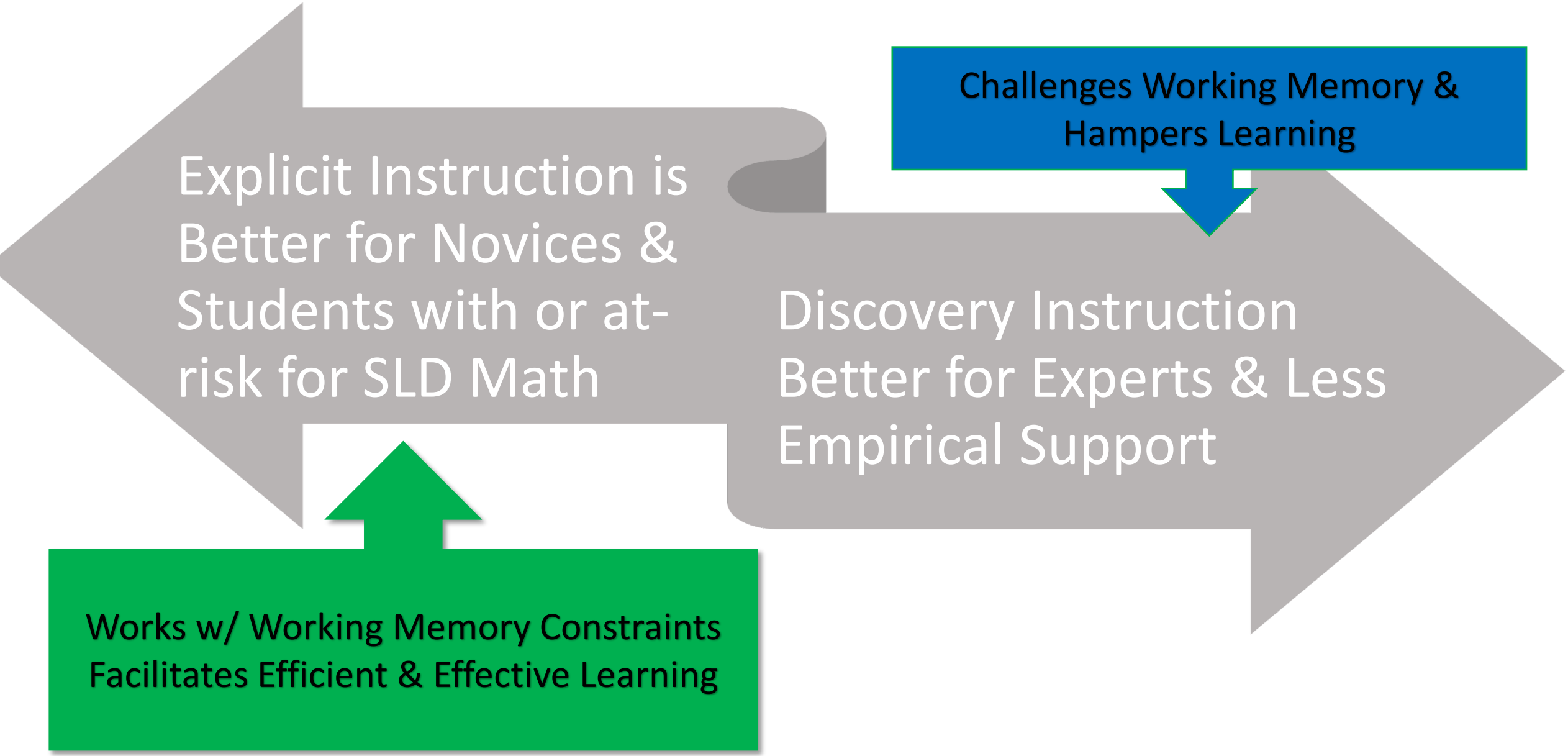
Novice Learners:

- Limited prior knowledge
- Remember & process parts
- Use inefficient problem-solving tactics
- Work backwards



Working Memory (WM) is Limited in Duration & Capacity

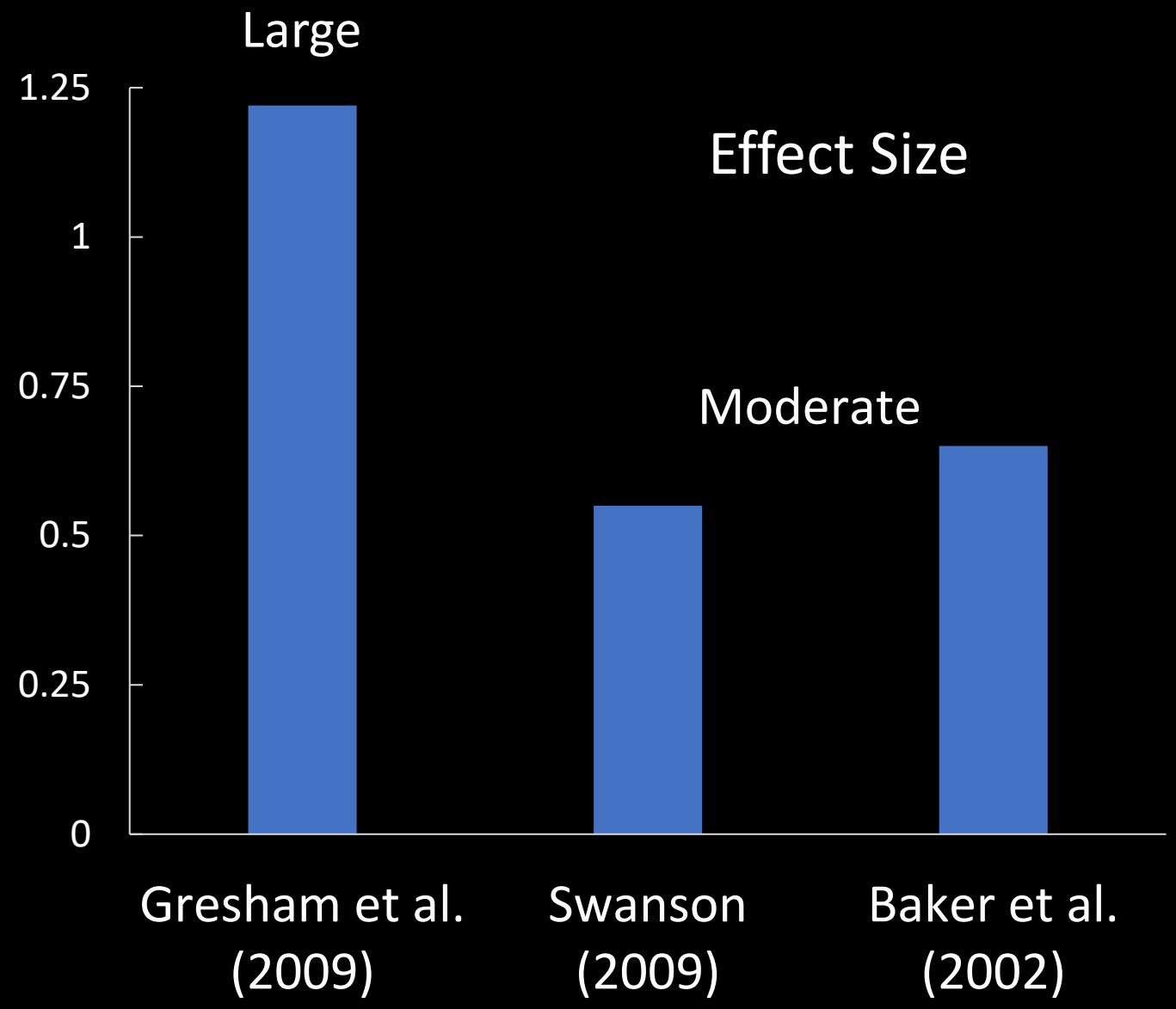
(Doabler et al., 2015; Smith et al., 2016)



(Kirschner & Hendrick, 2020)

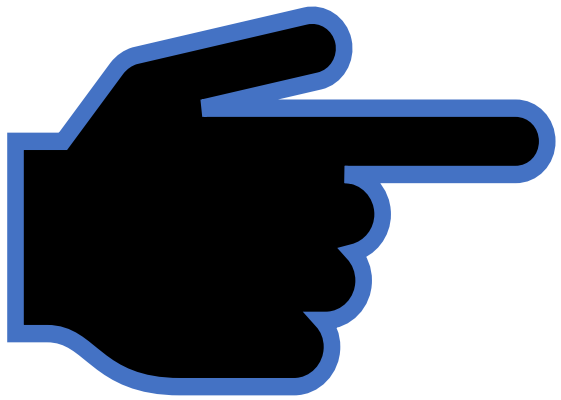
Evidence

Explicit Instruction is a High-Leverage, Evidence-based Practice



(Hlas & Hlas, 2012; McLeskey et al., 2017; Nelson et al., 2022)

Truth



- Clear and concise demonstrations
- Frequent OTPs to verbalize
- Timely feedback
- High quality & frequent teacher-student interactions
- Scaffolding according to instructional level
- Evaluates for mastery

(Doabler et al., 2015; Smith et al., 2016)

BEST PRACTICES

INCORPORATE EXPLICIT INSTRUCTION INTO YOUR LESSONS EVERY DAY

USE A CURRICULUM THAT INCORPORATES EXPLICIT INSTRUCTION

PROVIDE EXPLICIT INSTRUCTION DURING INTERVENTION SUPPORTS

MYTH #7
ALL
MATH STANDARDS
ARE
CREATED EQUAL

History: A Mile Wide & an Inch Deep

Number of Math Topics Listed (Schmidt & Houang, 2012)	Grade Level				
	First	Second	Third	Fourth	Fifth
A+ International Countries	5	9	12	16	21
Common Core Mathematics Standards	8	11	13	17	21
Sample of 50 States' Mathematics Standards (2008-2009)	13	15	18	20	21
State Averages (1995)	12	17	21	26	28

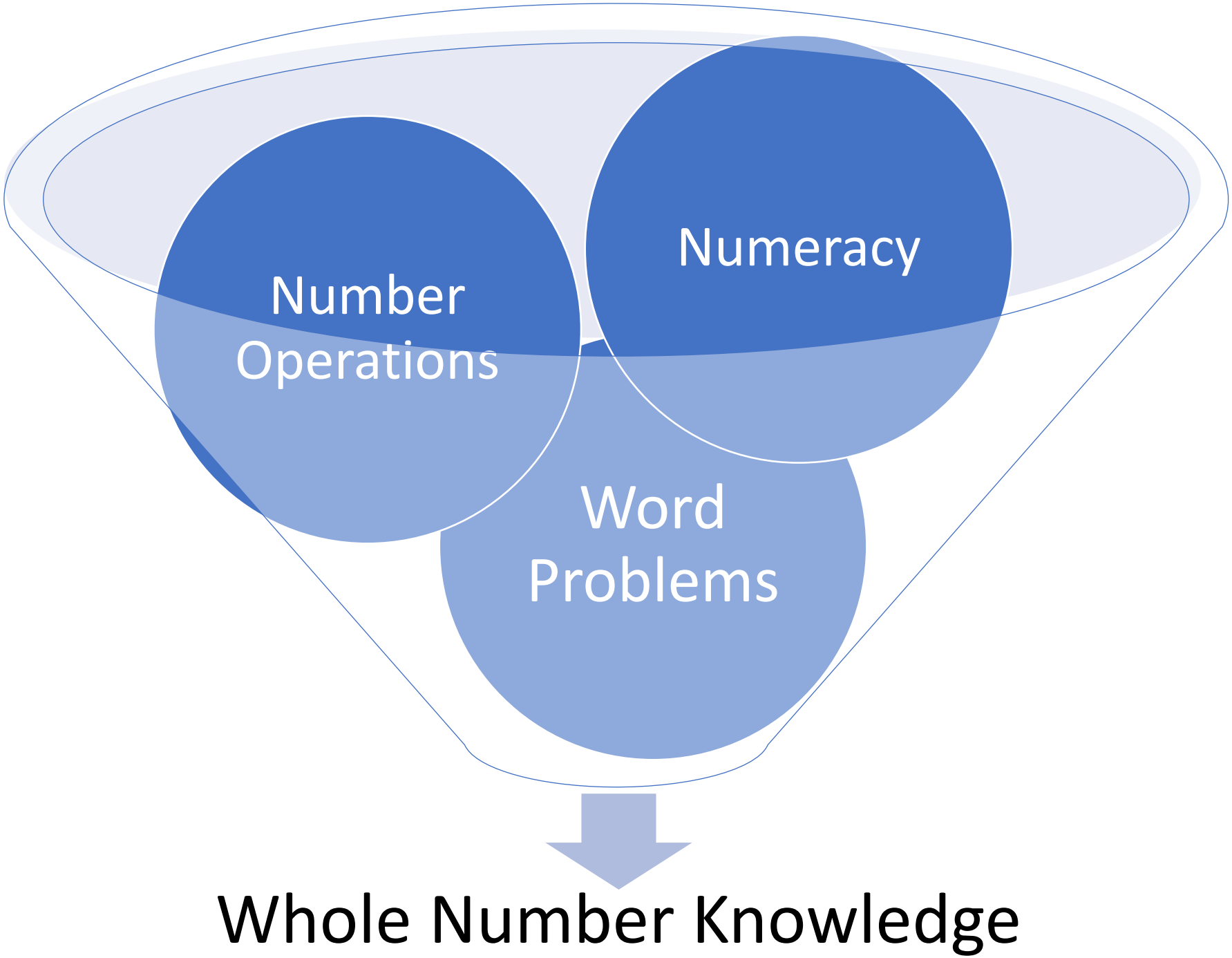
CRITICAL FOUNDATIONS FOR

(Gersten et al., 2009; National Mathematics Advisory Panel [NMAP], 2008; USDOE, 2008)

Algebra

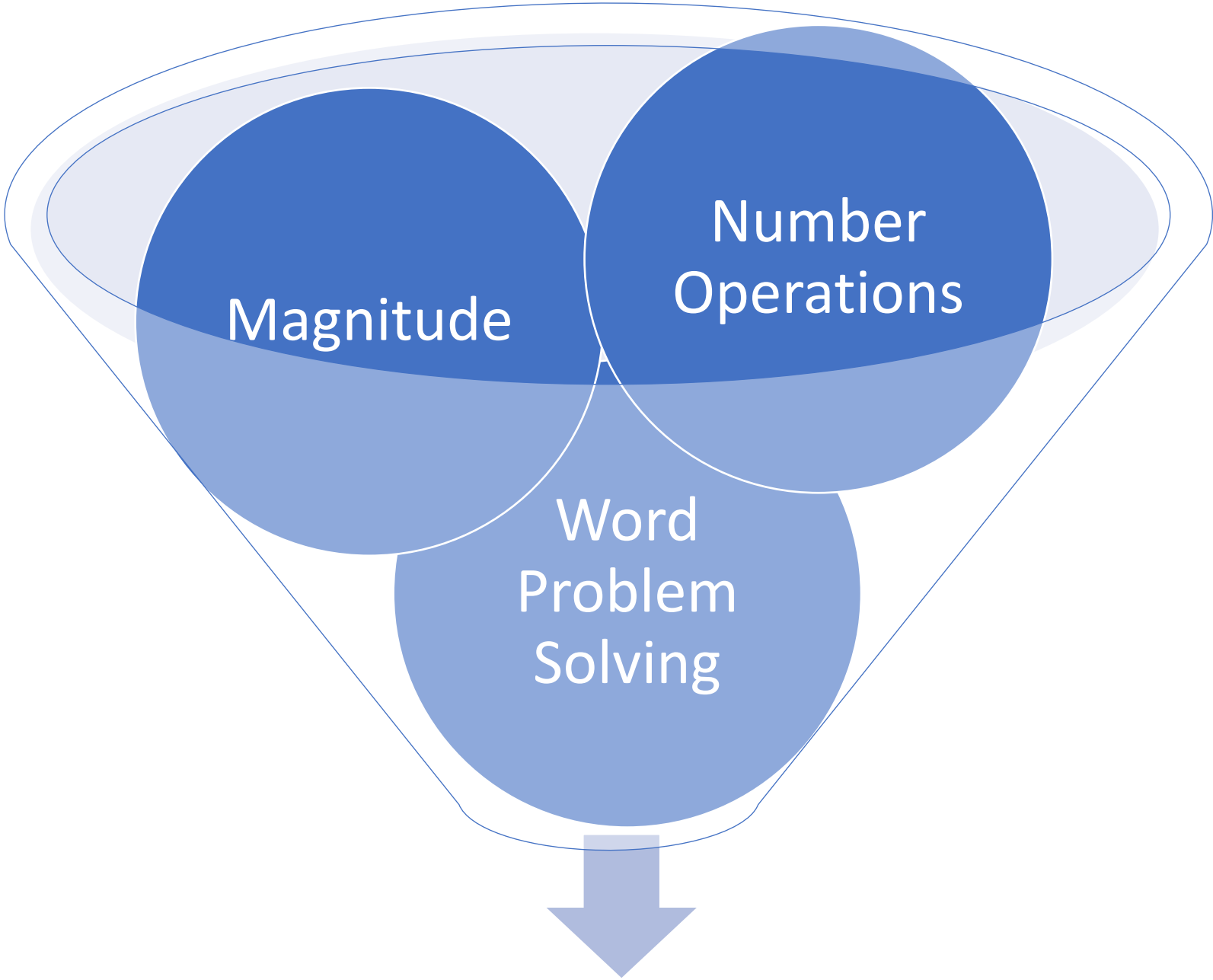
- Whole Number Proficiency
- Fluency with Fractions
- Key Aspects of Geometry
- Key Aspects of Measurement

Bucket 1



National Mathematics Advisory Panel (2008)

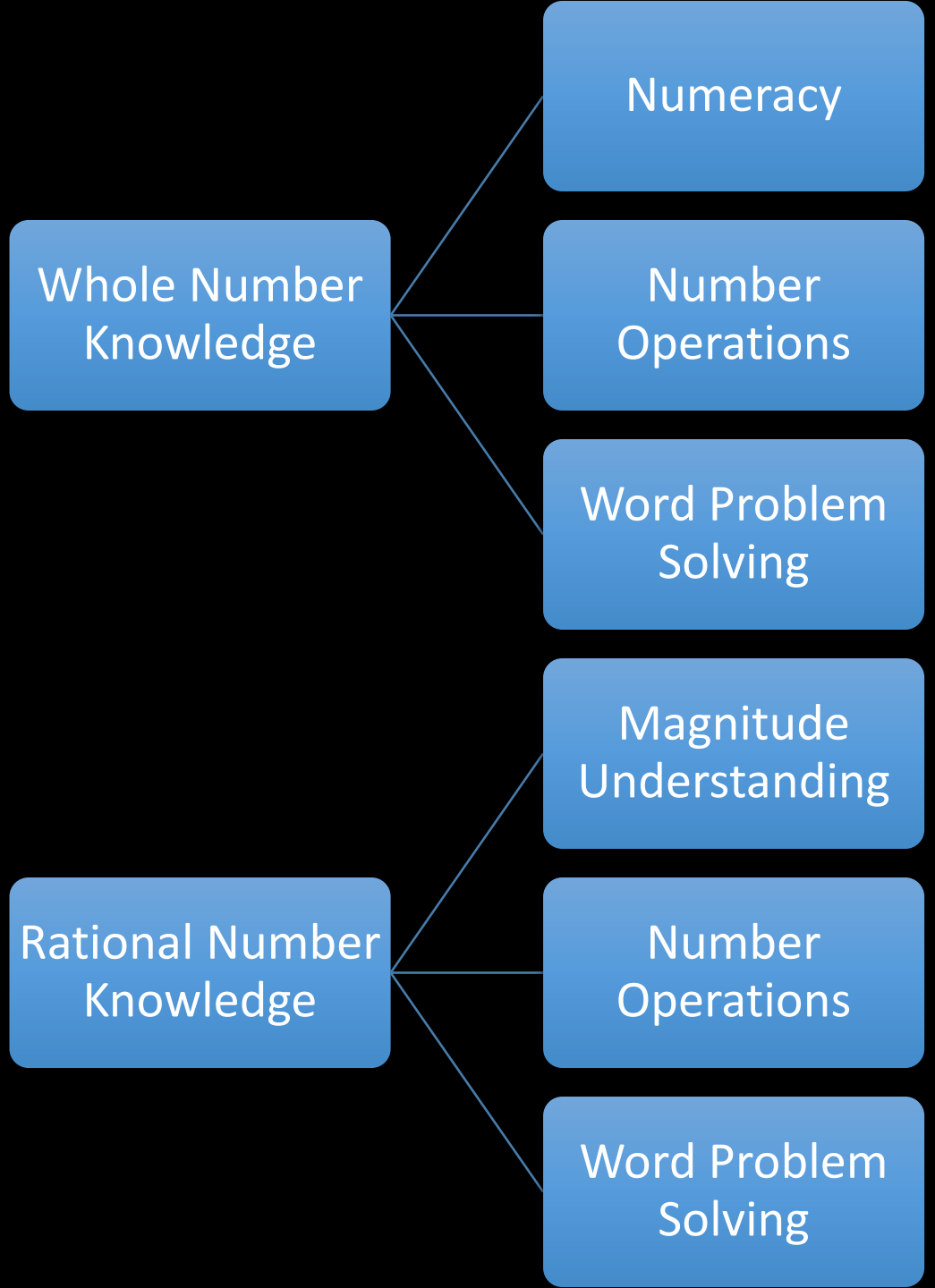
Bucket 2


Magnitude
Number Operations
Word Problem Solving
Rational Number Knowledge

Best Practices:

K-8 Emphasis

Teach Foundational Skills 1st



(Hansen, Jordan, & Rodrigues, 2017; Numkung et al., 2018; Resnick et al., 2018)

MYTH #8

EXECUTIVE FUNCTIONING TRAINING MATTERS

Executive Functioning: What is it?

- Set of cognitive skills required to direct behavior toward a goal by planning, focusing attention, remembering, & juggling tasks
- Refers to
  - Working Memory * Mental Flexibility * Self-control

Responsible for:

- Regulating emotions
- Planning, organizing, prioritizing
- Self-monitoring (keeping track of what you are doing)
- Inhibition
- Persisting on Tasks

What Is Executive Function? | Understood

A Guide to Executive Function - Center on the Developing Child at Harvard University

Relationship between Math & EF and EF Training

Moderate association (average correlation = .31) between EF and math achievement

This relationship was reduced when studies controlled for IQ and other background characteristics

Very few rigorous EF training intervention studies exist

EF training interventions improved EF functioning but not academic outcomes

(Jacob & Parkinson, 2015; Kassai et al., 2019)

The most effective way to address math skill deficits is to DIRECTLY remediate math skills

Best Practices

To Individualize Math Interventions

- Minimize cognitive load on working memory and reasoning by
  - *including explicit instruction & breaking down problems into smaller more manageable parts*
- Minimize excessive language load by
  - *Include visual and concrete representations*
  - *Provide clear and concise math language*
- Increase repetition and opportunities to practice to *promote skill fluency* (especially if carryover from one day to next doesn't happen)

(e.g., Doabler et al.,. 2015; Hughes et al., 2016; Powell et al, 2019)

MYTH #9

GROWTH MINDSET INTERVENTIONS INCREASE MATH PERFORMANCE

Students from OECD countries scored 23 points higher in math if reported having a growth mindset (PISA, 2018)

2/3 of students world-wide reported having a growth mindset

Research On Stand-alone Growth Mindset Interventions Yield **Minimal Gains** On Math Outcomes & **Replication Attempts Failed**

Math Outcomes Improved When Evidence-based **Math Interventions** & **Self-regulated Learning Skills** Were Added

Truth

(Fuchs et al., 2021; Li & Bates, 2020; Lee et al., 2021; 2022; Macnamara & Burgoyne, 2023; Peterson, 2018; PISA, 2018; Sisk et al., 2018; Wang et al., 2019; Yeager et al., 2019)

BEST PRACTICES

GET STUDENTS INVOLVED IN THEIR OWN LEARNING & HELP THEM BECOME AWARE OF HOW THEY THINK DURING PROBLEM SOLVING

Model & Praise Effort & Persistence

Demonstrate New Strategies To Solve Problems When Students Are Stuck

Teach Students How To PLAN, MONITOR, CHECK & MODIFY Their Work w/Heuristics, Mnemonics, & Verbalization

Help Students Establish Short-Term Learning Goals

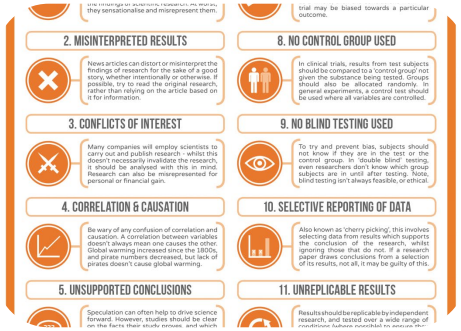
Show Students How To Monitor Progress Toward Learning Goals & Record Accomplishments

(Fuchs et al., 2021; Li & Bates, 2020; Macnamara & Burgoyne, 2023; Montague et al., 2011; Park et al., 2016; Pfannenstiel et al., 2015) Pellegrini et al, 2021 PISA, 2018; Sisk et al., 2018; Yeager et al., 2019)


SUMMARY

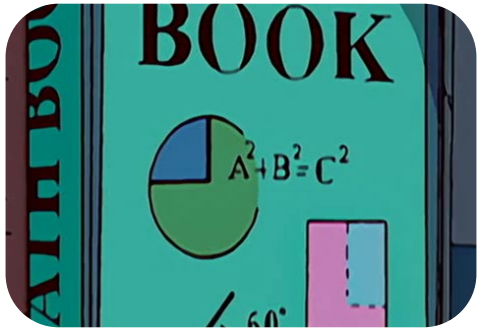
- What Myth Will you Bust in Your School?
- Why or How Will You Bust the Myth?

How Did We Get Here?



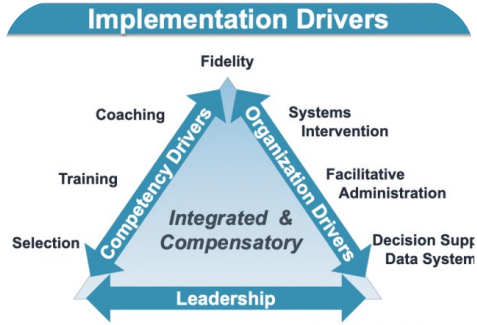
Pseudoscience is Seductive

Reform Efforts Left Behind Proven Practices



Limited tSOM Examples Included in Textbooks

Overload of information on the internet and via social media



Implementation Challenges

Often its Not the Instructional Strategy… It's the Application

Manipulatives	• Provide only when students are 1st learning a new concept or skill
Timed Activities	• Use Only AFTER High Accuracy is Demonstrated on a Skill
Games	• Offer when students are accurate and fluent with required skills
Challenging Novel Problems	• Deliver only after prerequisite skills are mastered

Interleave	conceptual understanding & procedural knowledge in every lesson
Teach	the standard algorithm
Challenge	students with novel problems after demonstrating accuracy, fluency, generalization with key skills & concepts
Plan	Lots of opportunities to practice with timed activities
Offer	Math skill building interventions to address math anxiety first
Prioritize	Key components that promote algebra readiness such as proficiency with whole & rationale number knowledge
Use	explicit systematic instruction everyday & at all tiers (including core instruction)
Individualize	By reducing language and WM load with explicit instruction and precise concise vocabulary
Show	Students how to engage in their own learning

Myth	Truth	Best Practice
Teach Conceptual Knowledge 1st	Conceptual understanding & procedural knowledge are mutually dependent & equally important	Interleave Conceptual & Procedural Knowledge in Every Lesson
Standard Algorithms are Harmful	Algorithms provide a link between conceptual and procedural knowledge	Teach the Standard Algorithm
Productive Struggle Leads to Deeper Learning	Productive struggle leads to frustration, misconceptions, and lost instructional time	Provide Challenge Problems AFTER Students Are Accurate, Fluent, And Generalize Skills/Concepts
Fact Fluency Doesn't Matter	Fact fluency predicts later math performance	Plan Lots of Opportunities for [Timed] Fact Practice
Timed Tests/Tasks Cause Anxiety	There is no causal evidence that timed tests cause anxiety	Address Math Skill Gaps First To Address Math Anxiety And Math Skills
Explicit Instruction Only Helps Some Students	Explicit instruction is the most effective instructional method	Provide Explicit Instruction at all MTSS Tiers
All Content Standards are Created Equal	There are key critical foundation skills that predict algebra readiness	Identify & Teach Foundational Skills (to Mastery) First
Executive Functioning Training Matters	Small correlation with math outcomes; EFT improves EF not math	Individualize By Reducing Language & WM Load
Growth Mindset Increases Math Achievement	Most kids already have a growth mindset	Get Students Involved In Their Own Learning


Questions

Math Myth Busters & The Science of Math

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