



MINNESOTA MATH INTERVENTIONS

**Unlock New Strategies for Teaching Math to All Learners:
A Sample Lesson from the Minnesota Math Interventions (MNMI)
On-Line Training Modules**

Ten Minnesota Commitments to Equity

1. Prioritize equity.
2. Start from within.
3. Measure what matters.
4. Go local.
5. Follow the money.
6. Start early.
7. Monitor implementation of standards.
8. Value people.
9. **Improve conditions for learning.**
10. Give students options.



- **Minnesota Math Interventions (MNMI)**
 - ❑ **Project Background**
 - ❑ **Meet our Experts**
 - ❑ **Exploring the Needs of our Target Population**
 - ❑ **The MNMI Foundational Modules**
 - ❑ **The MNMI Grade Band Modules**
- **A Math Language Lesson from Module E**
- **Incorporating MNMI into Your MTSS Framework**

Minnesota Math Interventions (MNMI)

About This Project

The intent of this project is to increase teacher **content** and **pedagogical knowledge** related to teaching math to students with a **disability or math difficulty**.

We rely on **research related to disability and difficulty** to drive the content within these modules.

Our Team

Implementation Project Managers

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Dr. Vicki Weinberg

Lead Training Module Developers

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Sarah Sirna

Dr. Miriam White

Margaret Williams

Dr. Terrence Wyberg

Questions for You



Think of the **students** you serve.

Describe one or two of the **difficulties** these students have with **math**.

What are the needs of **math teachers** and **math interventionists** across Minnesota, particularly as they support students with disabilities?



Meet Our Experts



Brad Witzel, Ph.D.



Sarah Powell, Ph.D.



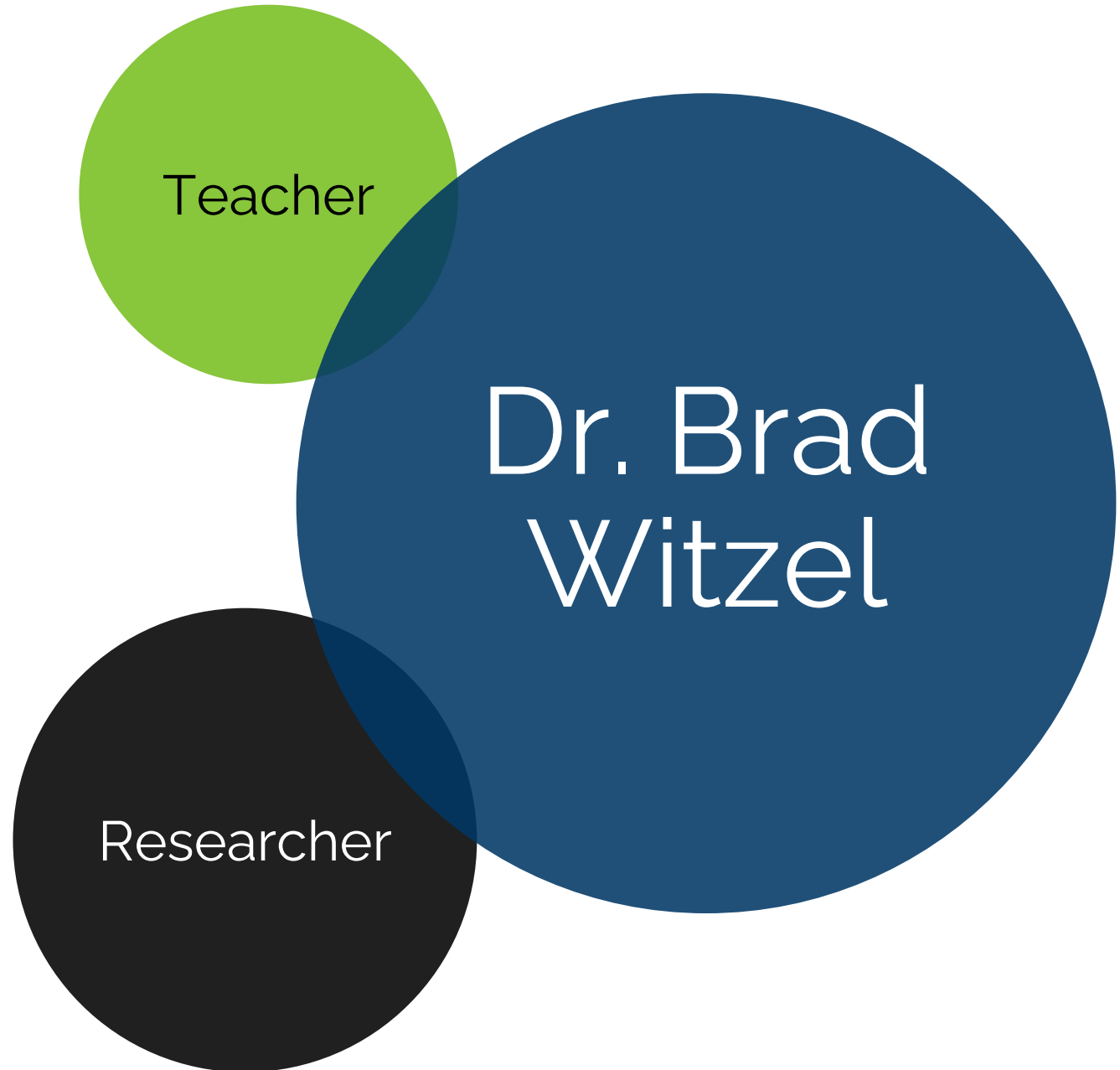
Karen Tzanetopoulos,
M.S., CCC-SLP



Sandra Elliott, Ph.D.

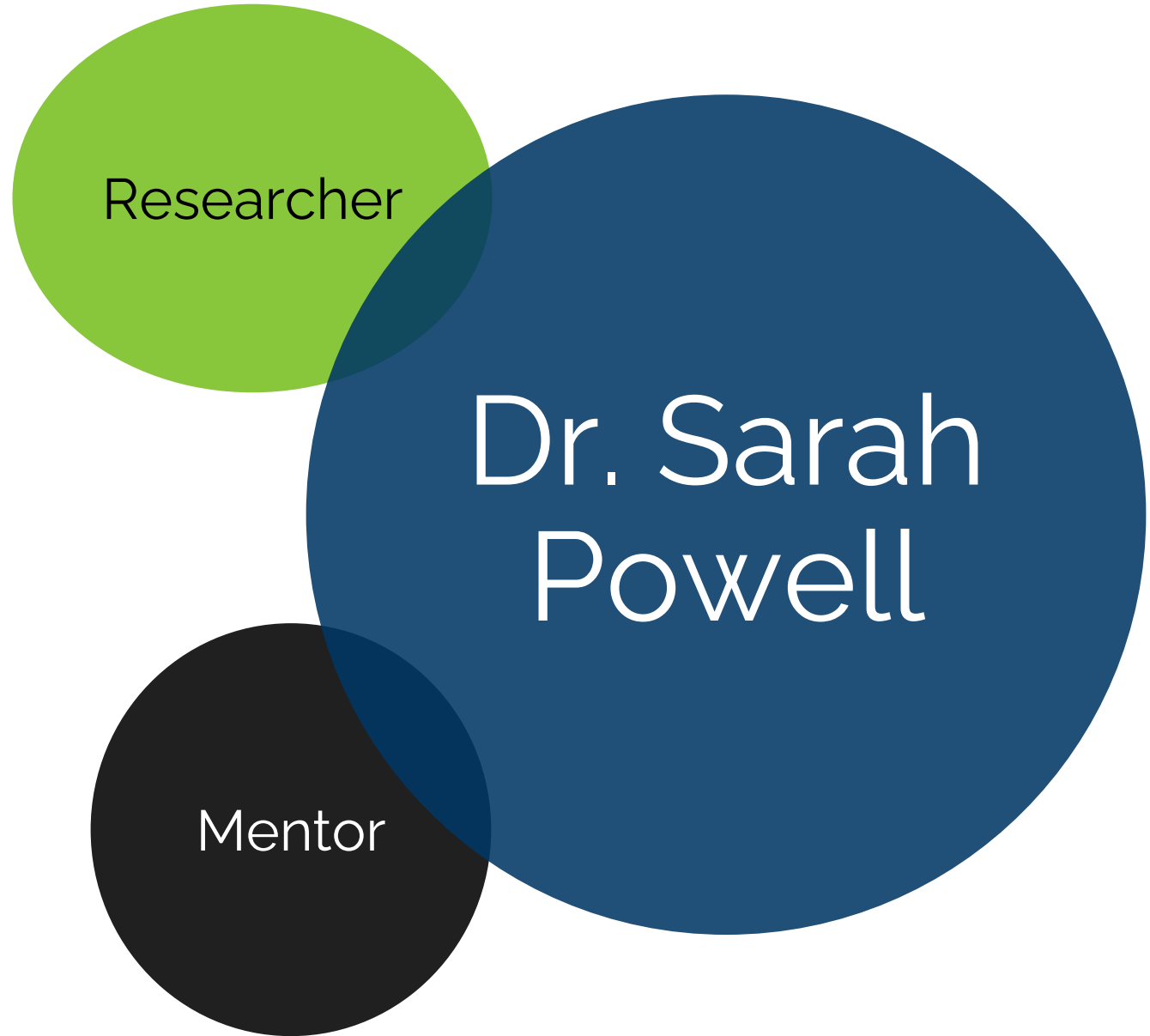
Dr. Brad Witzel, Adelaide
Worth Daniels
Distinguished Professor of
Education at Western
Carolina University.

- Studies strategies for students with persistent math underachievement.
- 10 books
- 80+ publications
- 800+ presentations



Dr. Sarah Powell is a Professor in the College of Education at The University of Texas at Austin and an Associate Director of the Meadows Center for Preventing Educational Risk.

Her research and teaching focus on the development and testing of interventions for students who experience difficulty with mathematics.



Karen Tzanetopoulos is an author, lecturer, and math PD instructor.

Specializes in:

- The role of language in learning math
- Math cognition
- Spatial skills and math

MATH
LEARNING
EXPERT

Karen
Tzanetopoulos

SPEECH AND
LANGUAGE
PATHOLOGIS
T

Dr. Sandra Elliott

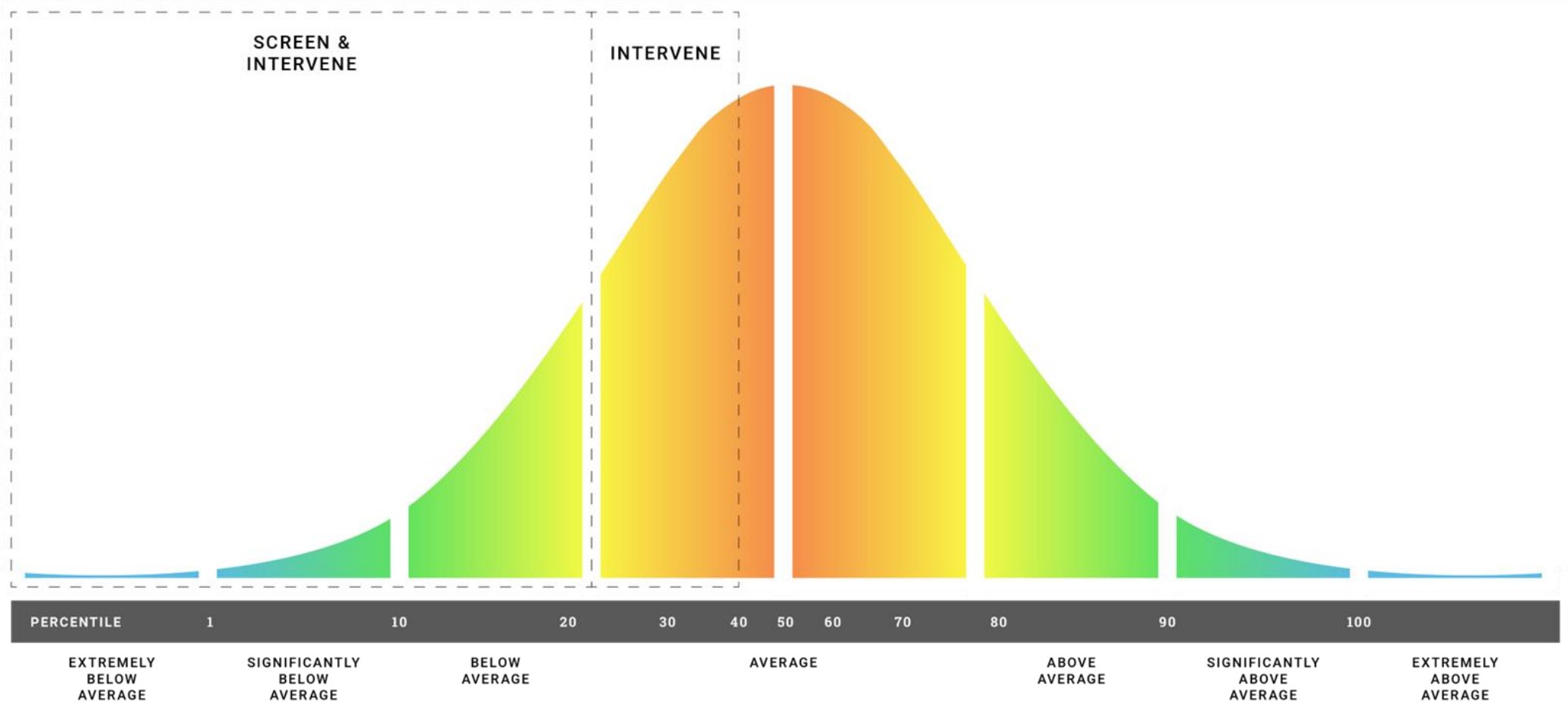
- Board Member, Dyscalculia Research and Training Institute
- Senior Advisor, TouchMath
- Author, *Sum Thing Is Up: A Practical Guide to Dyscalculia*
- Research areas- dyscalculia, Exceptional Education and AI
- Founder and CEO of Elliott Street Consultancy

Education
Expert and
Advocate

Dr.
Sandra
Elliott

Leading
Authority on
Mathematics
Education and
Learning
Differences

Who Struggles With Math?



Who are the children that struggle with math (and language)?

- Specific Learning Disability (SLD)
- Dyslexia
- Developmental Language Disorder
- Dyscalculia
- English Language Learners
- Hearing Impaired and Deaf
- Opportunity gaps in language experience



Minnesota Math Interventions

**Foundational
Modules**

Grade-Band Modules

Prekindergarten – Grade 5

Grade 6 – Grade 12

Foundational Modules

Module A:
Design

Module B:
Delivery: Acquisition

Module C:
Delivery: Proficiency,
Generalization, and Adaptation

Module D:
Data: Informed Instruction
and Intervention

Module E:
Components of Intervention

What is Specially Designed Instruction (SDI)?

Adapting as appropriate the content, methodology or delivery of instruction (i) to **address the unique needs** of a child that result from the child's disability; and (ii) to **ensure access of the child to the general curriculum**, so that the child can meet the same educational standards within the Jurisdiction of the public agency that apply to all children (IDEA, C.F.R 34 §300.39).

Applies to students who need improved instruction and intervention.

Levels of Research Trustworthiness

- Systematic Reviews and Meta-Analyses
- Randomized Controlled Trials (RCTs)
- Quasi-Experimental Studies

High Level of Evidence

- Survey / Correlation Design
- Single-Case Design Studies

Moderate Level of Evidence

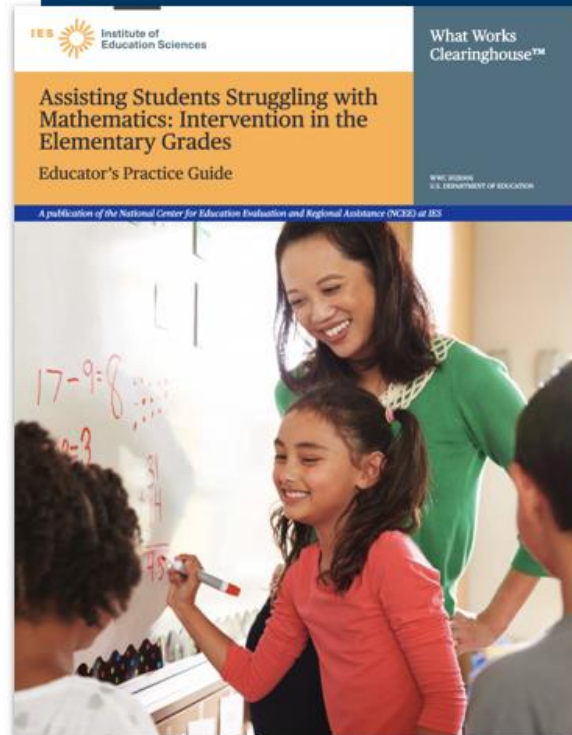
- Case Studies
- Position Papers

Initial Level of Evidence

Module A Sample

IES Practice Guides

<https://ies.ed.gov/ncee/wwc/practiceguides>



- 1** Systematic Instruction: Provide systematic instruction during intervention to develop student understanding of mathematical ideas.
▼ [Show More](#)
- 2** Mathematical Language: Teach clear and concise mathematical language and support students' use of the language to help students effectively communicate their understanding of mathematical concepts.
▼ [Show More](#)
- 3** Representations: Use a well-chosen set of concrete and semi-concrete representations to support students' learning of mathematical concepts and procedures.
▼ [Show More](#)
- 4** Number Lines: Use the number line to facilitate the learning of mathematical concepts and procedures, build understanding of grade-level material, and prepare students for advanced mathematics.
▼ [Show More](#)
- 5** Word Problems: Provide deliberate instruction on word problems to deepen students' mathematical understanding and support their capacity to apply mathematical ideas.
▼ [Show More](#)
- 6** Timed Activities: Regularly include timed activities as one way to build fluency in mathematics.
▼ [Show More](#)

STRONG EVIDENCE	TIER 1 STRONG
STRONG EVIDENCE	TIER 1 STRONG
STRONG EVIDENCE	TIER 1 STRONG
STRONG EVIDENCE	TIER 1 STRONG
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Instructional Hierarchy



Acquisition



Proficiency



Generalization



Adaptation

Minnesota Math Interventions

Language

Engagement

Acquisition

Proficiency

Generalization

And

Problem

Solving



Acquisition



MODELING

Think-alouds
Planned examples

PRACTICE

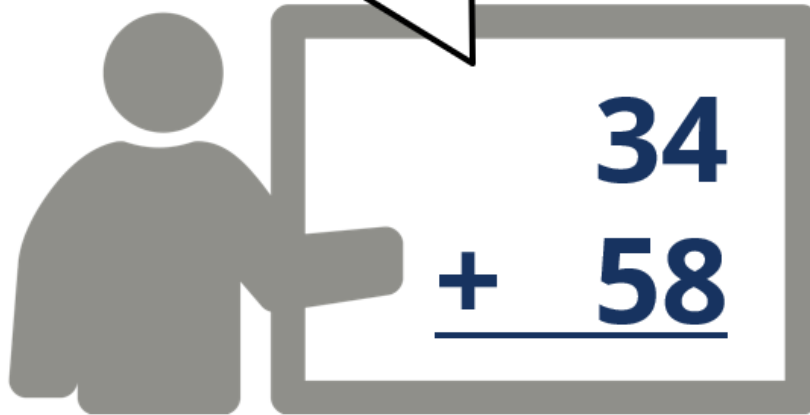
Guided practice
Independent practice

SUPPORTS

High and low-level questions
Frequent responses
Providing affirmative and corrective feedback

Think-alouds

Now, let's add the partial sums. What's 80 plus 12? Use your tools!



80 plus 12 equals 92.



Module C Sample



Acquisition

MODELING

Think-alouds
Planned examples

PRACTICE

Guided practice
Independent practice

SUPPORTS

High and low-level questions
Frequent responses
Providing affirmative and corrective feedback

Minnesota Math Interventions

Language

Engagement

Acquisition

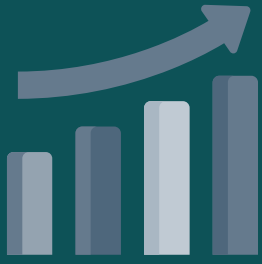
Proficiency

Generalization

And

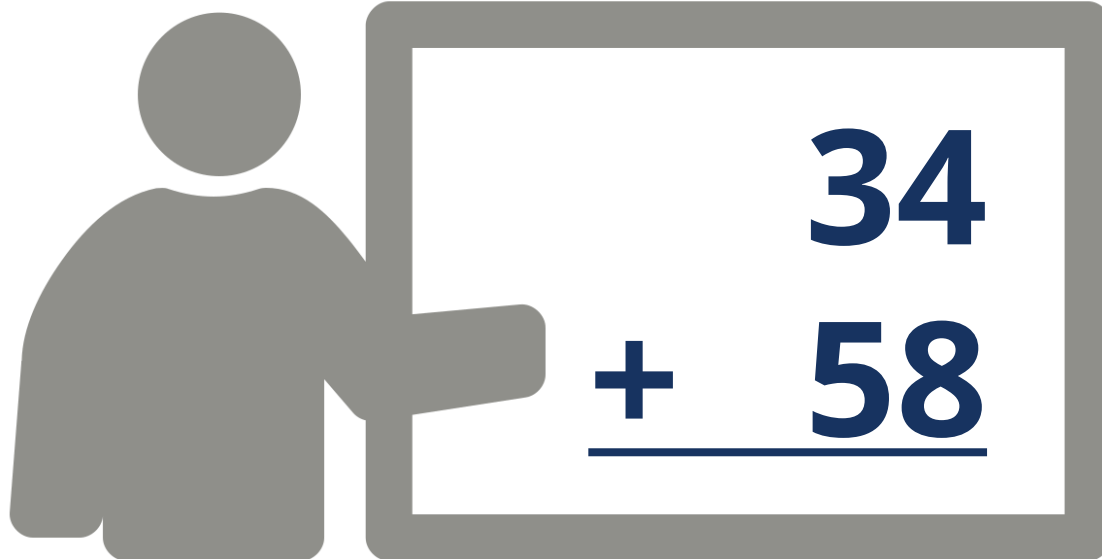
Problem

Solving



Proficiency

Intentionally designed practice

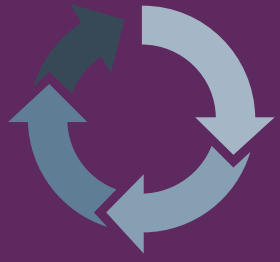


$$\begin{array}{r} 64 \\ + 18 \\ \hline \end{array}$$

$$\begin{array}{r} 75 \\ + 39 \\ \hline \end{array}$$

$$\begin{array}{r} 29 \\ + 63 \\ \hline \end{array}$$

$$\begin{array}{r} 84 \\ + 77 \\ \hline \end{array}$$



Generalization

Students demonstrate **accuracy for similar problems** learned during acquisition and practiced during proficiency.

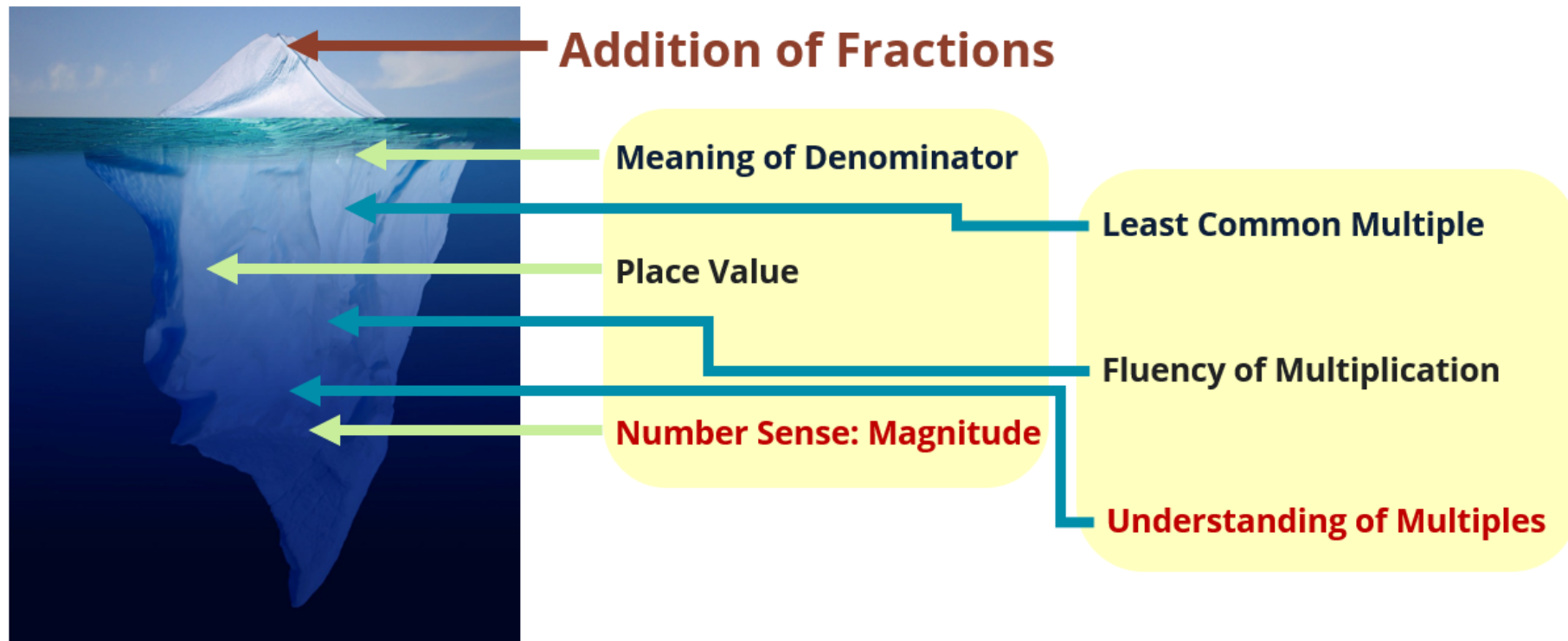
- Generalization is about **applying knowledge** within practice opportunities.
- Generalization is also about distinguishing when to use a specific strategy.



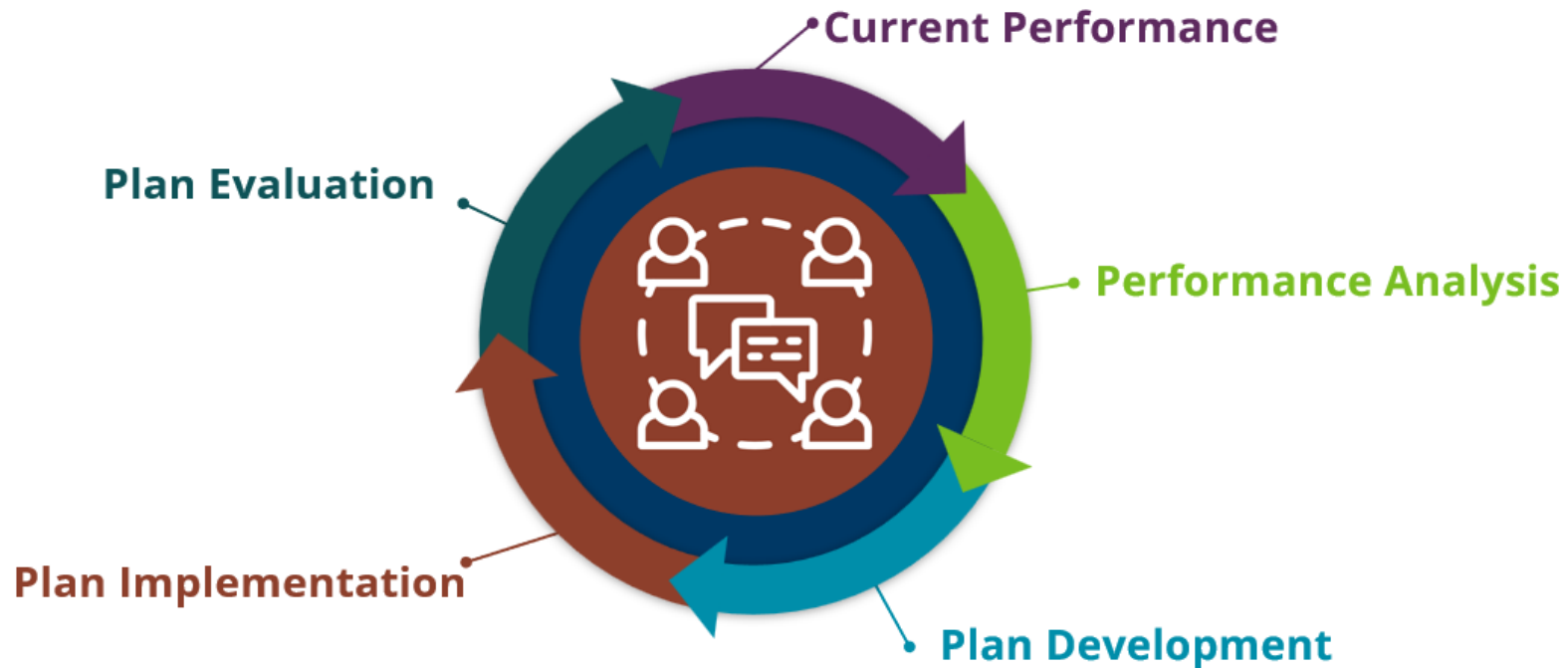
Adaptation

Many adaptation conversations
focus on **problem solving.**

How is assessment like an iceberg?



DBDM - Process



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Module E Sample: The Complex Role of Language In Learning Math



Module E Sample



DO'S

1. Use a strategy to help students work through the process of problem solving.

1. Help students identify common word-problem schemas.

Module E Sample

Schemas

Total

Equal Groups

Difference

Set

Change

Proportion

Minnesota Math Interventions

**Foundational
Modules**

Grade-Band Modules

Kindergarten – Grade 5

Grade 6 – Grade 12

Grade-Band Modules

Elementary
Grade-Band
Modules

Secondary
Grade-Band
Modules

Elementary Grade-Band Modules: Number and Quantity



K	1	2	3	4	5
0.3.5.1	1.3.5.1	2.3.5.2	3.3.5.3	4.3.5.2	
0.3.5.2	1.3.5.2	2.3.7.2			
0.3.5.3	1.3.5.3				
0.3.5.4	1.3.6.1				
0.3.5.5	1.3.7.2				
0.3.6.1					

Grade-Band Modules

Elementary
Grade-Band
Modules

Secondary
Grade-Band
Modules

Elementary Grade-Band Modules



1. Number and Quantity

- **Section A:** Counting and Comparison
 - Stable order
 - One-to-one correspondence
 - Cardinality
 - Subitizing
 - Comparison
- **Section B:** Whole-Number Operations
 - Addition
 - Subtraction
 - Multiplication
 - Division

Within each section:

- **Vocabulary**
- **Acquisition**
(modeling and practice)
- **Proficiency** activities
- Generalization ideas
- Adaptation (through **word-problem solving**)

Elementary Grade-Band Modules: Number and Quantity



The Counting Principles

Acquisition

STABLE ORDER

ONE-TO-ONE CORRESPONDENCE

CARDINALITY

ORDER IRRELEVANCE

ABSTRACTION

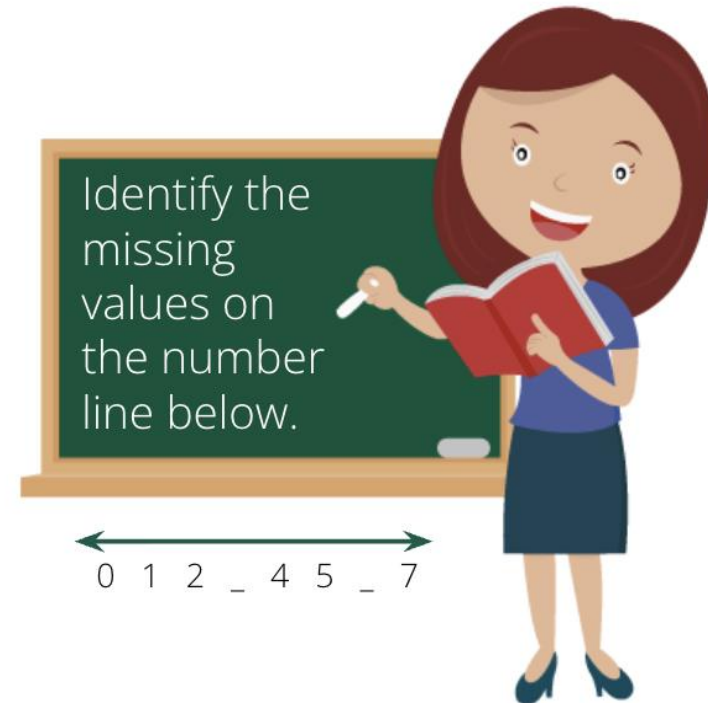


Elementary Grade-Band Modules: Number and Quantity



Problem Solving

Early Grade Examples



Grade-Band Modules

Elementary
Grade-Band
Modules

Secondary
Grade-Band
Modules

Secondary Sample

Unit Rate

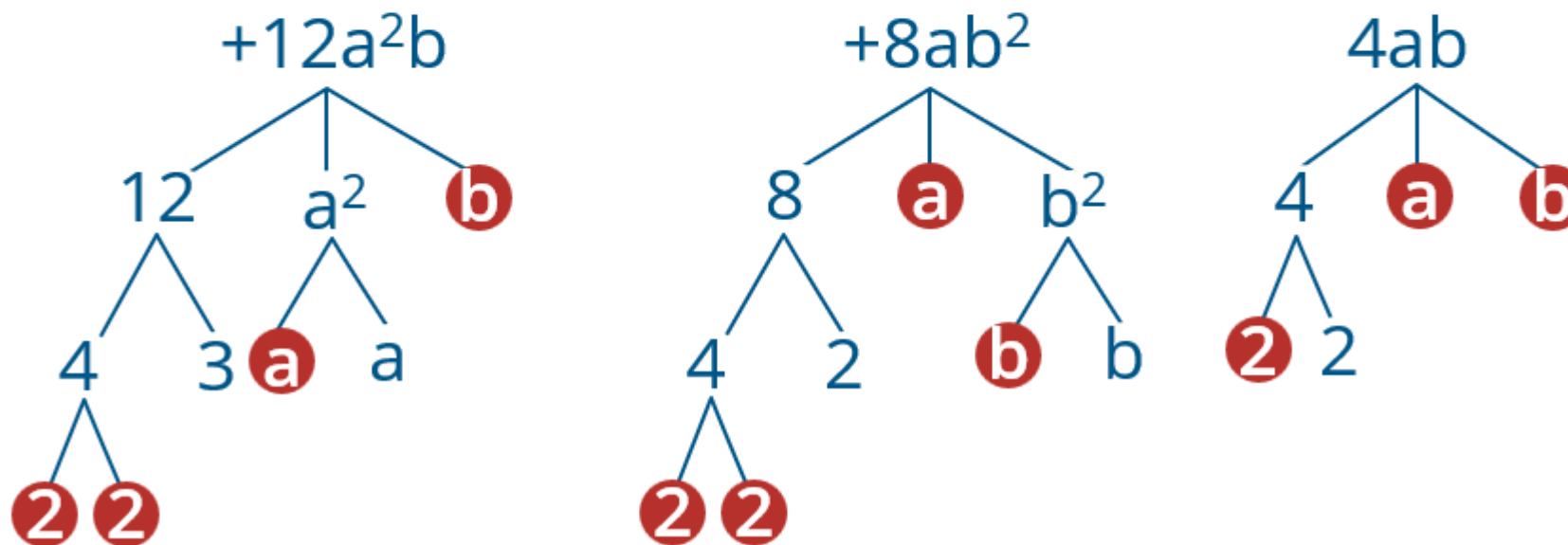
1 fire fighter
per 12,000
population.



Secondary Sample

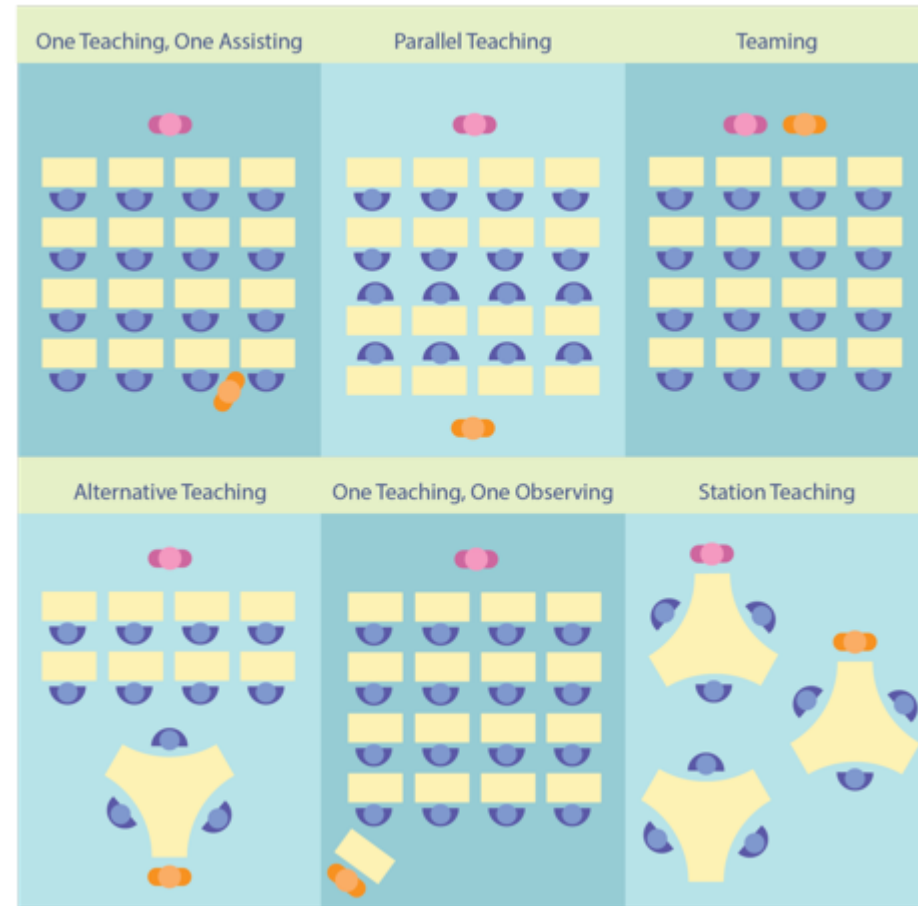
Construct Understanding

Factor $12a^2b + 8ab^2 - 4ab$



Secondary Sample

Co-Teaching Approaches



A Math Language Lesson from Module E

Specific Learning Disability (SLD)

**75-80% of students with SLD
have primary deficits that are
language-based**

What is language?

Spoken: Listening and Speaking

Written: Reading and Writing

Symbolic: letters, words, numerals, math symbols

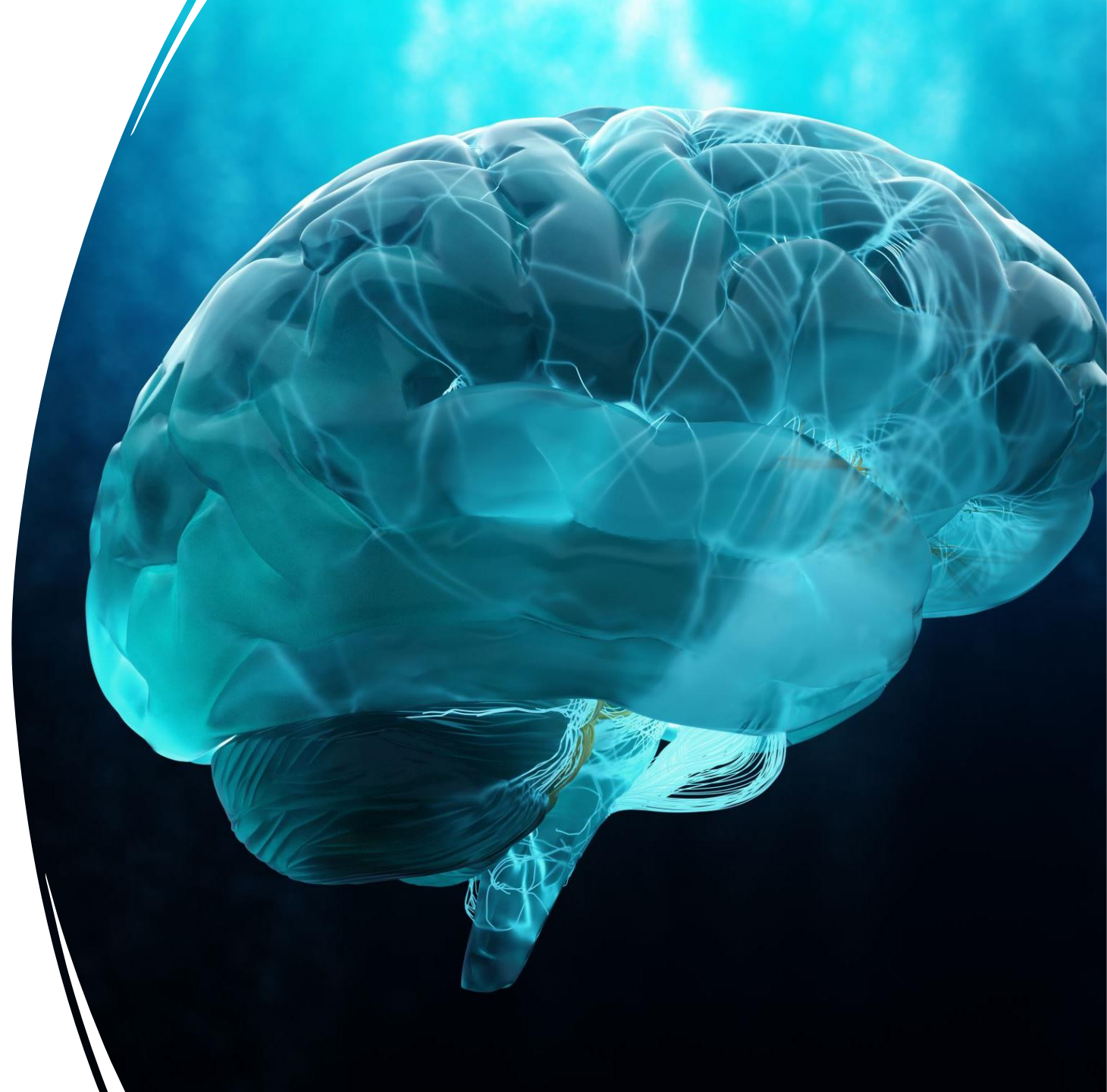
Gestures: Using and interpreting

The wonderful human brain

Connection

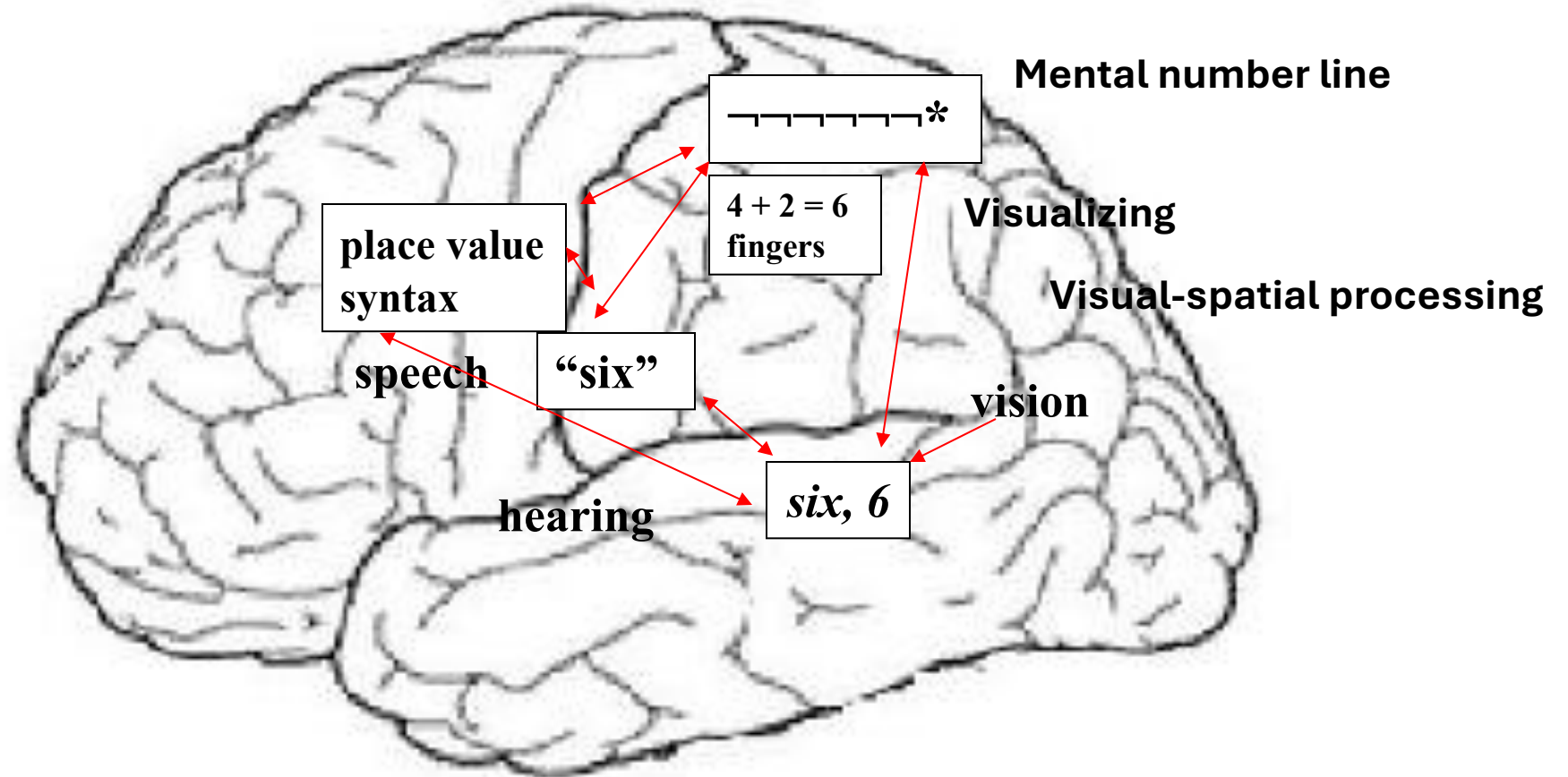
Integration

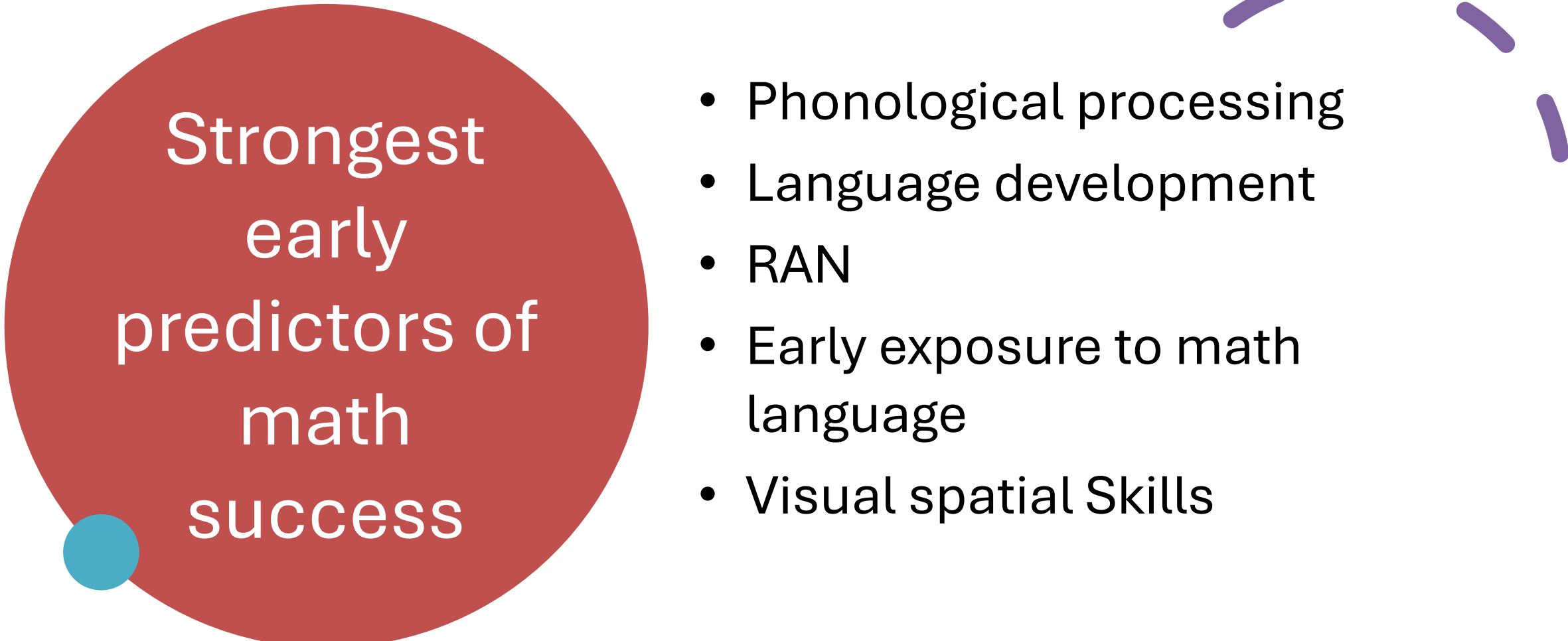
Specialization



Math, Language, Reading Brain

(left hemisphere)





Strongest
early
predictors of
math
success

- Phonological processing
- Language development
- RAN
- Early exposure to math language
- Visual spatial Skills

Early Math Language

**The most
consistent
predictor of later
mathematical
skills is early
*mathematical
language.***

“Quality of children’s long-term **phonological representations** mediates individual differences in single digit arithmetic.” De Smedt, 2018

How well a child **processes math words** has a direct impact on ability to quickly add, subtract, multiply, and divide. DeSmedt, 2018

“**Problems in early language development may explain the comorbidity between reading and mathematics disorder.**” Kristin Moll, 2015

Accuracy and speed of **number naming** and **counting fluency** are strongly correlated to math success! **RAN!**



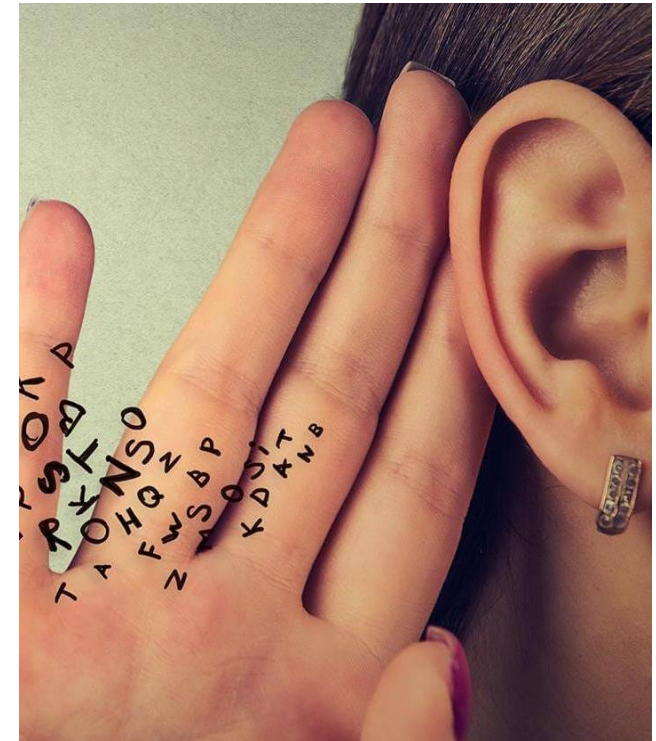
Early Math Language

- Mathematical **language** is significantly related to numeracy skills:
 - verbal counting
 - one-to-one correspondence
 - numeral identification
 - *Magnitude comparison*
 - ordering numerals
 - math fact retrieval

Hornburg, 2018

Phonological Processing

- Number names, Counting and 1 : 1 Correspondence
- Number Sense
- Learning math facts
- Learning and retrieving math vocabulary
- Fraction and decimal names
- Reading accuracy and comprehension (directions and word problems)



RAN

Rapid Automatic Naming (RAN) Fast and accurate word retrieval Another language component



- Counting, 1:1 correspondence
 - Math facts retrieval
 - Transcoding
 - Speed and accuracy of oral responses
 - Explanation of thinking and reasoning
 - Speed of solving problems
 - Impact of RAN increases with math complexity
- Word Problems

English Math Language is Complex

- **Phonological and Morphological** : Long words, Hard to say and read. Number names (15 and 50) and vocabulary (numerator)
- **Abstract and non-transparent vocabulary:**
 - Number names (15 vs. 50)
 - Operations (times)
 - Vocabulary: denominator
- **Syntax**
 - Unique to math (Take 2 from 10).
 - Complexity in word problems

Math symbols: Abstract language

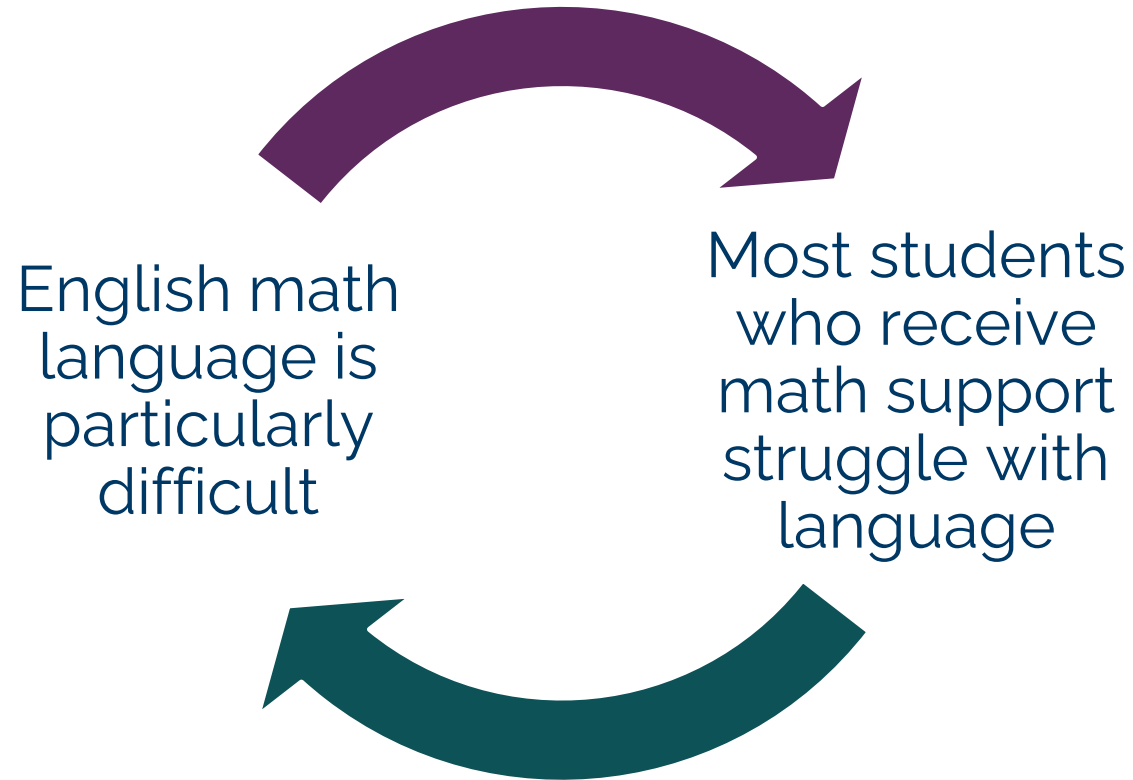
- + - \times < > \div $A = \pi r^2$
- Math symbols require language processing
- The same operation has multiple symbols (multiplication)
- Visual processing and semantics
- Equations with many symbols
- Students with dyslexia may miss some symbols
- Can be difficult to write

The Achilles Heel

The structures of English math language that are complex are the very same structures that children with language difficulties struggle with most.

Children must break through the language barriers to learn math.

Double Whammy



Big Ideas of how to help

- Reduce the language load of math instruction
- Modify abstract English math language
- Apply the science of reading
- Provide concrete, visual, and manipulative instruction
- Concrete – Representational - Abstract
- Reduce syntactic complexity of word problems
- Modify requirements for verbal explanation of reasoning



Help with phonological processing and RAN: Counting

- Non-symbolic first, then symbolic
 - Count **slowly** and over articulate sounds
 - **Pause** between numbers when counting
- Child **feels** all sounds within a number word
- 1:1 correspondence strategies
 - Manipulatives that show **magnitude**
 - Counting and 1:1 correspondence on the number



Help in the classroom

- ★ **Know** that students are missing some instruction and peer discussion
- ★ **Repeat** instructions, clarify directions, retell
- ★ Use **gestures** while speaking
- ★ Help students **SEE** math: Use number lines, number blocks, manipulatives
- ★ Provide **class notes**
- ★ Provide **extra examples and models** of solving problems
- ★ Make sure students can easily **say** and **understand** vocabulary words: provide meaning with visuals, demonstrations, gestures, manipulatives

Incorporating MNMI into Your MTSS Framework

Minnesota Multi-Tiered System of Supports



**Infrastructure for
Continuous
Improvement**



**Family and
Community
Engagement**



**Multi-Layered
Practices and
Support**



Assessment



**Data-Based
Decision
Making**

Component 1: Infrastructure for Continuous Improvement

The physical, relational, and procedural mechanisms in a system that supports people as they coordinate and work efficiently together. **These components provide the structural stability for initiatives to be implemented, sustained,** and improved independent of particular individuals. An effective school infrastructure increases the likelihood that improvement efforts are focused and aligned and that educators are empowered to ensure equitable, healing-centered, assets-based social, emotional, behavioral, developmental and academic outcomes for every student.

- 1.1 District Mission, Vision, Policies, and Procedures
- 1.2 Leadership
- 1.3 Core Beliefs
- 1.4 School Climate
- 1.5 Professional Learning
- 1.6 Collaborative Linked Teams



Component 2: Family and Community Engagement

Family and community engagement (FACE) is a process and a practice **rooted in relational-trust** which creates opportunities for equitable partnerships between families and school and district staff. These partnerships, from birth to graduation, nurture shared responsibility for students' academic, social and emotional success and **honor the lived experiences, expertise, and cultural knowledge of all educational partners** - students, teachers, families, and communities.

- 2.1 Sustain High-Trust and Reciprocal Relationships
- 2.2 Amplify Family & Community Voice
- 2.3 Link Families to Learning
- 2.4 Expect All Departments and Staff to Partner with Families
- 2.5 Commit to Continuous Improvement of the Family and Community Engagement Process
- 2.6 Inclusive and Transparent Communication
- 2.7 Schools as Community Space



Component 3: Multi-Layered Practices and Supports

Tiered service facilitation is a school-wide, culturally and linguistically sustaining, **multilayered system** of practices that **differentiates and intensifies instruction and supports as needed** so that each student meets rigorous and meaningful social, emotional, behavioral, developmental, and academic benchmarks. The tiers described refer to levels of support students receive, not to students themselves.

3.1 Tier 1 (Core) Practices

3.2 Tier 2 (Supplemental) Intervention

3.3 Tier 3 (Intensive) Intervention



Component 4: Assessment

Assessment is the process of **gathering evidence aligned to a specific purpose** to be used in making educational decisions that improve the learning conditions for every student. A variety of assessment types and tools are used within the education system, and the results should be interpreted according to the intended purpose and the level of specificity of the information produced. Assessments are designed for specific purposes and uses, and validity evidence must be available to support intended interpretations and uses.

- 4.1 Systems Evaluation
- 4.2 Universal Screening
- 4.3 Progress Monitoring
- 4.4 Diagnostic Assessment
- 4.5 Outcomes Assessment for Summative Purposes



Component 5: Data-Based Decision Making

Data are used to solve problems and make important decisions that impact student academic, behavioral, and social-emotional well-being. Such decisions should create a **continuous cycle of systems improvement involving educator support, policy enhancement, and procedural/instructional improvement**. Data sources might include existing academic and demographic records, surveys, interviews, observations, program/policy/process data and fidelity data.

5.1 Accessible and Integrated Data

5.2 Educational Decision Making

5.3 System Performance



- **Usability Testing and Leadership Training**
- **Additional Module Development including a Pre-K grade band series**
- **Downloadable Teacher Resources**
- **Downloadable Family Resources**
- **Supplemental demonstration and implementation resources focused on math language**

Any questions?

Scan the QR code if you would you like to receive more information about the project



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**Thank you for taking the time
to join us today!**

