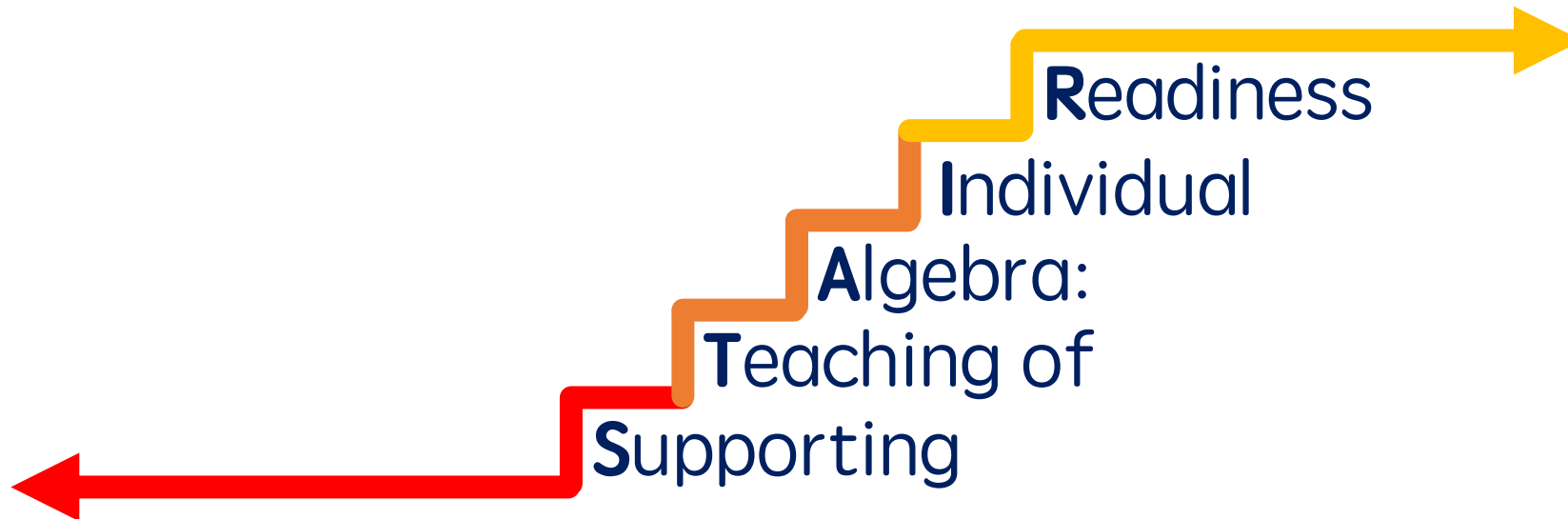


# Using Data to Improve Math Outcomes for Middle School Students

Sarah R. Powell, University of Texas at Austin

Leanne Ketterlin-Geller, Southern Methodist University

Erica Lembke, University of Missouri



This session is hosted by:



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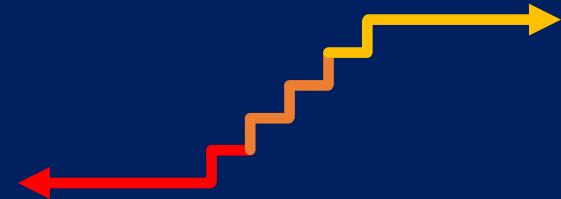


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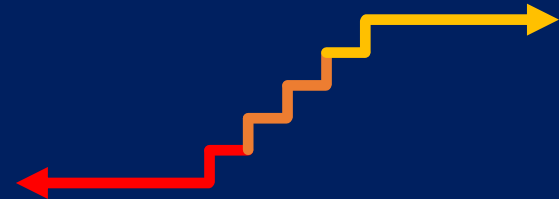
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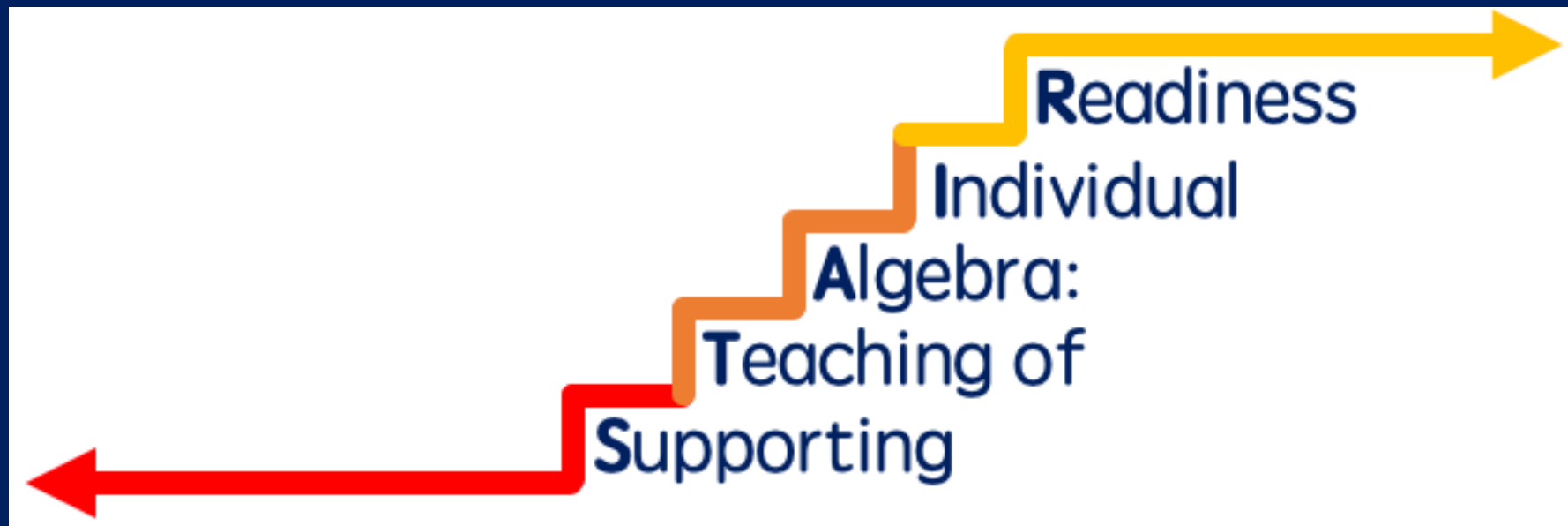
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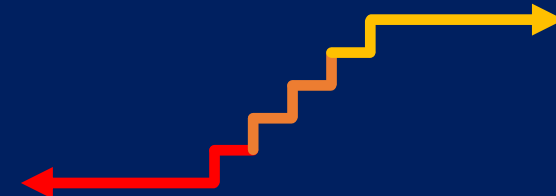
# Struggling Mathematicians

- 2019 Grade 8 Mathematics NAEP data (NCES, 2019):
  - 9% of SWDs scored at or above proficient
  - 37% of students without disabilities scored at or above proficient
- 2015 Grade 12 Mathematics NAEP data (NCES, 2015):
  - 3% of SWDs scored at or above proficient
  - 25% of students without disabilities scored at or above proficient
- SWDs also fail to graduate at twice the rate of their peers



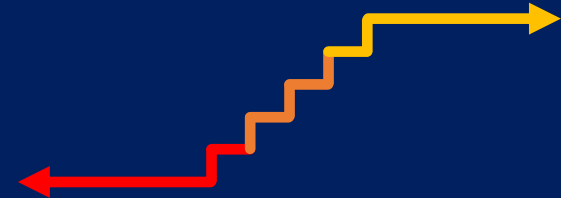


- Intensive intervention in middle schools
  - Systems-level perspective
  - Data-based individualization
- Goal → preparation for Algebra 1

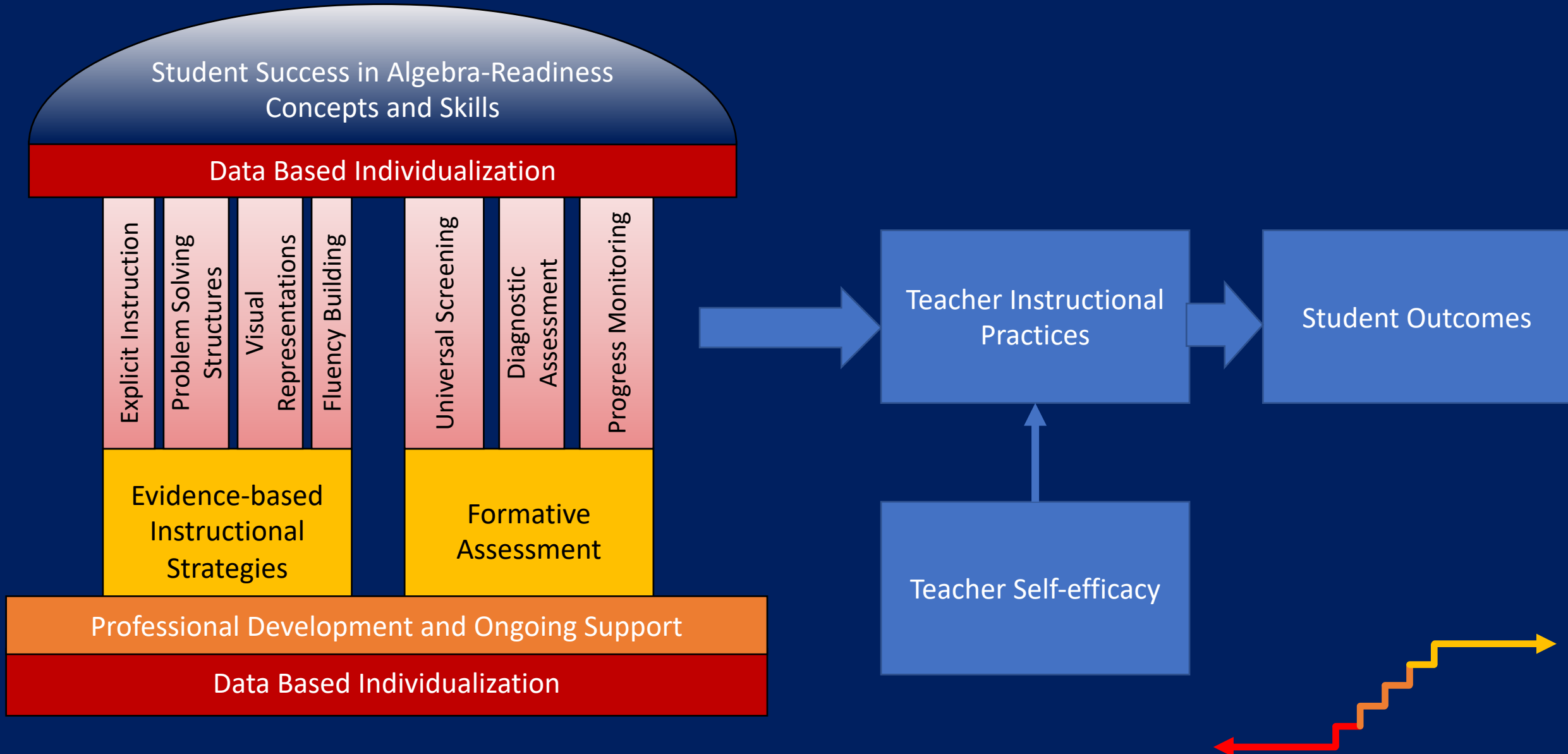


# Theoretical Background

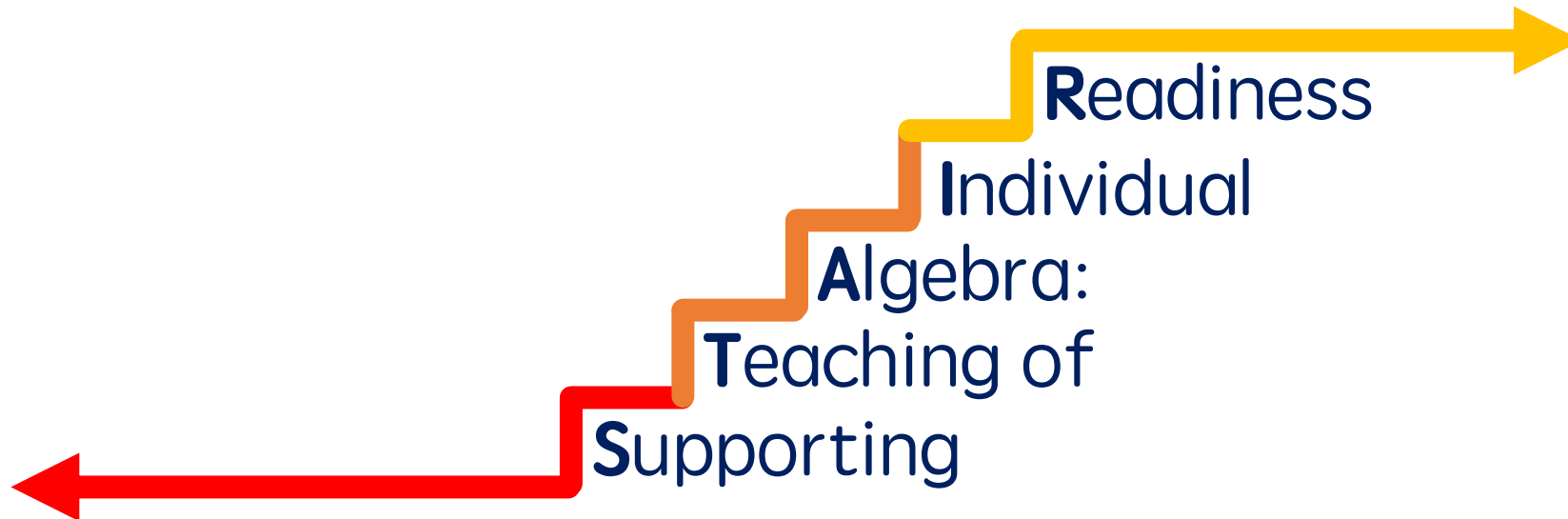
- Interventions implemented within a MTSS context can improve outcomes for students with disabilities (Fuchs et al., 2012; Johnson & Smith, 2011; Mason et al., 2019; Prewett et al., 2012)
- Data-based individualization integrates evidence-based instruction and assessment practices that improve student outcomes (e.g., Allinder, 1995; Choi et al., 2017; Fuchs et al., 1992; Staman et al., 2017; van Geel et al., 2016)
- Teachers' use of data is influenced by several factors: Collaboration, leadership, culture, time and resources, assessment literacy, attitudes including self-efficacy), assessment resources (Hoogland et al., 2016)
- Teachers' data use can be improved by: Improve collaboration, implement effective professional development focused on assessment literacy (Schildkamp, 2019), provide ongoing support (Datnow & Hubbard, 2016)



# Theory of Action



# Data-Based Individualization





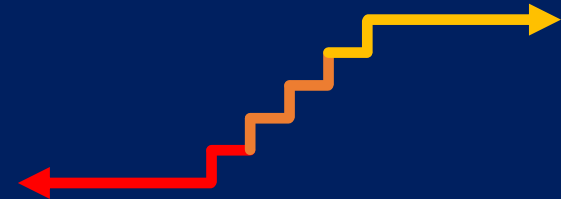
# Data-Based Individualization (DBI)

Is...

- A systematic *framework* for making instructional decisions
- A dynamic *process* of ongoing assessment and intervention
- Intended to support students with intensive needs
- Based on MTSS framework

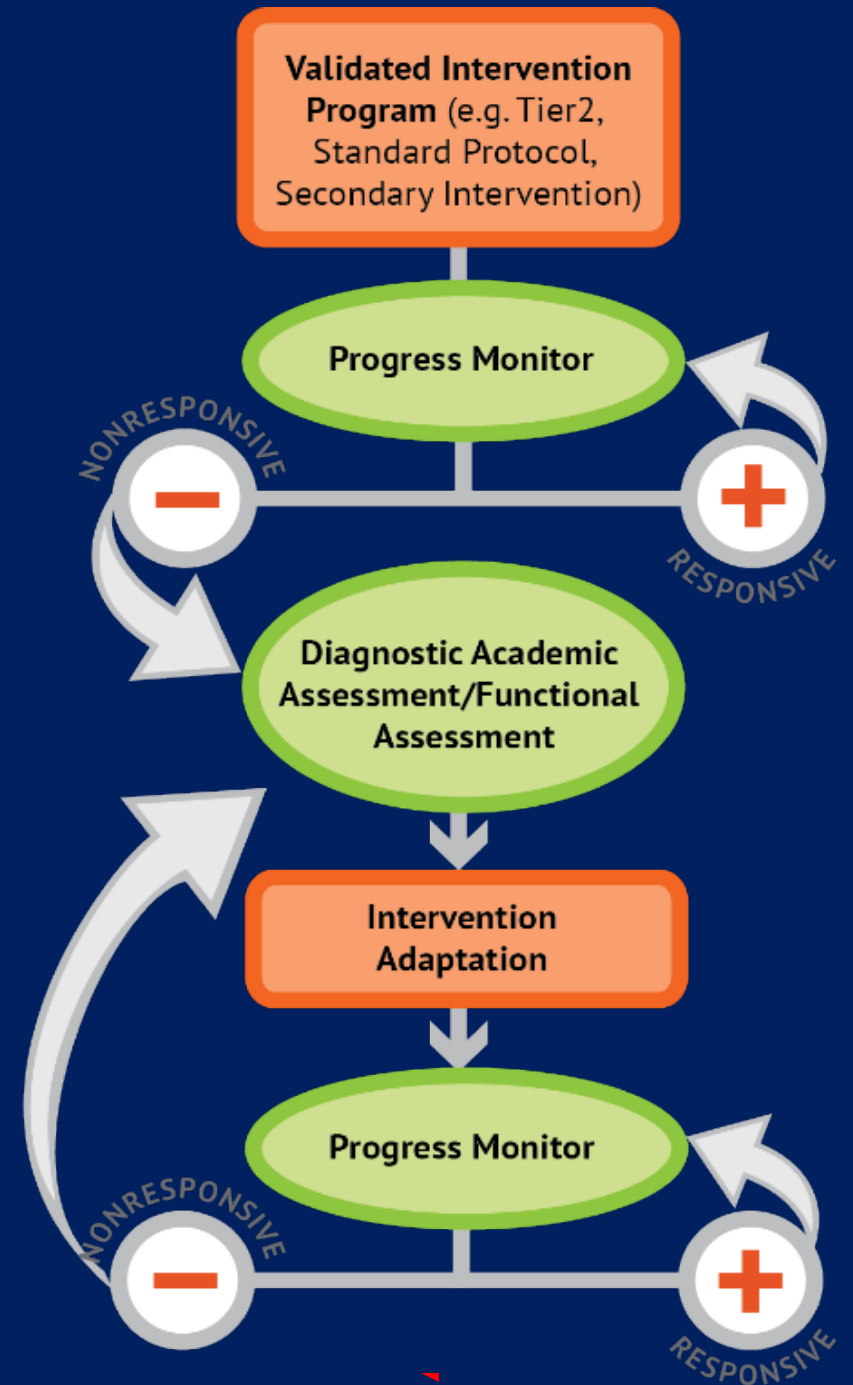
Is not...

- A curriculum
- An assessment
- A single intervention



# Key Components

- Two primary components
  - **Assessment**
  - **Instruction**



**Validated Intervention Program** (e.g. Tier2, Standard Protocol, Secondary Intervention)

Progress Monitor

NONRESPONSIVE

—

+

RESPONSIVE

Diagnostic Academic Assessment/Functional Assessment

Intervention Adaptation

Progress Monitor

NONRESPONSIVE

—

+

RESPONSIVE

1

- Establish validated intervention program in place

**Validated Intervention Program** (e.g. Tier2, Standard Protocol, Secondary Intervention)

Progress Monitor

NONRESPONSIVE

RESPONSIVE

Diagnostic Academic Assessment/Functional Assessment

Intervention Adaptation

Progress Monitor

NONRESPONSIVE

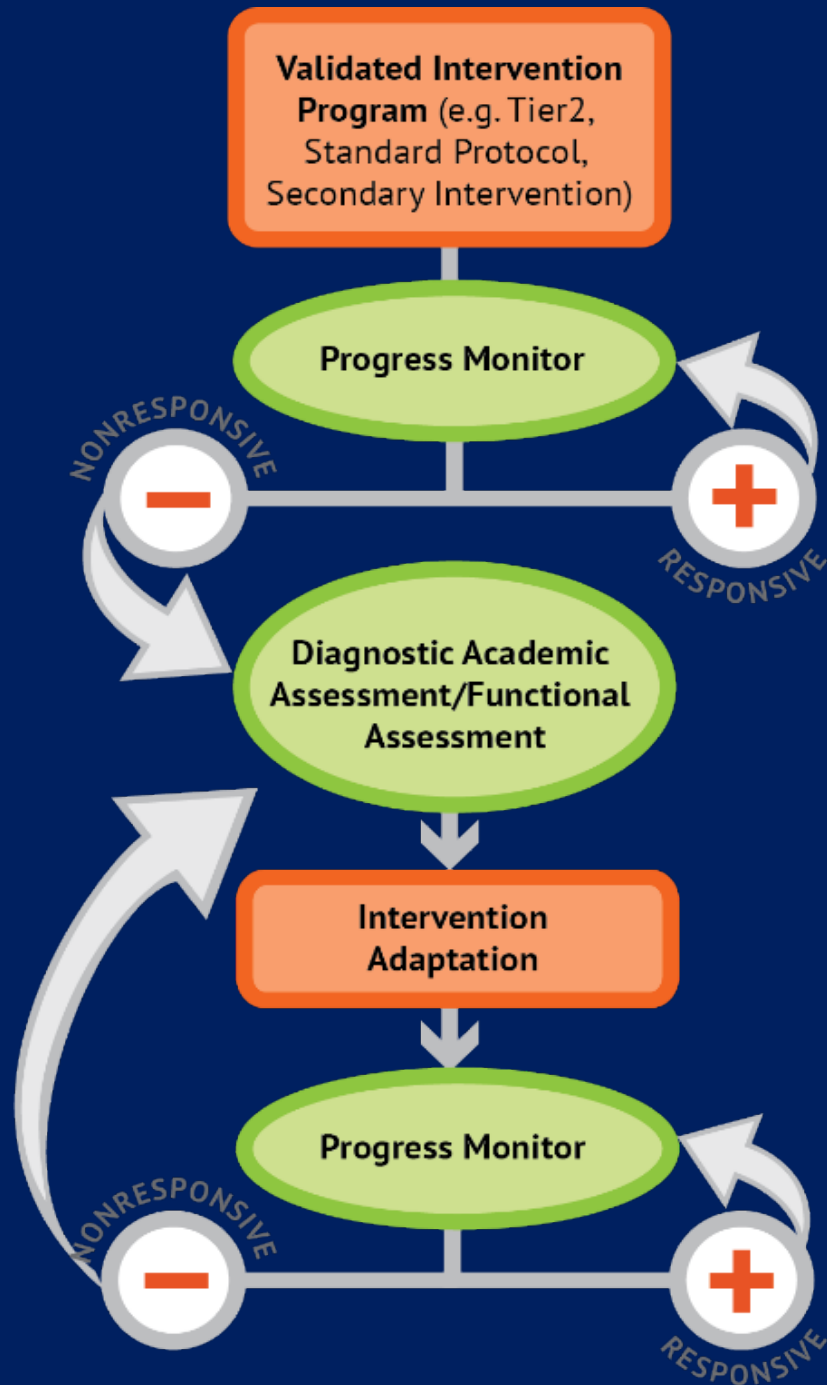
RESPONSIVE

1

- Establish validated intervention program in place

2

- Progress monitor
  - Establish a present level
  - Set an ambitious long term goal
  - Collect frequent data
  - Use decision rules



1

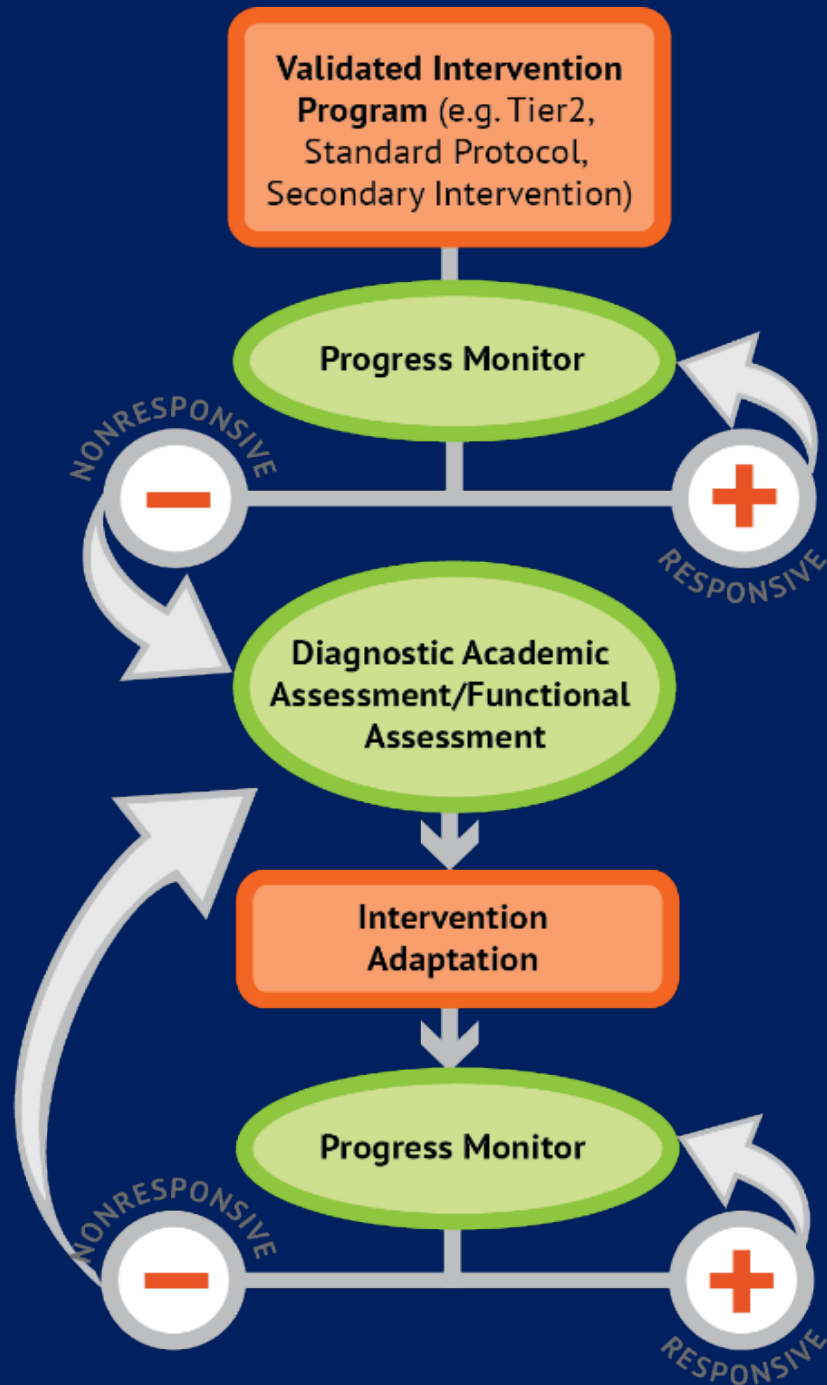
- Establish validated intervention program in place

2

- Progress monitor
  - Establish a present level
  - Set an ambitious long term goal
  - Collect frequent data
  - Use decision rules

3

- Based on student responsiveness:
  - Continue the instructional program with progress monitoring
  - Collect diagnostic data



1

- Establish validated intervention program in place

2

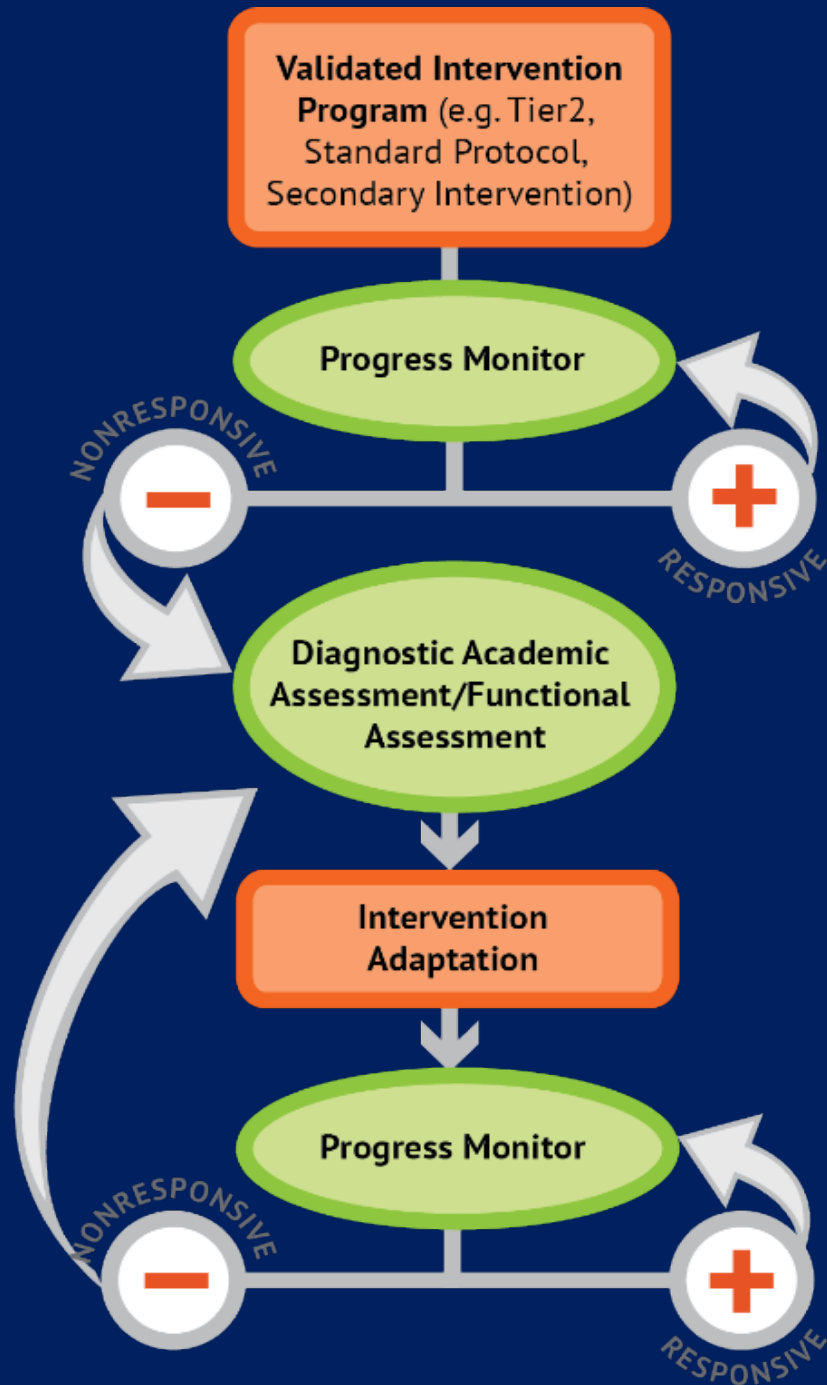
- Progress monitor
  - Establish a present level
  - Set an ambitious long term goal
  - Collect frequent data
  - Use decision rules

3

- Based on student responsiveness:
  - Continue the instructional program with progress monitoring
  - Collect diagnostic data

4

- Make an instructional change based on hypothesis



1

- Establish validated intervention program in place

2

- Progress monitor
  - Establish a present level
  - Set an ambitious long term goal
  - Collect frequent data
  - Use decision rules

3

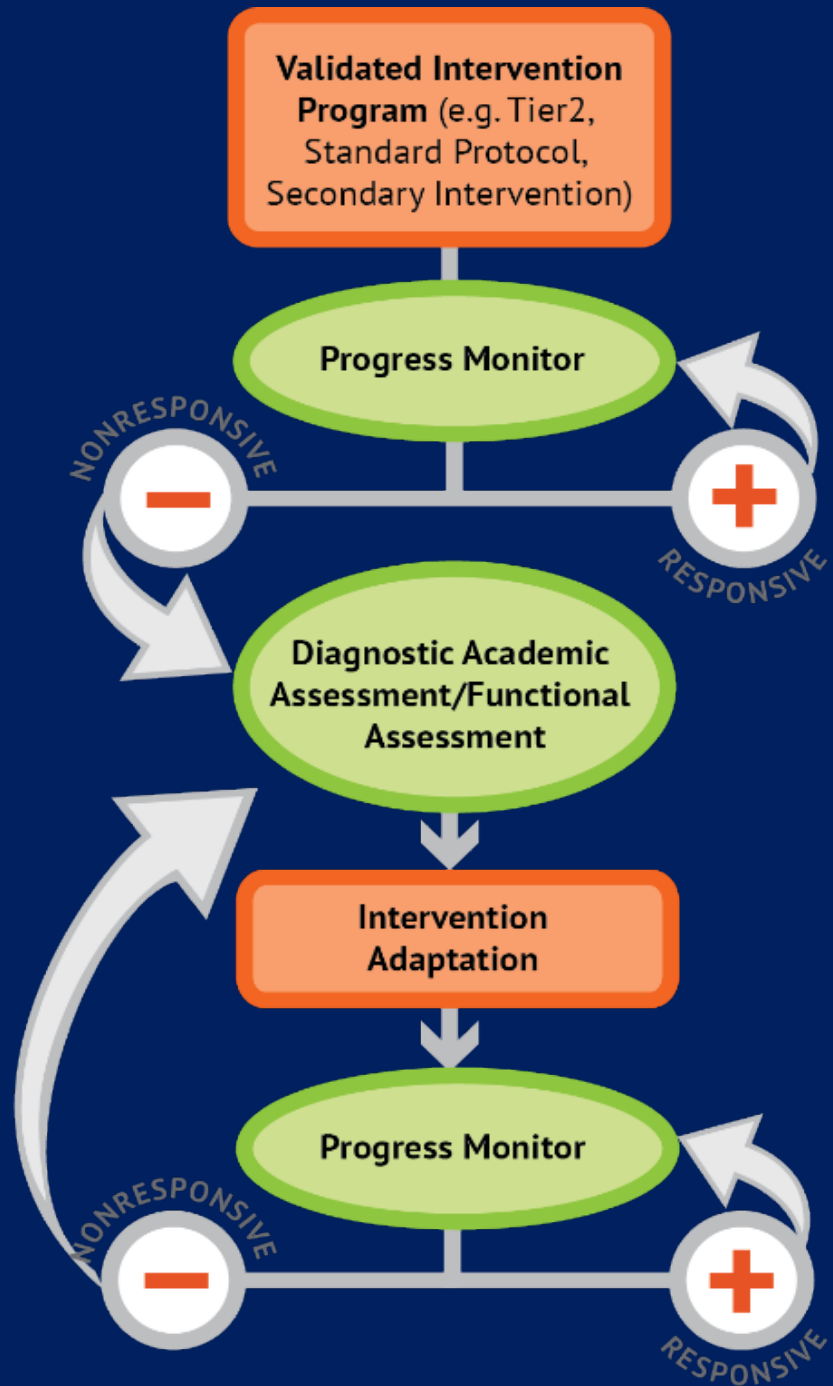
- Based on student responsiveness:
  - Continue the instructional program with progress monitoring
  - Collect diagnostic data

4

- Make an instructional change based on hypothesis

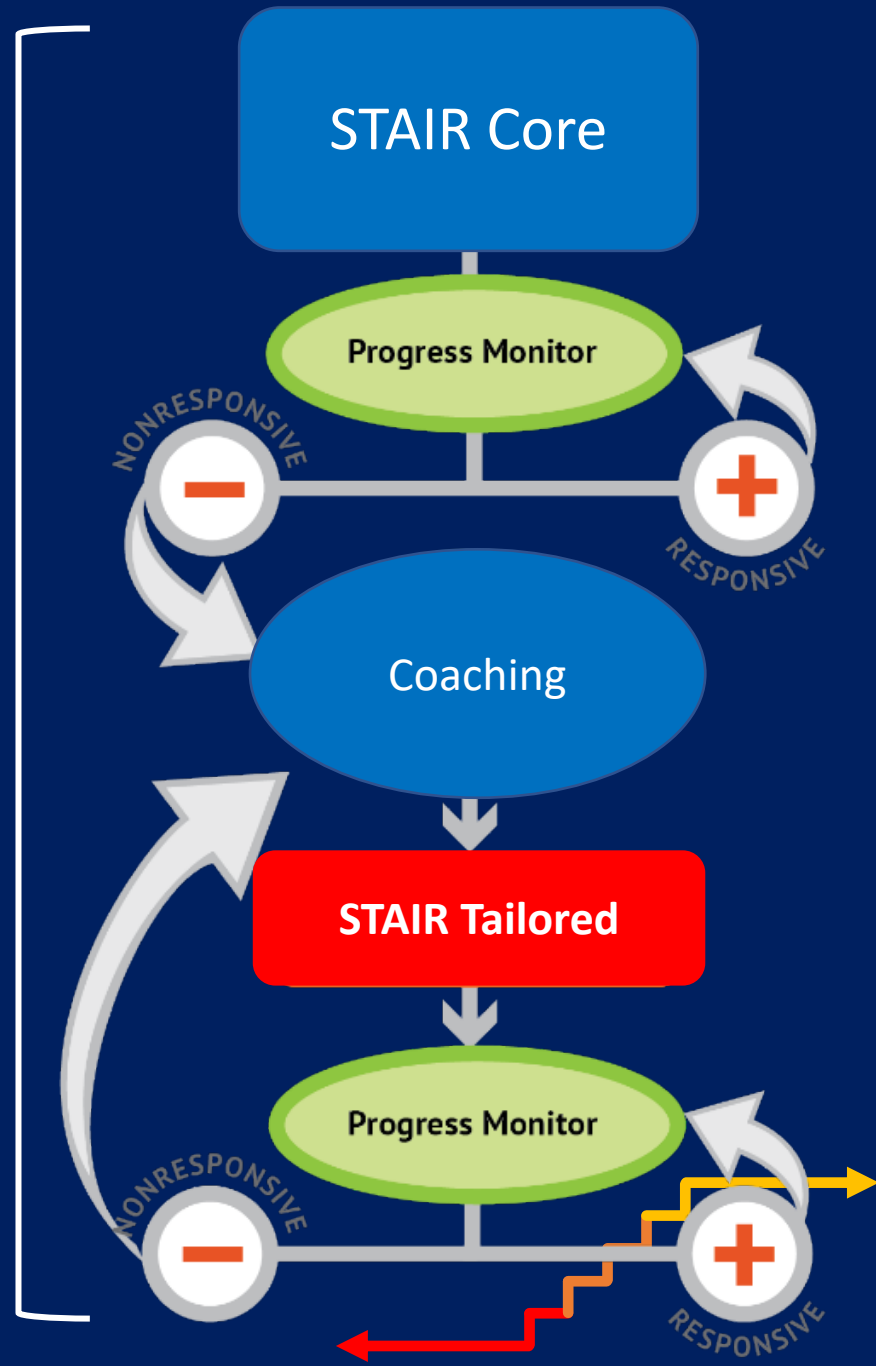
5

- Continue to monitor progress to determine adequacy of student response to instruction



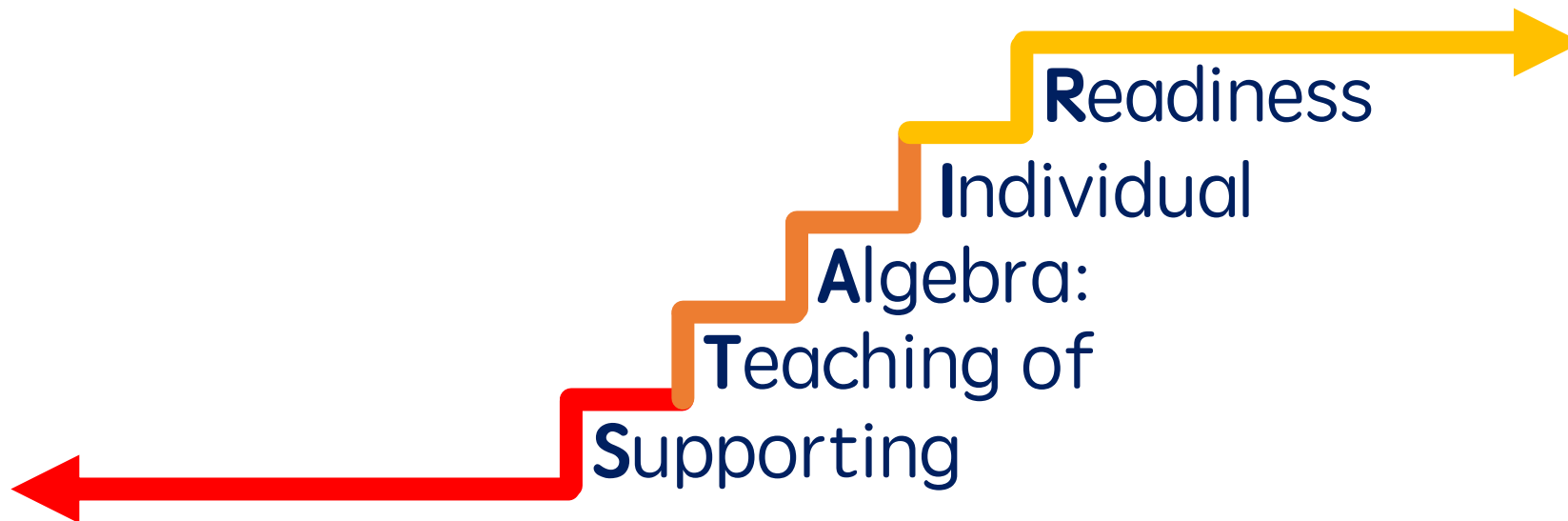
After STAIR Core, teachers implement DBI with their students

And we used STAIR Tailored to improve teaching practices for students

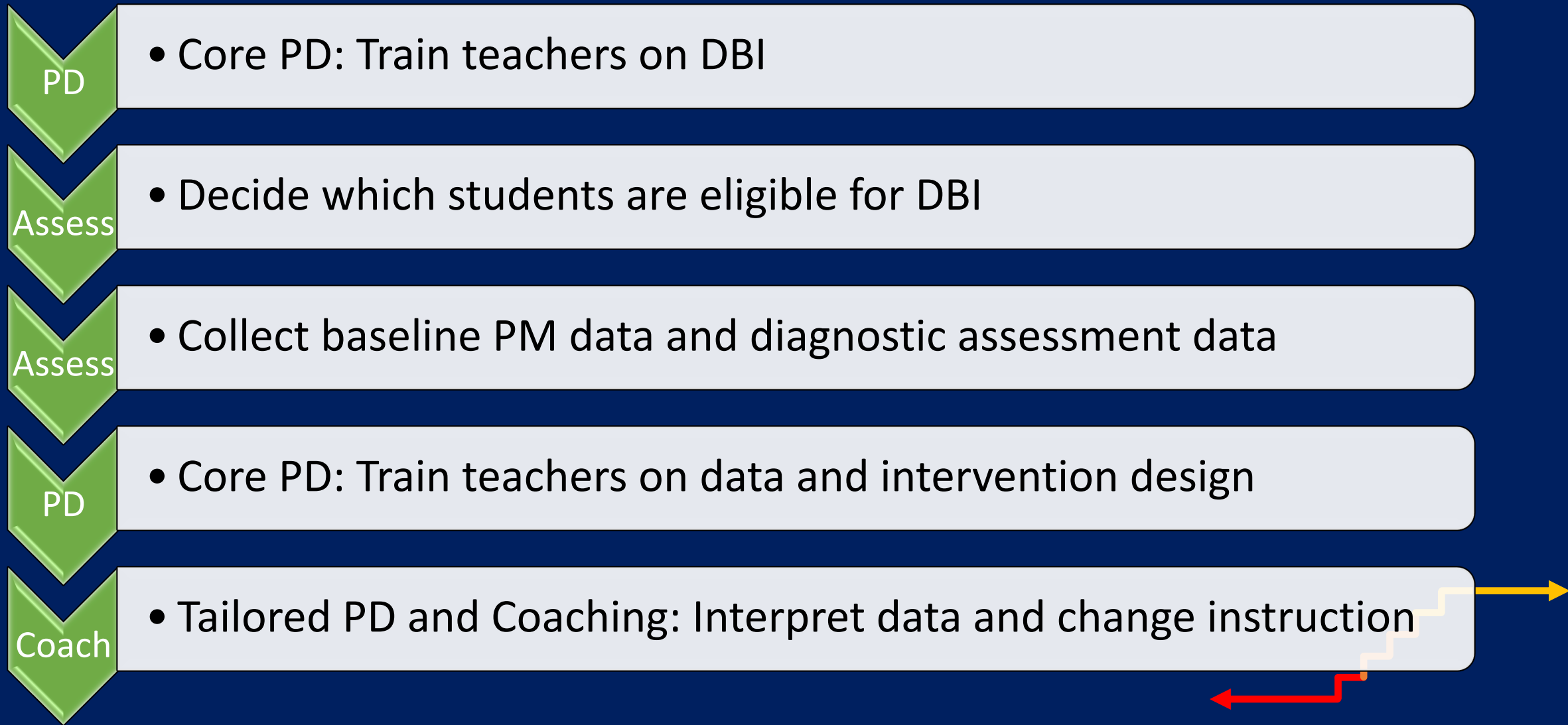




# Project STAIR



# Flowchart for Project STAIR

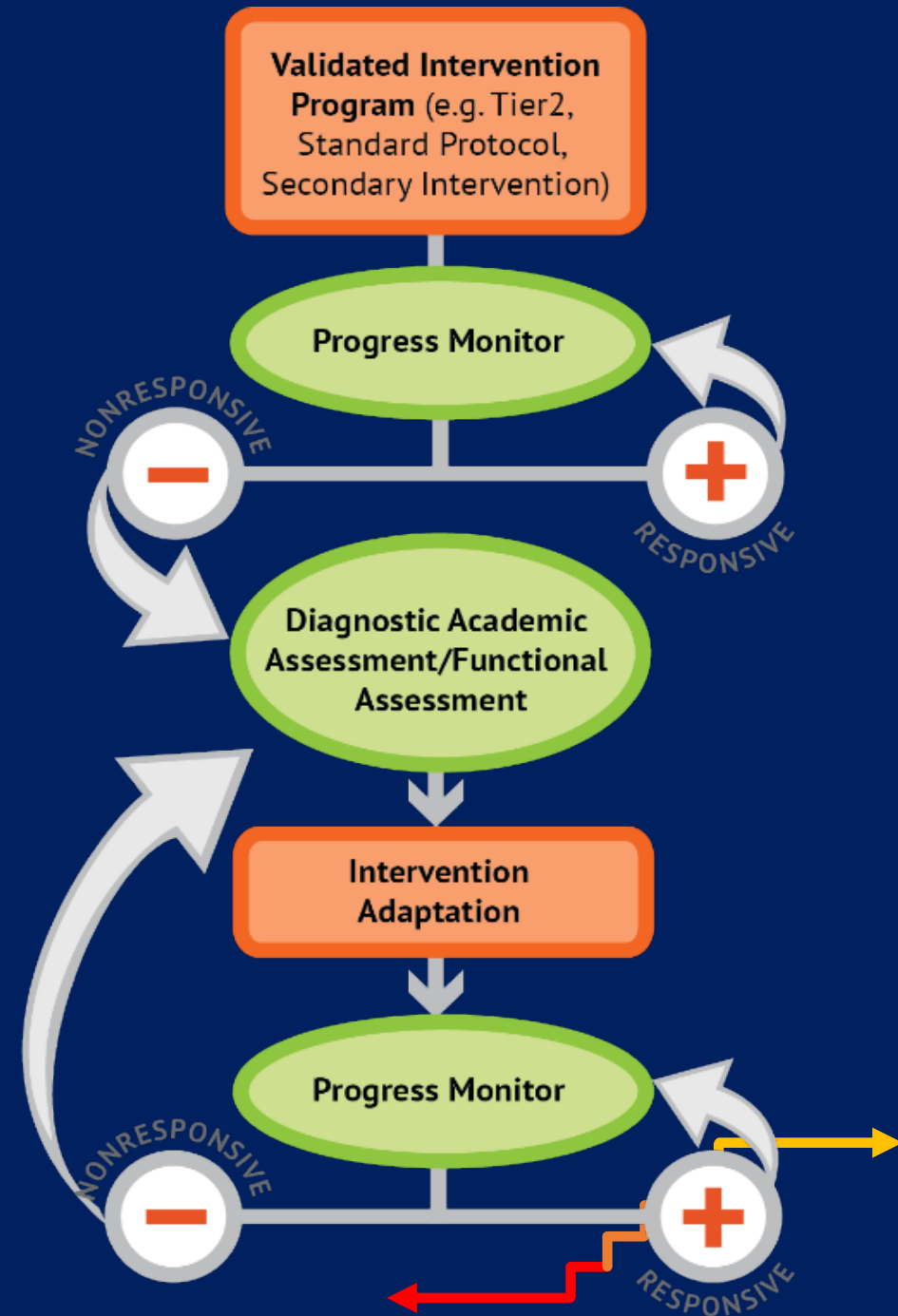


# Core PD

- Day 1: Framework of Data-based Individualization
- Two primary components
  - Day 2: Assessment
  - Day 3: Instruction




# Tailored PD



# Diagnostic Data

- Diagnostic Online Mathematics Assessment (DOMA)

PreAlgebra Challenge



Welcome  
Ricky

instructions

your  
answer as  
a fraction:

submit

$$2\frac{5}{8} \div 7 =$$

1

2

3

4

5

6

7

8

9

+/-

.

0


← delete

- integer operations
- fraction operations
- decimal operation
- comparing and converting
- estimating and rounding
- evaluating exponents
- ratios and proportions
- simplifying expressions
- coordinate graphing
- linear functions
- simple equations
- geometry
- interpreting data
- simple probability

# Progress Monitoring

- Algebraic Readiness Progress Monitoring (ARPM)
  - Number Properties

1	$\frac{1}{2}(10 \times 60)$ <input type="text"/> $5 \times 10$	16	$58 + 1.7$ <input type="text"/> $1.7 + 5.8$
2	$\frac{2}{3} \times \frac{3}{2}$ <input type="text"/> $0$	17	$\frac{3}{12} \times \frac{5}{8}$ <input type="text"/> $\frac{5}{8} \times \frac{1}{4}$
3	$8.8 \times 1.2$ <input type="text"/> $1.3 \times 8.8$	18	$1\frac{1}{4}(7 \times 8)$ <input type="text"/> $8\frac{3}{4} \times 1\frac{1}{2}$
4	$-9(-2 + -6)$ <input type="text"/> $90 + 54$	19	$-90 \times -32$ <input type="text"/> $-90 \times -32$



# Progress Monitoring

- Algebraic Readiness Progress Monitoring (ARPM)
  - Proportional Reasoning

1	33 to 44 <input type="text"/> 44 to 55	16	11:18 <input type="text"/> 11:15
2	$\frac{10}{9}$ <input type="text"/> 2	17	13:15 <input type="text"/> 15:17
3	8:10 <input type="text"/> 4:5	18	$\frac{11}{1}$ <input type="text"/> $\frac{132}{44}$
4	6.50:7.50 <input type="text"/> 7.25:8.25	19	9 to 12 <input type="text"/> 3 to 4

# Progress Monitoring

- Algebraic Readiness Progress Monitoring (ARPM)
  - Quantity Discrimination

7	$\frac{43}{6}$	2	$\frac{1}{2}$	0.33	3	-15	-13
1.25	137%	5	$5\frac{3}{10}$	5.7	6	25%	$\frac{1}{5}$
$6\frac{15}{16}$	$\frac{26}{4}$	8	$3\frac{1}{2}$	32%	9	151%	$15\frac{1}{10}$
16.95	$19\frac{17}{20}$	11	2.2	-24	12	62%	0.062



# Graphing

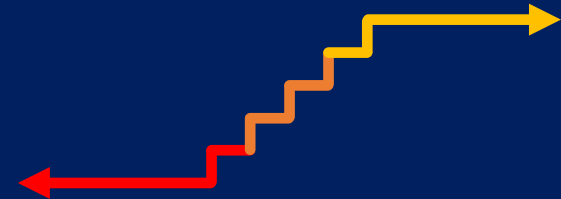


## STUDENT DATA ENTRY

Student #  Last Name  First Name

	Dates	QD	NP	PR
Baseline 1	27-Aug	6	3	4
Baseline 2	3-Sep	8	4	5
Baseline 3	10-Sep	6	3	4

Student		Date	QD	NP	PR
testy testerson	Intervention 1	17-Sep	7	2	5
		24-Sep	7	3	4
		1-Oct	8	4	7
		8-Oct	8	6	6
		15-Oct	9	7	9
		22-Oct	8	5	7
		29-Oct	10	9	9
		5-Nov	12	8	9
		12-Nov	13	10	10

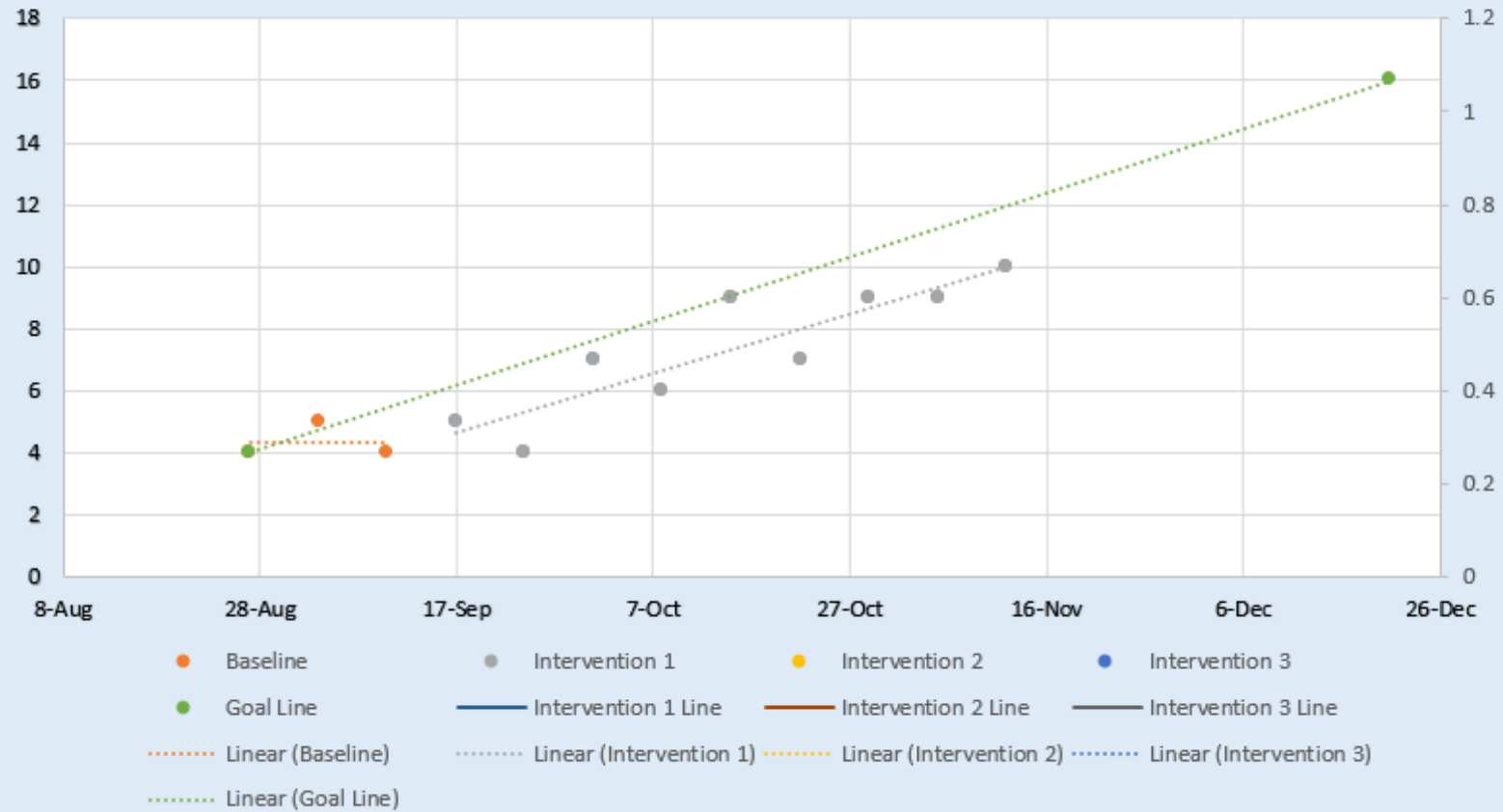




# Graphing

PR Median	4
PR Goal	16

PR Data



# Tailored PD

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## Readiness Individual Algebra: Teaching of Supporting

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**STAIR Tailored:**  
Practice to Research...  
and Back to Practice:  
Students' Mathematical Identities

6:13

PRP Student's Math Identities  
II Practice to Research & Ba...

34 views • 1 month ago

**STAIR Tailored:**  
Practice to Research...  
and Back to Practice:  
Productive Struggle and Enacting  
Cognitively Demanding Tasks

7:17

PRP Cognitively Demanding II  
Practice to Research & Bac...

11 views • 2 months ago

Importance of  
Conceptual Understanding

6:01

Importance of Conceptual  
Understanding in Math II...

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**STAIR Tailored:**  
Explicit Instruction:  
Asking the Right Questions  
Part 2

4:36

How to Ask High-Level  
Questions in Math - Part 2 II...

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**STAIR Tailored:**  
Explicit Instruction:  
Asking the Right Questions  
Part 1

5:27

How to Ask the Right  
Questions in Math II...

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**STAIR Tailored:**  
Identifying Cognitively  
Demanding Tasks

10:10

Identifying Cognitively  
Demanding Tasks II...

16 views • 2 months ago

**STAIR Tailored:**  
Creating Cognitively  
Demanding Tasks

6:02

Creating Cognitively  
Demanding Tasks II...

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**STAIR Tailored:**  
Factoring Quadratic Expressions  
Part 5: Establishing Equivalency  
Between Quadratic Expressions  
and Factored Forms

5:34

Factoring Quadratic  
Expressions - Part 5 II...

13 views • 2 months ago

**STAIR Tailored:**  
Factoring Quadratic Expressions -  
Part 4: The Box Method

5:50

Factoring Quadratic  
Expressions - Part 4 II...

10 views • 2 months ago

**STAIR Tailored:**  
Factoring Quadratic Expressions  
Part 3: Discovering Rules for  
Factoring Quadratic Expressions

8:14

Factoring Quadratic  
Expressions - Part 3 II...

10 views • 3 months ago

**STAIR Tailored:**  
Factoring Quadratic Expressions -  
Part 2: Using Manipulatives to Factor  
Quadratic Expressions

6:46

Factoring Quadratic  
Expressions - Part 2 II...

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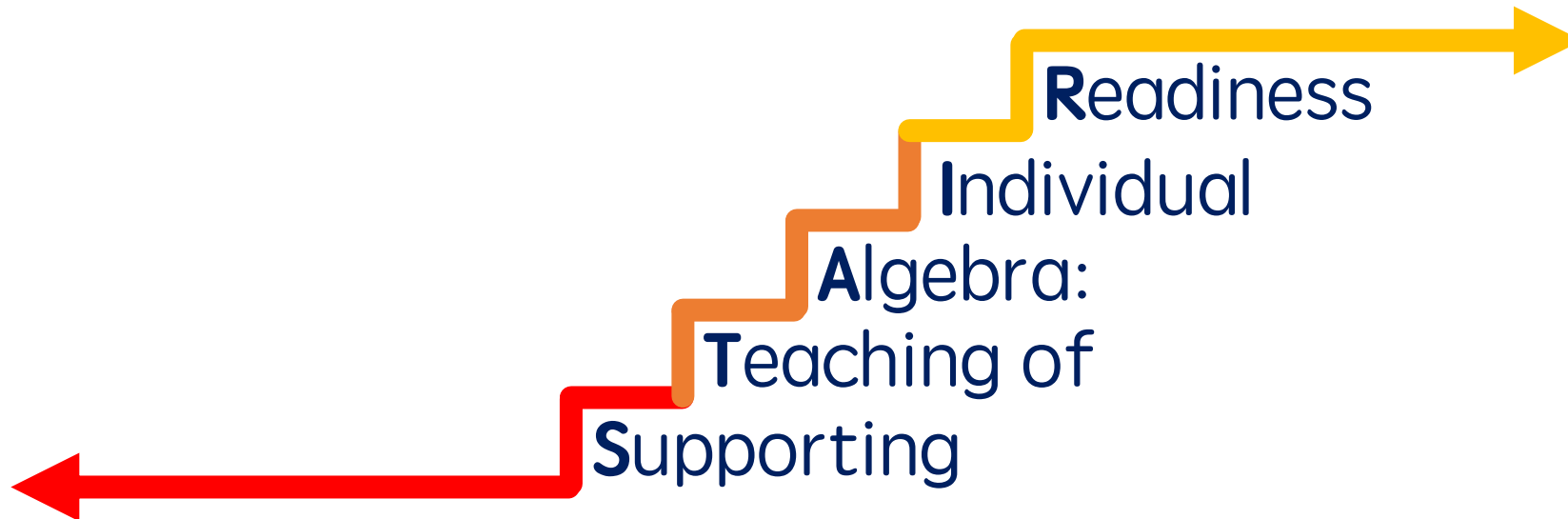
**STAIR Tailored:**  
Factoring Quadratic  
Expressions - Part 1: Quadratic  
Expressions as a Product  
of Two Linear Expressions

5:41

Factoring Quadratic  
Expressions - Part 1 II...

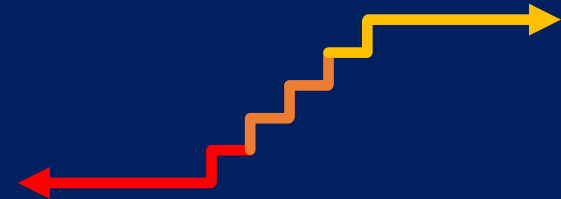
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# Year 1 Pilot Study



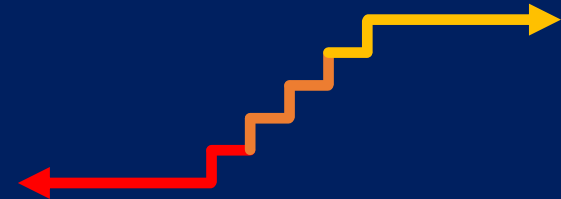
# Research Questions

- What impact does Project STAIR have on teacher and student outcomes:
  - Does participation impact teachers' capacity, confidence, and self-perception associated with implementing DBI?
  - Does teachers' participation impact student proximal and distal outcomes?
- What changes are needed to the Project STAIR intervention to improve teacher and student outcomes?



# Participants

- 22 teachers from 4 schools in Texas and Missouri
  - 53% had previous PD on using data to improve instruction
  - 58% had previous PD on math assessment
- 56 eligible students (identified as needing intensive intervention)
  - Approximate equal distribution across grades 6-8
  - 59% female
  - 46% African American, 29% Caucasian, 20% Hispanic/Latinx
  - 16% dual language learner; 16% receiving special education



# Measures

Student	Sep	Oct	Nov	Dec	Jan
Universal Screener (STAR)	X				X
Diagnostic Assessment (DOMA)	X				X
Progress Monitoring (ARPM)	Weekly	Weekly	Weekly	Weekly	Weekly
Algebra Achievement (IAAT)	X				X
Teacher					
Teacher Instructional Practice Survey	X				X
Self-efficacy Survey	X				X

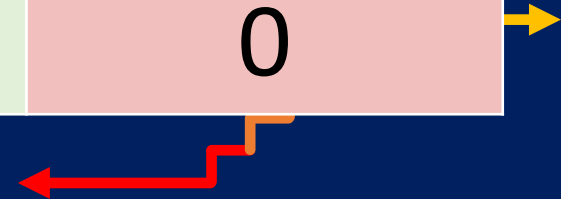


# Results: Teacher-level Effects

- Paired samples *t*-tests to examine pre- to post-test changes

	Understanding	Importance	Confidence	Frequency of Use
DBI Content Knowledge	+	0	0	0
Evidence-based Instruction	+	0	0	0
Assessment	+	+	+	0


+ = significant at  $p < .05$ ; 0 = not significant at  $p < .05$



# Results: Teacher-level Effects

	Significant Change
I like to teach math.	+
I can effectively teach math.	+
I am confident in my ability to teach math to the students in the grade I teach.	+
I am confident that I can answer questions about math.	0
I would be confident if my supervisor wanted to observe me teaching a math lesson.	0
I know how to do the math, and am comfortable explaining how I got my answer.	0
I understand math concepts, and I am able to do the steps to solve the problem.	0

+ = significant at  $p < .05$ ; 0 = not significant at  $p < .05$





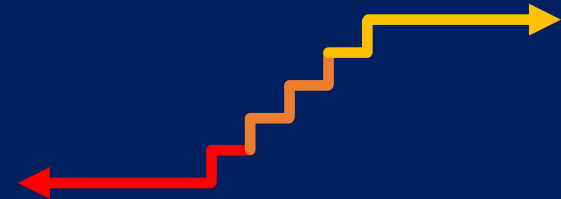
# Results: Student-level Effects

- 2-level multi-level modeling
  - Unconditional, 2-level models of students nested in teachers

	Significant Change	% variance explained by teacher differences
Proximal Measure: ARPM Number Properties	+	-
Proximal Measure: ARPM Quantity Discrimination	+	36%
Proximal Measure: ARPM Proportional Reasoning	0	8%
Distal Measure: DOMA	0	33%
Distal Measure: IAAT	0	34%

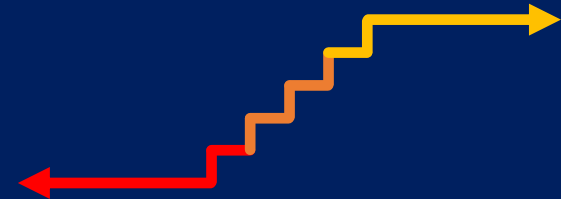
# Discussion: Effects of Project STAIR

- Teachers:
  - Project STAIR was effective at improving teachers' understanding of DBI, instruction, and assessment
  - Project STAIR was effective at improving teachers' perception of importance and confidence in using data
- Students:
  - Project STAIR was effective at improving outcomes on proximal measures



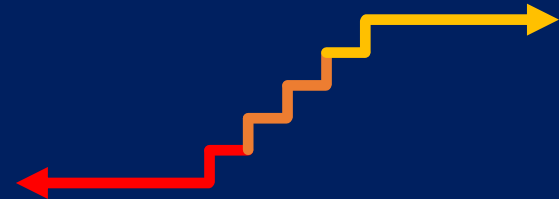
# Improvements for Project STAIR

- Strategies for implementation (no change in frequency)
  - May be a measurement issue (need direct measures)
  - Include more strategies to support teachers' implementation of DBI in PD and in coaching
- Emphasize importance and build confidence in DBI and instruction (no changes)
  - May be more stable constructs; need sensitive measures
  - Target during coaching



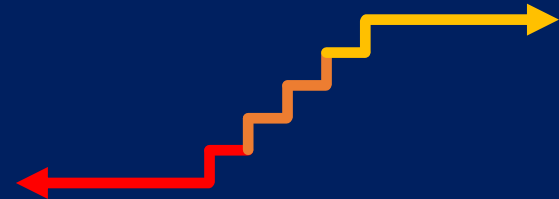
# Implications for Practice

- DBI → possible solution to achievement crisis
  - Support teachers with a framework
- Project STAIR PD improves some teacher outcomes
  - Attends to systems-level factors
  - Comprehensive model with ongoing support
- Improving teachers' understanding, importance, and confidence using data may improve student outcomes



# Future Directions

- Changes for 2019-20:
  - Implementation with a randomly-assigned comparison group
  - Intensified PD
  - Structured coaching sessions to identify teacher needs more precisely



# Readiness Individual Algebra: Teaching of Supporting



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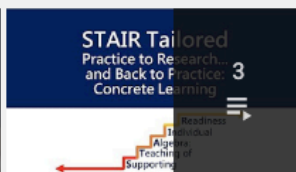
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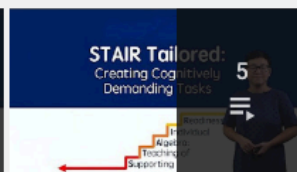
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Practice to Research & Back to Practice

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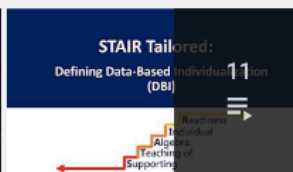
Accessible Math Tasks

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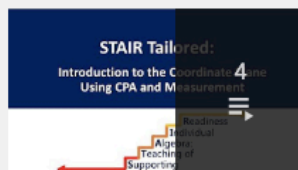
Culturally Responsive Teaching

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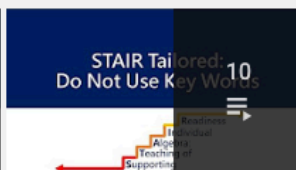
Data-Based Individualization

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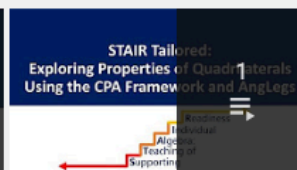
Coordinate Plane/Grids

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Word Problem Instruction

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Introduction to Geometry

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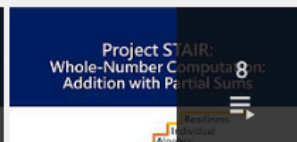
Introduction to Equations

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Integers

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@Project STAIR

<https://www.youtube.com/channel/UCE2puwDtUSNXFONIOhmYmvA/playlists>

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