Vision: Every child in every district receives the instruction that they need and deserve…every day.

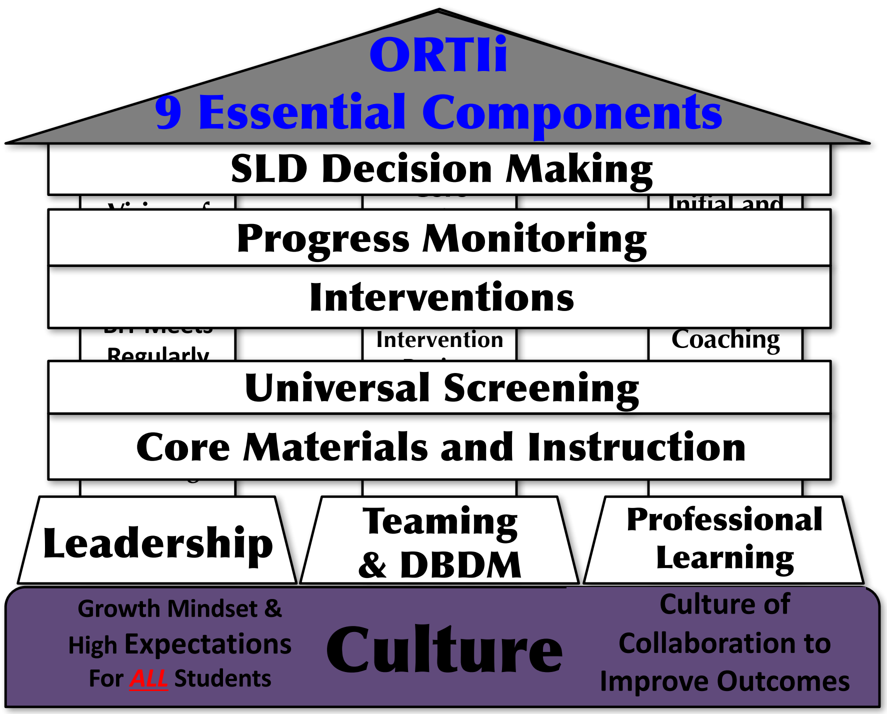
Math RTI

All Students Can Succeed in Math

Reach & Teach *All* Students

Session Outcomes

- Be affirmed for your good practices.
- Be reminded of things you used to do but forgot about.
- See things that you already do, now use and can expand on.
- See things that are new and you would like to try.



Mindset

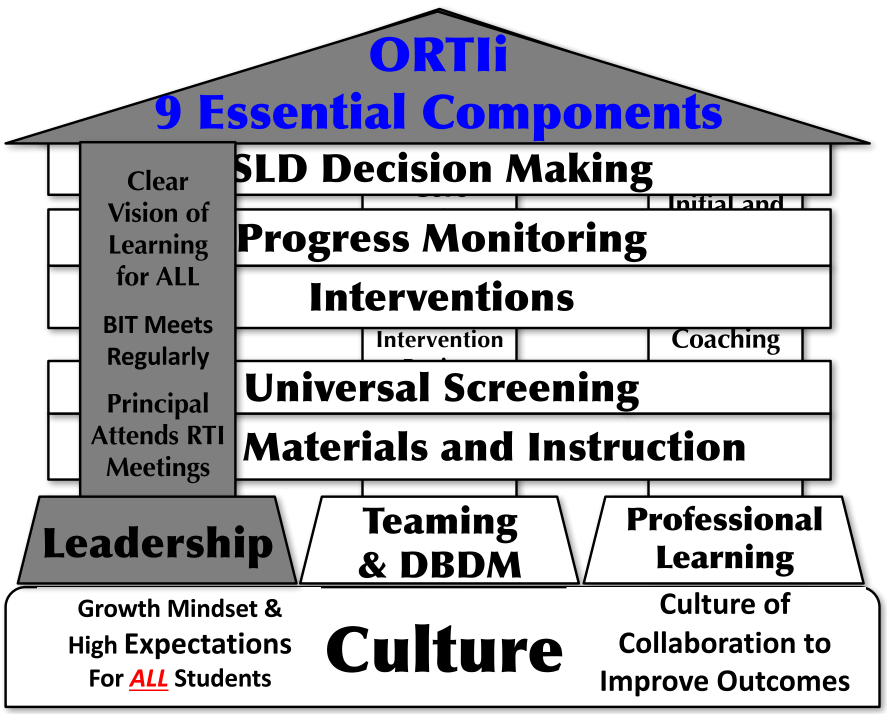
- Related to your belief about yourself
- Creates the lens used to view yourself and the world
- Growth mindset – We can change (grow) despite (or because of) obstacles
- Fixed mindset – We cannot change significantly

Mindset Work

Mathematical Mindsets

"The new evidence from brain research tells us that everyone, with the right teaching and messages, can be successful in math, and everyone can achieve at the highest levels in school. There are few children who have very particular special educational needs that make math learning difficult, but for the vast majority of children - about 95% - any levels of school math are within their reach. And the potential of of the brain to grow and change is just as strong in children with special needs."

Boaler 2016



From Installation Matrix

- Promote a healthy and positive atmosphere which supports meaningful collaboration amongst staff and has a common purpose
- Communicate the "why" to staff
- Develop shared interest
- PLCs
- Support activities that *improve* connections amongst staff

Leadership Pushes Beliefs

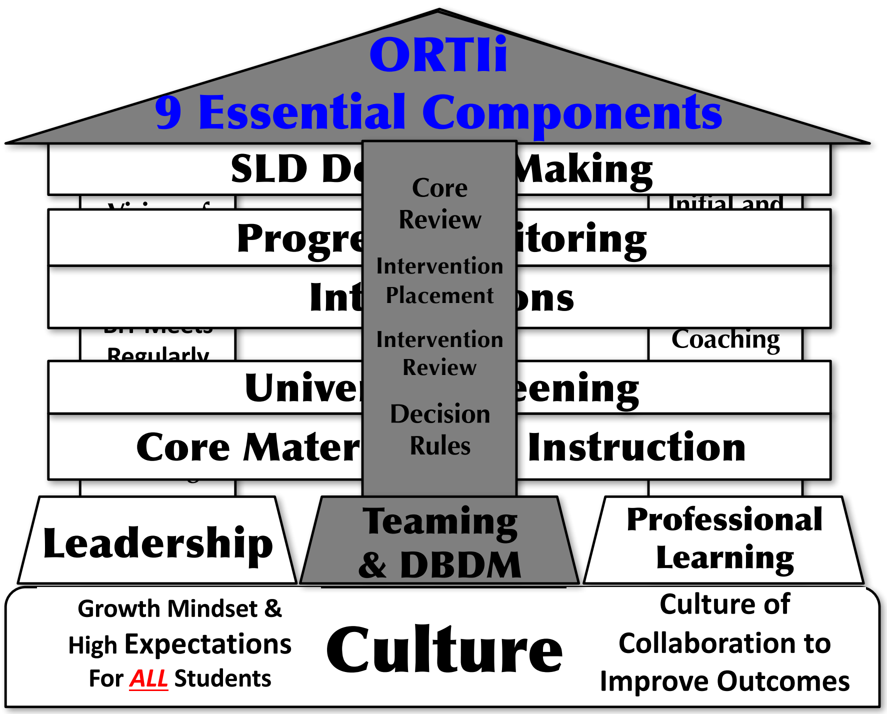
"The question is not whether all students can succeed in mathematics but whether the adults organizing mathematics learning opportunities can alter traditional beliefs and practices to promote success for all."

NCTM, 2014

Access and Equity Principle

- "An excellent mathematics program requires that all students have access to a high-quality mathematics curriculum, effective teaching and learning, high expectations, and the support and resources needed to maximize their learning potential."

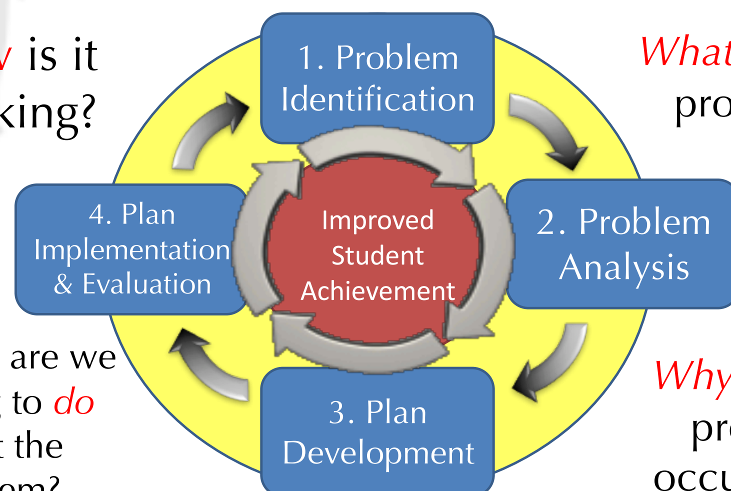
NCTM, 2014



The Problem Solving Process

How is it working?

What is the problem?



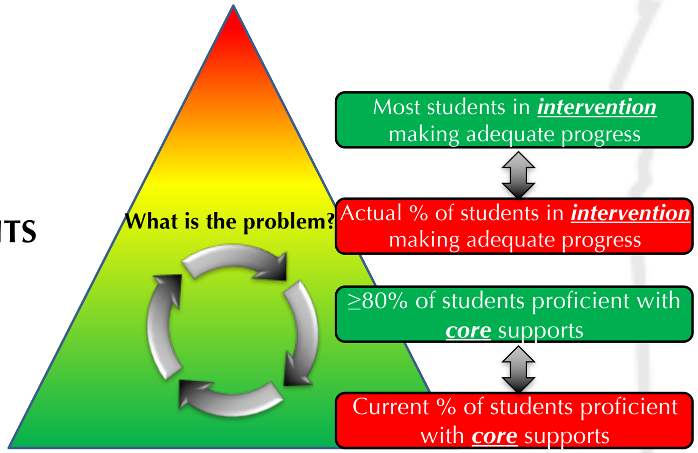
What are we going to *do* about the problem?

Why is the problem occurring?

1. Problem Identification

Tier 2/3:
20% Meetings
SOME STUDENTS

Tier 1:
100% Meetings
ALL STUDENTS

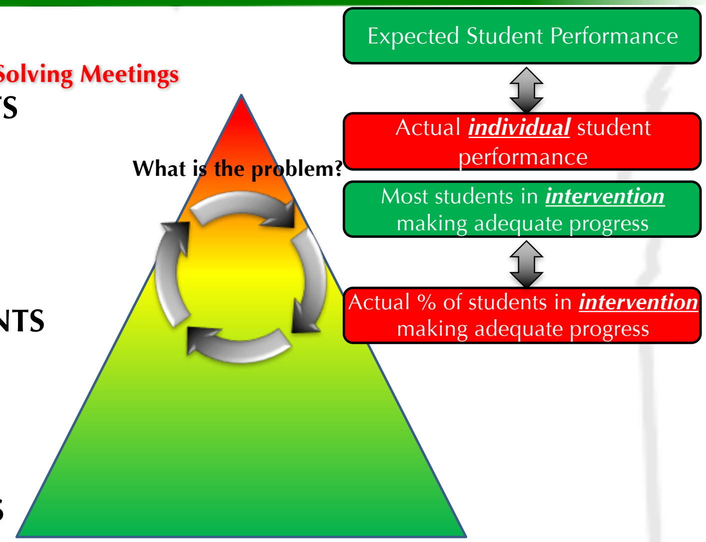


1. Problem Identification

Tier 3:
Individual Problem Solving Meetings
FEW STUDENTS

Tier 2/3:
EBIS Meetings
SOME STUDENTS

Tier 1:
100% Meetings
ALL STUDENTS

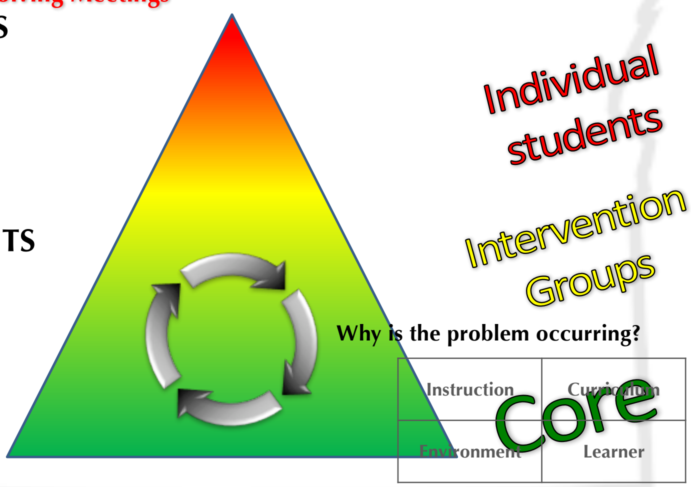


2. Problem Analysis

Tier 3:
Individual Problem Solving Meetings
FEW STUDENTS

Tier 2/3:
EBIS Meetings
SOME STUDENTS

Tier 1:
100% Meetings
ALL STUDENTS



Hypothesis Development

Instruction:	Curriculum:
• Mathematical Teaching Practices • Explicitness of instruction • Pacing • Opportunities to Respond • Student questioning and discourse • Concrete → Representational → Abstract	
Environment:	**Learner:**

Hypothesis Development

Instruction:
- Mathematical Teaching Practices
- Explicitness of instruction
- Pacing
- Opportunities to Respond
- Student questioning and discourse
- Concrete → Representational → Abstract

Curriculum:
- Fidelity to curriculum materials
- Teaches skills to mastery
- Adequate opportunity for practice and review
- Match between skills and learner
- Progression Level

Environment:
- Classroom routines and behavior
- Student engagement
- Teacher-student interactions
- Group size and arrangement
- Transition times minimized

Learner:
- Motivation
- Persistence
- Self-efficacy
- Attendance
- Academic skills across domains
- Connections with school
- Vocabulary/Language skills

When it comes to teaching…

*"It is clear that the program is less important than **how it is delivered**, with the most impressive gains associated with more intensity and an **explicit, systematic** delivery"*

Fletcher & colleagues, 2007

3. Plan Development

Tier 3:
Individual Problem Solving Meetings
FEW STUDENTS

Tier 2/3:
EBIS Meetings
SOME STUDENTS

Tier 1:
100% Meetings
ALL STUDENTS

Individual students

Intervention Groups

Instruction	Curriculum
Environment	Learner

Core

Plan Development

Instruction:

Change Instructional Delivery

Add Instructional Time

Curriculum:

Change/Add Program

Math Facts? Number Sense?

Vocab support

Environment:

Change group Size

Increase engagement

Add motivational system

Increase Attendance

Learner:
- Motivation
- Persistence
- Self-efficacy
- Attendance
- Academic skills across domains
- Connections with school
- Vocabulary/Language skills

4. Plan Implementation & Evaluation

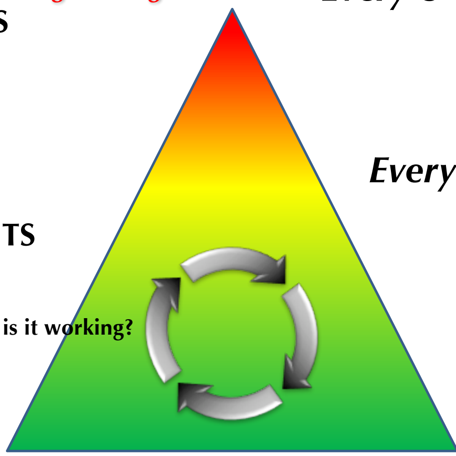
Tier 3:
Individual Problem Solving Meetings
FEW STUDENTS

Every 8-12 weeks

Tier 2/3:
20% Meetings
SOME STUDENTS

Every 8-12 weeks

Tier 1:
100% Meetings
ALL STUDENTS



2-3 times/year

2 times month (PLC's)

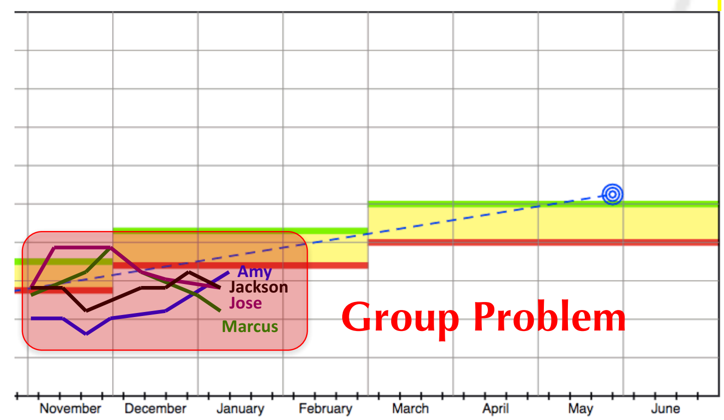
Tier 1 Problem Solving

- This can happen at the ***school or grade*** level
  - Do we have at least 80% of our students proficient on our screener?
  - If *NO*:
    - Are we implementing core with fidelity? How do we know?
    - What can we change for the core?
      - Instruction, Curriculum, Environment
  - If *YES*:
    - Celebrate the success!
    - Are we meeting the needs of all of our subcategories of students?

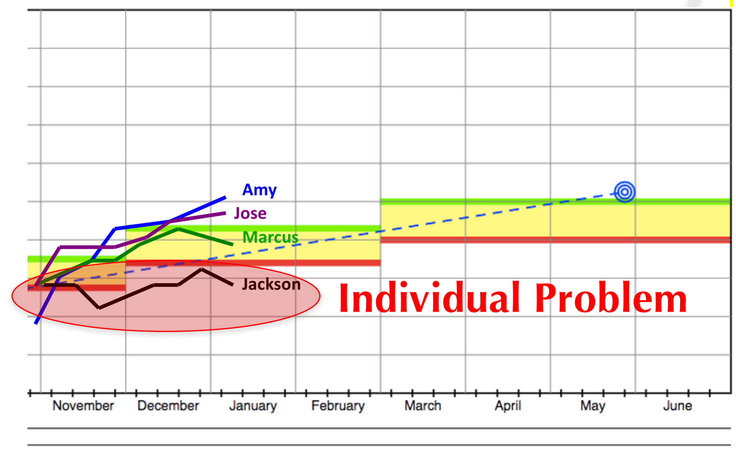
Tier 2/3 Problem Solving

- This happens at the ***intervention group*** level
  - Do we have at least 50% of our students in an intervention group making progress towards proficiency?
  - If *NO*:
    - Are we implementing the intervention with fidelity? How do we know?
    - What can we change for the group?
      - Instruction, Curriculum, Environment
  - If *YES*:
    - Problem solve for the individual students not making progress

Group or Individual Problem?

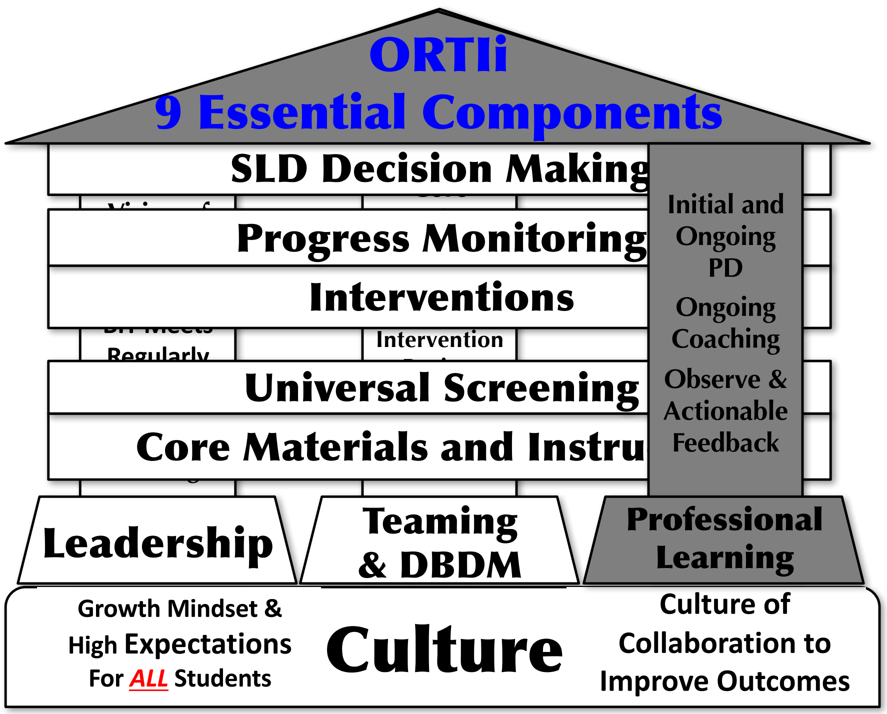


Group or Individual Problem?



Problem Solving: Big Ideas

- Follow the problem solving steps/questions:
  1. *What is the problem?*
  2. *Why is it occurring?*
  3. *What are we going to do about it?*
  4. *How is our plan working?*
- The steps/questions are the same at each tier
- Focus on what ***we can control*** (The ICE)
- Use data/evidence for all steps at all tiers



7 Keys to Success for Closing the Achievement Gap

1. High expectations
2. Leadership and focus
3. High Quality Teaching
4. Accountability
5. Professional Learning
6. Parent and Community Engagement
7. Commitment to Action

ODE Equity Dept

Trainings That Work

- One shot "Math Trainings" will not create competent and confident mathematics teachers. The ongoing, job imbedded, professional development is important.

- Recommendation: Teachers must know in detail the mathematical content they are responsible for teaching and its connections to other important mathematics, both prior to and beyond the level they are assigned to teach.
  - National Math Panel

Teachers' Math Anxiety

- Researchers found that Elementary Education majors have a high level of Math anxiety.
  - Beilock, 2009

The CCSS Requires Three Shifts in Mathematics

1. **Focus:** Focus strongly where the Standards focus.
2. **Coherence**: *Think* across grades and *link* to major topics within grades.
3. **Rigor:** In major topics, pursue *conceptual* **understanding,** procedural skill and *fluency*, and *application*.

Shift #1: Focus Strongly Where the Standards Focus

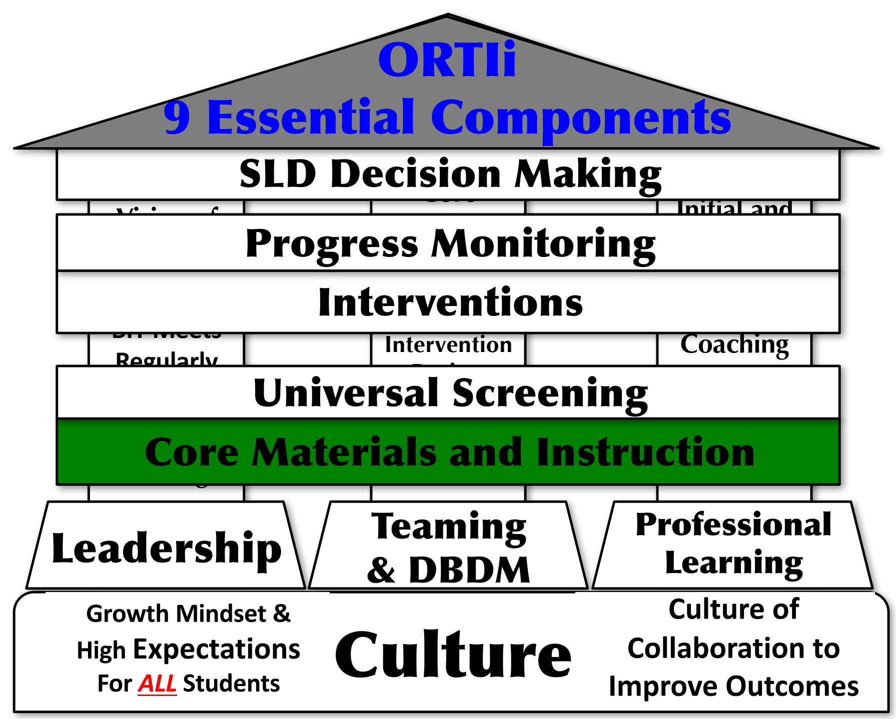
- Significantly narrow the scope of content and deepen how time and energy is spent in the math classroom.
- Focus deeply on what is emphasized in the standards, so that students gain strong foundations.

Shift #2: Coherence: Think Across Grades, and Link to Major Topics Within Grades

- Carefully connect the learning within and across grades so that students can build new understanding on foundations built in previous years.
- Begin to count on solid conceptual understanding of core content and build on it. Each standard is not a new event, but an extension of previous learning.

Shift #3: Rigor: In major topics, pursue *conceptual understanding*, procedural skill and *fluency*, and *application*

- The CCSS Math require a balance of:
  - Solid conceptual understanding
  - Procedural skill and fluency
  - Application of skills in problem solving situations
- Engaging in mathematical work that promotes deep knowledge of content, analytical reasoning, and use of appropriate tools



Solid Core Instruction is Critical!

- Instruction is the primary method of prevention
- A good tier 1 reduces the prevalence of math difficulties

Principles of Instruction

1. Begin a lesson with a short review of previous learning
2. Present new material in small steps with student practice after each step
3. Ask a large number of questions and check the responses of all students
4. Provide models
5. Guide student practice
6. Check for student understanding
7. Obtain a high success rate
8. Provide scaffolds for difficult tasks
9. Require and monitor independent practice
10. Engage students in weekly and monthly review

Building a Strong Foundation

1. Establish mathematics **goals** to focus learning
2. Implement **tasks** that promote reasoning and problem solving
3. Use and connect mathematical **representations**
4. Facilitate meaningful mathematical **discourse**
5. Pose purposeful **questions**
6. Build procedural **fluency** from conceptual **understanding**
7. Support **productive struggle** in learning mathematics
8. Elicit and use **evidence** of student thinking

- Principles to Actions: Teaching & Learning Practices

Standards of Practice for Math

- Instruction:
  - Focus on teaching Mathematics Practices
  - Mathematical Discourse
  - Use a Concrete->Representational->Abstract continuum
- Curriculum:
  - Ensure appropriate *focus* & *coherence*
  - Select *rigorous* math tasks
- Environment:
  - Standardized minutes with whole & (small group)
  - Instructional routines

The Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Importance of Mathematical Discourse

- Builds shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.

The Importance of Discourse

- Mathematical Discourse should:
  - Build on and honor students' thinking;
  - Provide students with the opportunity to share ideas, clarify understandings, and develop convincing arguments; and
  - Advance the mathematical learning of the whole class.

Examples of Math Models

- Concrete
  - Place value models
  - Counting blocks
  - Algebra tiles
- Representational
  - Number lines
  - Simple drawings
  - Graphs
- Abstract
  - Equations
  - Verbal description

Standards of Practice: Curriculum

Core Materials Contain A Lot

We need to make some decisions….

- *Current curricula may vary in quantity & rigor of the following components:*
- Depth
- Systematic and explicit
  - Scaffolding
- Opportunities to think-aloud/math verbalizations
- Practice and cumulative review

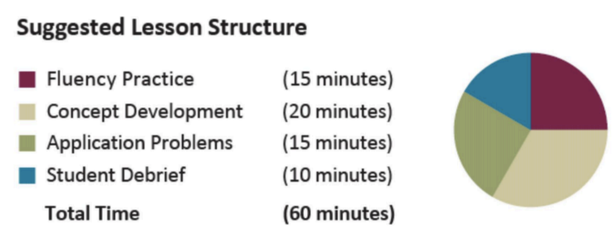
What is the task at hand?

- Determine the focus, coherence & rigor that is needed in your district.
  - *What are your expectations around core instruction?*
  - *How can you enhance instructional practices?*
- Determine how your expectations & practices for core will be communicated and supported
- Turn the expectations into habit

Standards of Practice: Environment (Time)

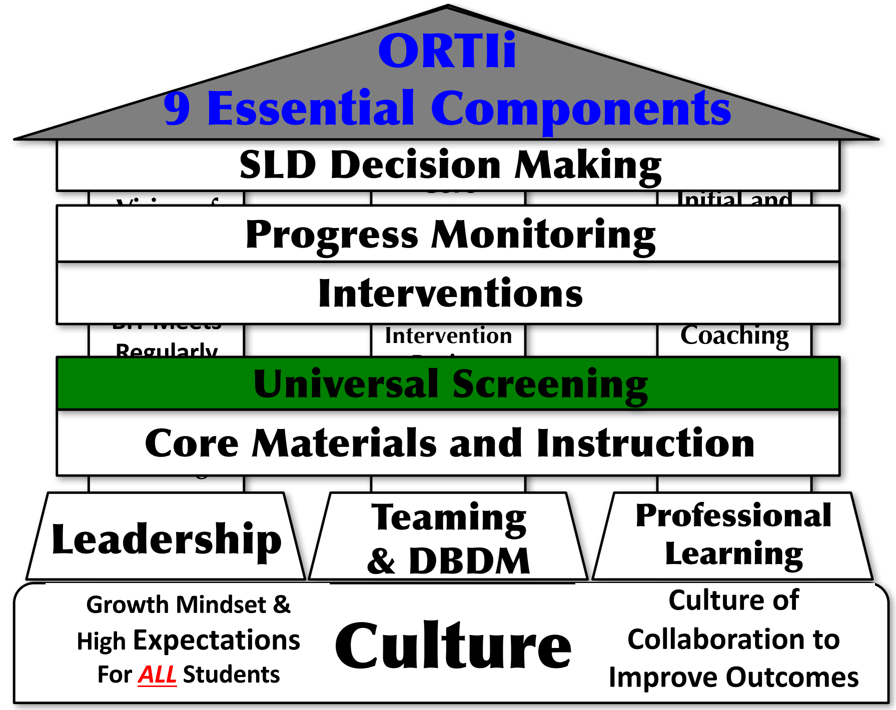
- Determine and communicate the time that will be the standard of math instruction

Fluency, concept development, and application layered in each lesson



Standards of Practice: Environment (Routines)

- Enhance student's learning of the following:
  - Number sense, operation sense, fluency, reasoning, mental math
  - Focus on a few rich routines from the beginning of the year (
  - Growth Mindset Thinking



For all our assessments…

What do we do with the data?

How does it change the way in which we instruct our students?

Purposes of Assessment

- Screening
- Outcome/Mastery
- Diagnostic
- Progress Monitoring

Universal Screening

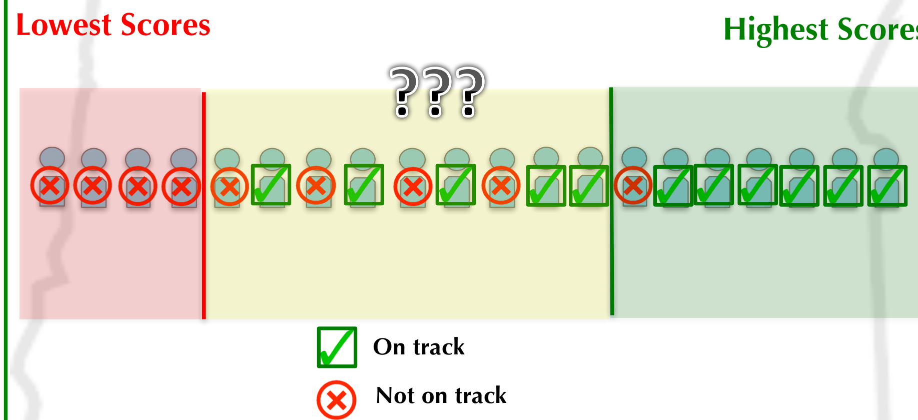
Brief

Standardized

Reliable, Valid

Culturally Appropriate

What our screeners tell us



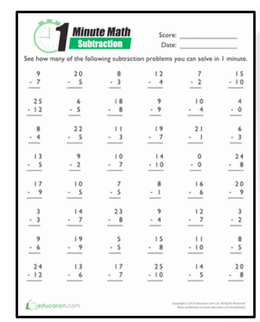
Screeners get muddy in the middle

Basic Skills Remove Barriers

- In **Reading**,
  - Students who demonstrate phonemic awareness & phonics skills will have ***fewer barriers*** to reading comprehension
  - Most students who read fluently and accurately will have good comprehension, but not all.
- In **Math**,
  - Students who demonstrate good number sense & procedural fluency on a math screener will have ***fewer barriers*** to deep conceptual understanding and efficiently and flexibly solving complex problems

Universal Screening

- Screeners are quick and relatively surface-level assessments because they have to be
- Other assessments for other purposes (e.g. diagnostic, mastery/outcome) do not need to look like a screener:
  - "Mad minute"
  - Math worksheets



Outcome/Mastery

- Did we reach the goal?
- Did we learn what we needed to?

SBAC, Unit Tests, Lesson Checkouts, other assessments?

Think purpose, not Test:
An Outcome/Mastery assessment may also be a Progress Monitoring/Formative Assessment if used in an ongoing way to change instruction

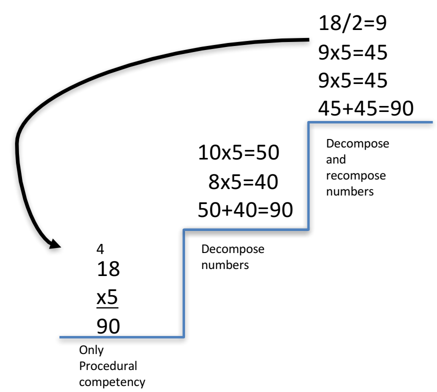
Mastery Assessments

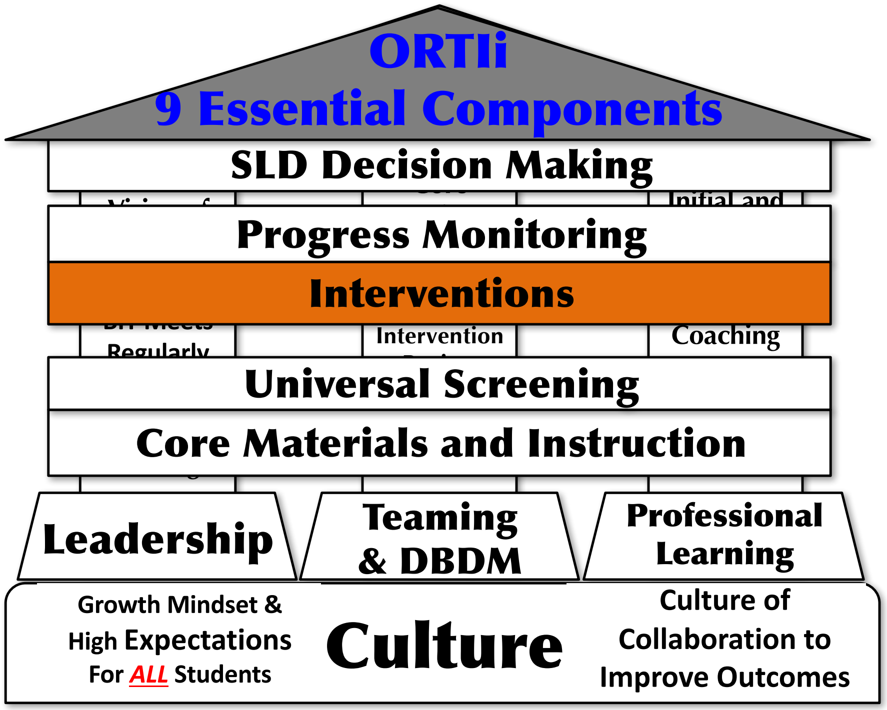
- When students are able to demonstrate knowledge and skills with complex mathematical thinking, they will be able to demonstrate procedural fluency because they have a full tool box to attack the problems.

Outcome Assessments

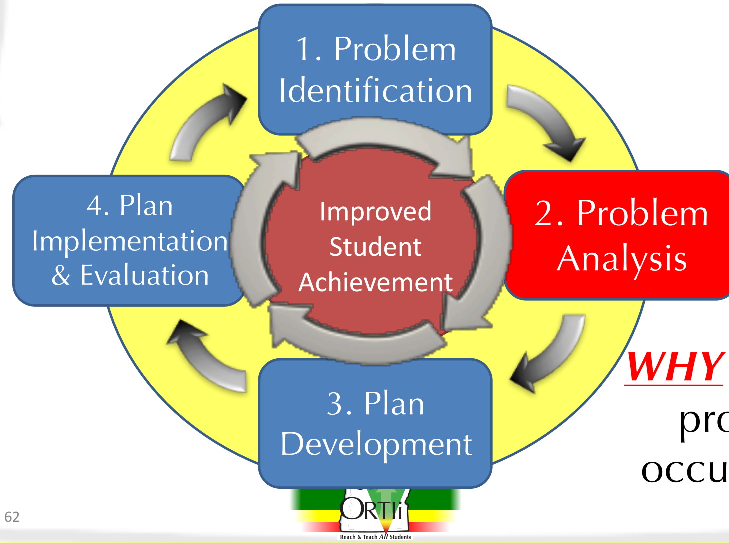
- We must move beyond shallow assessments
- Smarter Balanced Assessment is helping
  - 4 Claims
    - Concepts & Procedures
    - Problem Solving
    - Communicating Reasoning
    - Modeling and Data Analysis
  - Students will receive an overall mathematics composite score. For the enhanced assessment, students will receive a score for each of three major claim areas. (Math claims 2 and 4 are combined for the purposes of score reporting.)
- Higher level of Webb's Depth of Knowledge

- High level mathematical thinkers will do well on lower level tasks





Diagnostic

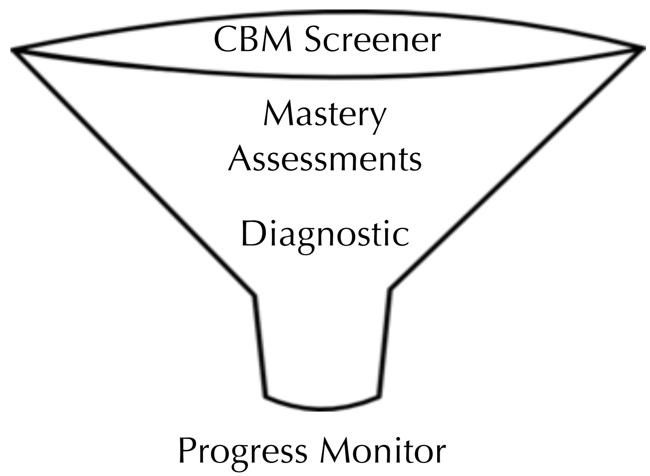


WHY is the problem occurring?

Diagnosing Thinking

- Using diagnostic assessment is to discover a students *Mathematical thinking*
- Many diagnostic assessments are purely procedural in nature. We must dig deeper to understand *why* students are making errors.

Mathematics Assessment "Funnel"



Decision Rules

- Example:
  - Student will receive intervention if they:
    - Are at risk on the screener
    - 20% or more behind the class average score on quizzes

Multiple Data Sources

Data to Make Decisions

Be sure that data plays a key role in the *placement* of students into mathematics interventions.

When?

- District Leadership Team Role:
  - What is considered an intervention
    - Inside the core as small group time
    - Outside the core as additional time
    - Alternating core and intervention instruction

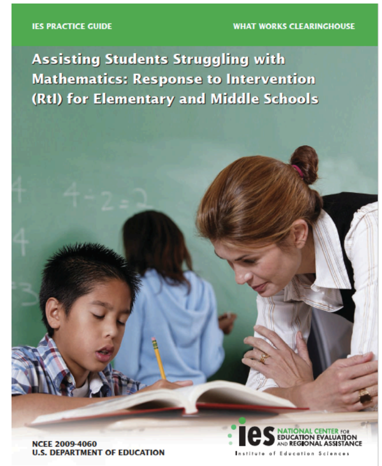
A Word on Computer Interventions

- Computer Assisted Instruction Effect Size 0.37
- Computers lack "Environmental Flexibility"
  - Students have low accountability
  - Delayed human feedback
  - Behavior issues can develop
  - No diagnostic ability, we don't know *why* students make mistakes

Intentionality

- Have a clear and intentional understanding about the intervention choices
- Do not place all students in the same mathematics intervention if they have different needs

IES Practice Guide



Recommendation 2

- “Instructional materials for students receiving interventions should focus intensely on in-depth treatment of whole numbers in kindergarten through grade 5 and on rational numbers in grades 4 through 8. These materials should be selected by committee.”

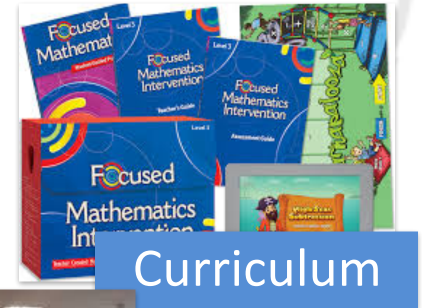
K-2 Intervention Focus Options

- Number Sense
- Addition
- Subtraction
- Core or Core Aligned
- Comprehensive

3-5 Intervention Focus Options

- Multiplication
- Division
- Fractions
- Core or Core Aligned
- Comprehensive

How is the Content Delivered?

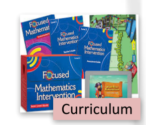


Recommendation 3

- "Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review."
- Reasoning, communicating and problem solving
  - MP2 Reason abstractly and quantitatively
  - MP3 Construct viable arguments and critique the reasoning of others

Recommendation 4

- "Interventions should include instruction on solving word problems that is based on common underlying structures."
- MP7: Look for and make use of structures
  - 7x5 = 7x3+7x2



CCSS Math Glossary

Mathematics Glossary » Table 1

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Common addition and subtraction.[1]

	RESULT UNKNOWN	CHANGE UNKNOWN	START UNKNOWN
ADD TO	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? **2 + 3 = ?**	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? **2 + ? = 5**	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? **? + 3 =5**
TAKE FROM	Five apples were on the table. I ate two apples. How many apples are on the table now?**5-2 = ?**	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat?**5 – ? = 3**	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before?**? -2 = 3**
	TOTAL UNKNOWN	ADDEND UNKNOWN	BOTH ADDENDS UNKNOWN[2]
PUT TOGETHER / TAKE APART[3]	Three red apples and two green apples are on the table. How many apples are on the table? **3 + 2 = ?**	Five apples are on the table. Three are red and the rest are green. How many apples are green? **3 + ? = 5, 5-3 = ?**	Grandma has five flowers. How many can she put in the red vase and how many in her blue vase? **5 = 0 + 5, 5 + 0 5 = 1 +4, 5 = 4 +1 5 = 2 + 3, 5 = 3 + 2**
COMPARE	DIFFERENCE UKNOWN	BIGGER UNKNOWN	SMALLER UNKNOWN
	("How many more?" version):Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy?("How many fewer?" version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have then Julie? **2 + ? = 5, 5 – 2 = ?**	(Version with "more"): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? **2 + 3 = ?, 3 + 2 = ?**	(Version with "more"):Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have?(Version with "fewer"): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? **5 – 3 = ?, ? + 3 = 5**

Mathematics Glossary » Table 2

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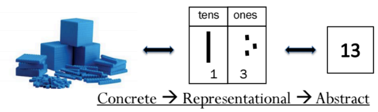
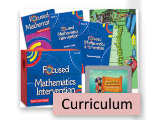
Common multiplication and division situations.[1]

	UNKNOWN PRODUCT	GROUP SIZE UNKNOWN ("HOW MANY IN EACH GROUP?" DIVISION)	NUMBER OF GROUPS UNKNOWN ("HOW MANY GROUPS?" DIVISION)
	3 x 6 = ?	**3 x ? = 18**, and **18 ÷ 3 = ?**	**? x 6 = 18**, and **18 ÷ 6 = ?**
EQUAL GROUPS	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example.* You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example.* You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example.* You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
ARRAYS[2], AREA[3]	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example.* What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example.* A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? *Area example.* A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
COMPARE	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example.* A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example.* A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example.* A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
GENERAL	**a x b = ?**	**a x ? = p** and **p ÷ a = ?**	**? x b = p**, and **p ÷ b = ?**

Recommendation 5

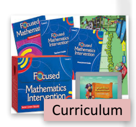
- "Intervention materials should include opportunities for students to work with visual representations of mathematical ideas and interventionists should be proficient in the use of visual representations of mathematical ideas."





Recommendation 6

- "Interventions at all grade levels should devote about 10 minutes in each session to building fluent retrieval of basic arithmetic facts."
- Only a portion of your focus!



Procedural Fluency Should…

- Build on a foundation of conceptual understanding;
- Result in generalized methods for solving problems; and
- Enable students to flexibly choose among methods to solve contextual and mathematical problems.

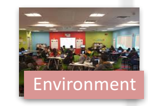
Fluency & Flexibility

- Fluency = efficient and correct
- Flexibility = multiple solution strategies determined by the problem.

Fluency = Accuracy + + Efficiency + + Flexibility

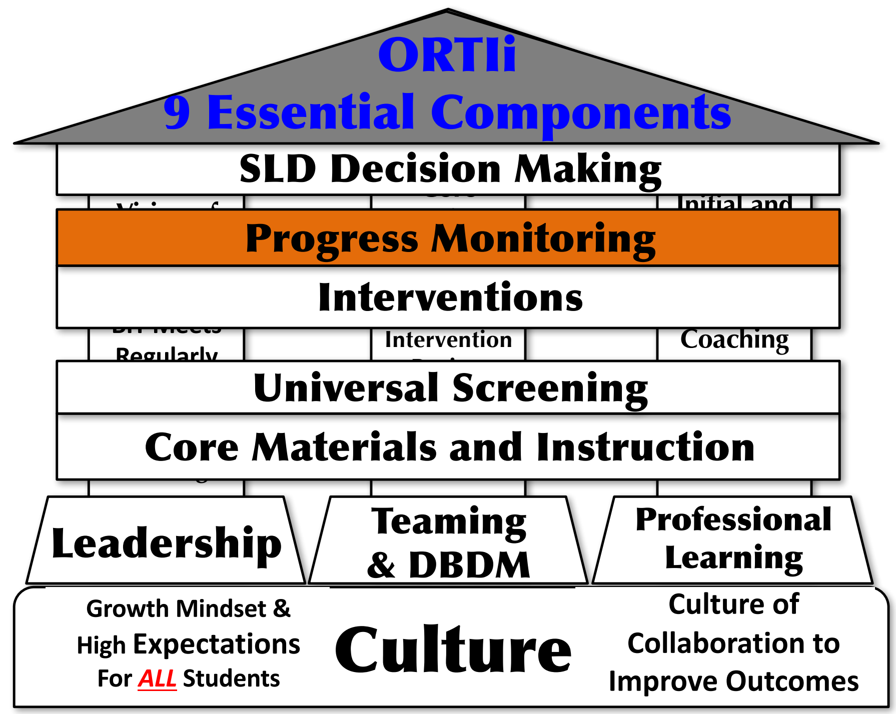
Recommendation 8

- Include motivational strategies in tier 2 and tier 3 interventions.
- MP1: Make sense of problems and persevere in solving them
  - Growth Mindset Language
- Look back at your PBIS system
  - Instruction
  - Curriculum
  - **Environment**



From Recommendation 2

- "The panel believes that alignment with the core curriculum is not as critical as ensuring that instruction builds students' foundational proficiencies. Tier 2 and tier 3 instruction focuses on foundational and often prerequisite skills that are determined by the students' rate of progress. So, in the opinion of the panel, acquiring these skills will be necessary for future achievement. Additionally, because tier 2 and tier 3 are supplemental, students will still be receiving core classroom instruction aligned to a school or district curriculum (tier 1)."



Purposes of Assessment

- Screening
- Outcome/Mastery
- Diagnostic
- Progress Monitoring

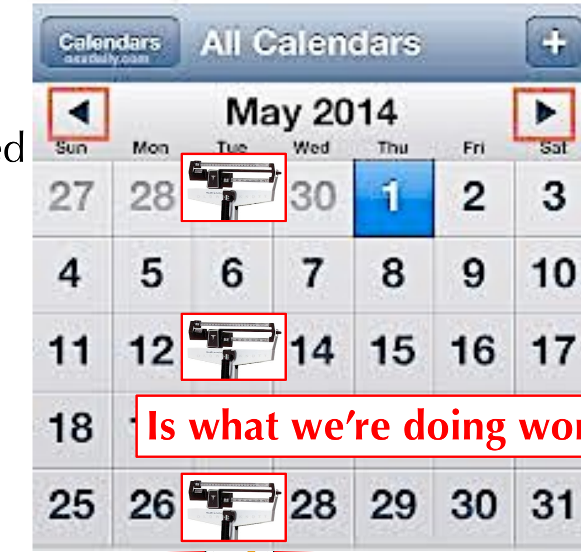
Progress Monitoring

Brief

Standardized

Reliable
Valid

Equivalent
Forms

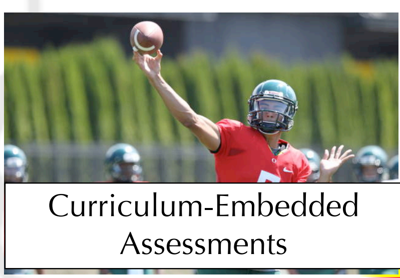


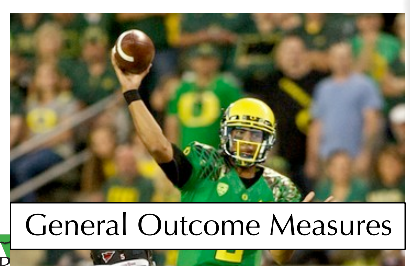
Is what we're doing working?

Curriculum-Embedded Assessments vs. General Outcome Measures

- Linked to specific interventions
- Measures taught skills
- Given ***daily/weekly***

- Research-based
- Measures generalization
- Given ***monthly***

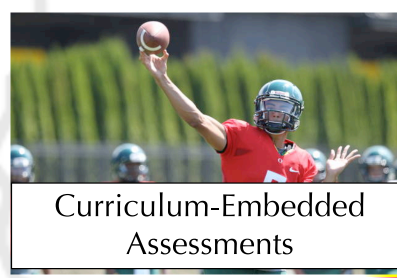


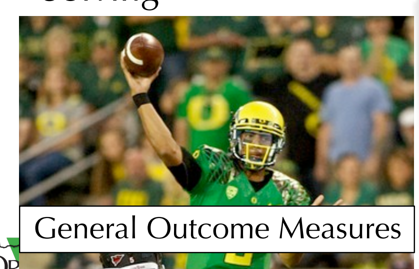


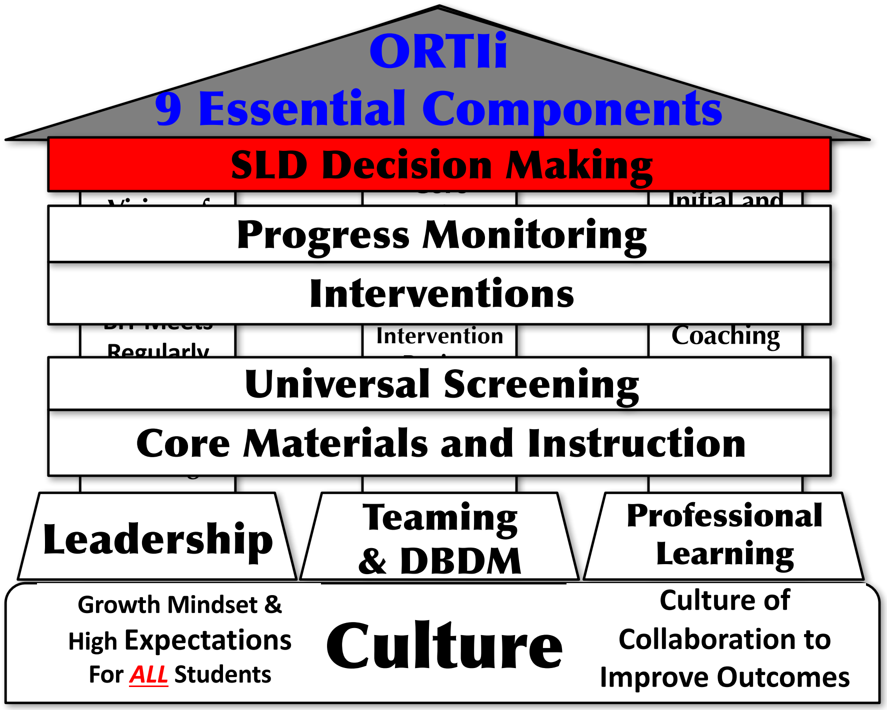
Curriculum-Embedded Assessments vs. General Outcome Measures

- Mastery Tests
- Unit/Lesson Tests
- Checkouts
- Exit Slips

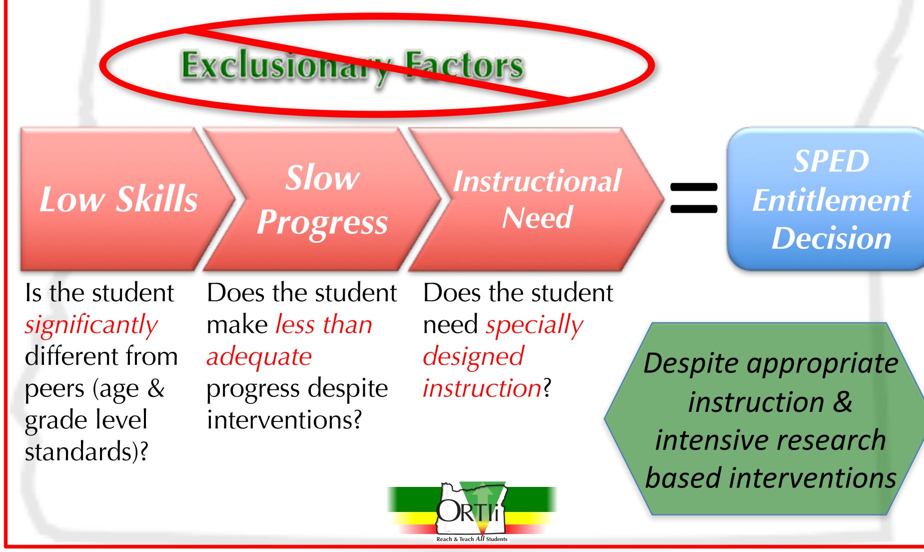
- Early Numeracy Measures
- Computation
- Concepts & Applications/Problem Solving







Four Key Questions



Session Outcomes

- Be affirmed for your good practices.
- Be reminded of things you used to do but forgot about.
- See things that you already do, now use and can expand on.
- See things that are new and you would like to try.

Access Resources

- Links to this presentation can be found on the conference web site.
- Use the Installation Matrix to begin the work of RTI in Math

Thank you for your time

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