

# From Research to Classroom Practice: A Collaborative Partnership for Implementing Cognitive Based High-Impact Math Strategies

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Dr. Paul J. Riccomini, The Pennsylvania State University  
Candace Lane & Marie Holden, Horry County Schools

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## Session Focus

- Introductions
- Horry County Schools Background
- Goal: Moving evidence-based cognitive strategies from professional development into consistent classroom practice.
- Forming the Partnership
- 3 Step Process
  - Step 1: Professional Development
    - Interleaving Practice
    - Worked Solution Strategy
  - Step 2: In-district School Level Planning
  - Step 3: External Coaching and Debriefing
- Lessons Learned
- Summary and Questions



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# Horry County Schools

**-Our Route to Greatness-  
Seeking Solutions that stick and  
Expertise that sparks change**

- Hello Dr. Riccomini-HIIT the spot
  - September 4-5 Professional Development
  - Selected Targeted Schools for Coaching
  - Side by Side Coaching
  - Built capacity

**Math Project #risewithreasoning**



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## 3 Step Process



### The Plan

- 1. Professional Development focused on Cognitive Based Instructional Practices**
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- 2. In-District School Level Planning**
  - Math Coaches, Teachers, Principals, and District Supervisors
- 3. Supporting teachers through Classroom Coaching & Debriefing Sessions**
  - Teachers coached on their use of the techniques

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# Cognitive Based Strategies

## Step 1: PD focused on HIIT-4-Math

### 1. Interleaving Practice – Boost retention

– Interleaving of skills vs blocking of skills

### 2. Worked Solution Strategy- Support Reasoning

– Solving a problem versus interacting with a solution



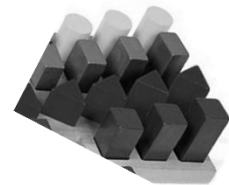
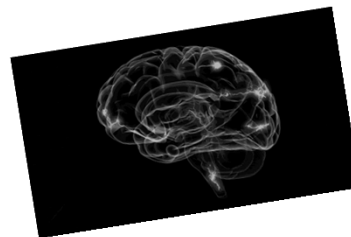
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# Meta-Analyses: How Good is IPF?

Hattie's Categories <u>Visible Learning - Influences</u> ( <a href="http://visiblelearningmetax.com">visiblelearningmetax.com</a> )	ES
Task Analysis	1.29
Mathematics Problem Solving	1.16
Mnemonics	0.80
Problem Solving Strategies	0.67
Math Direct-Guided Learning	0.61
Meta-cognitive strategies	0.60
Direct Instruction	0.59
Skill-Focused Content	0.58
Explicit Instruction	0.57
Setting Clear Goals	0.51
Interleaving Mixed Practice	<b>0.44</b>
Advance Organizers	0.42
Fully Worked Examples	<b>0.37</b>



Hattie, 2024:  
<https://www.visiblelearningmetax.com/Influences>

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# How are Learner Characteristics?

## • Strategic Learners

- Able to **analyze a problem** and develop a plan
- Able to **organize multiple goals** and **switch flexibly** from simple to more complicated goals
- Access their **background knowledge** and apply it to novel tasks
- Develop new **organizational or procedural strategies** as the task becomes more complex
- Use effective **self-regulated strategies** while completing a task

## • Non-Strategic Learners

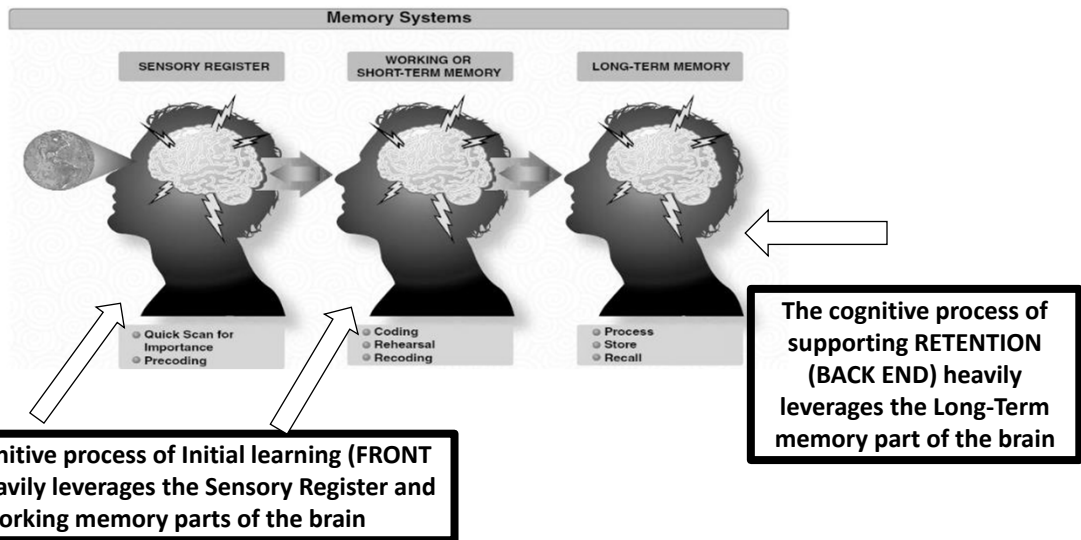
- **Unorganized, impulsive**, unaware of where to begin an assignment
- **Unaware of possible steps** to break the problem into a **manageable task**
- **Exhibit problems with memory**
- **Unable to focus** on a task
- **Lack persistence**
- Easily frustrated and **lacking persistence**

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# Cognitive Process of Learning

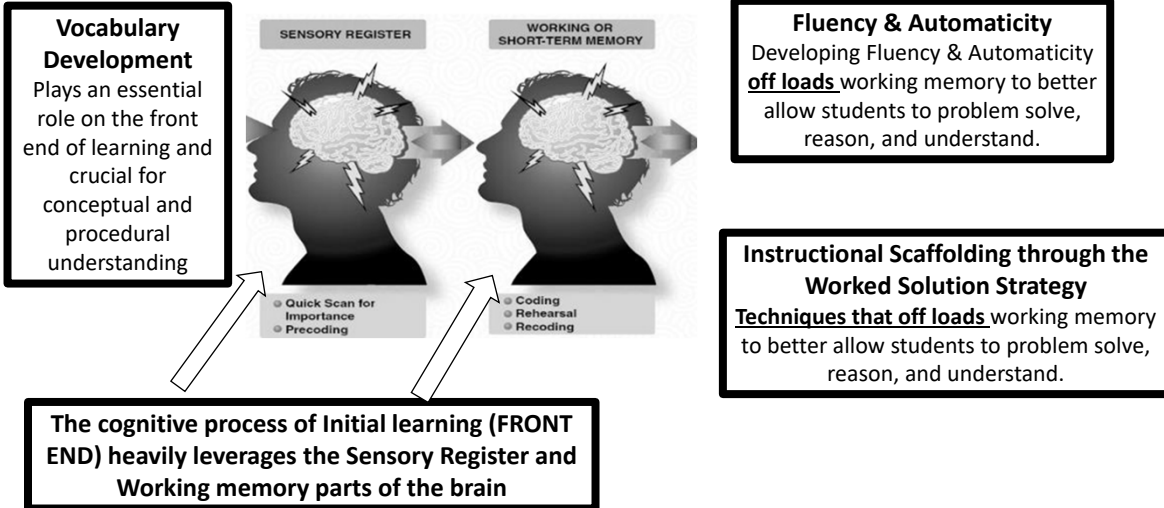


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# Cognitive Process of Learning

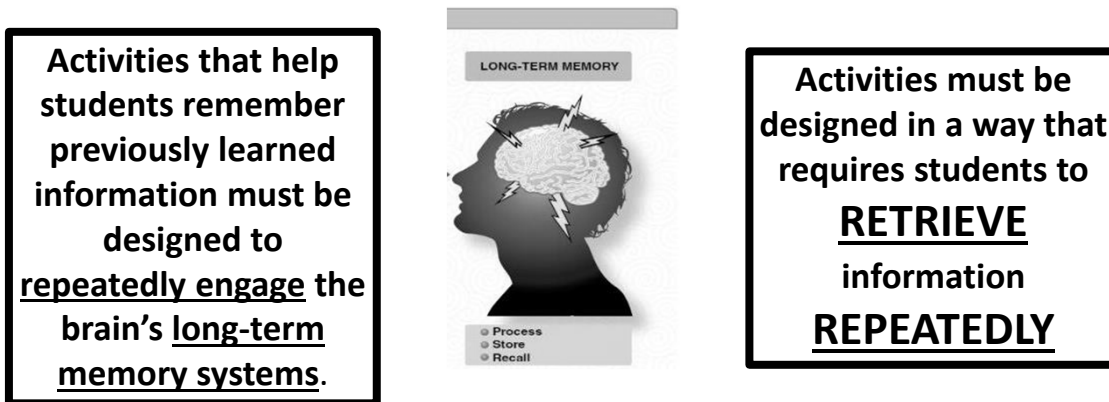


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# Cognitive Process of Learning



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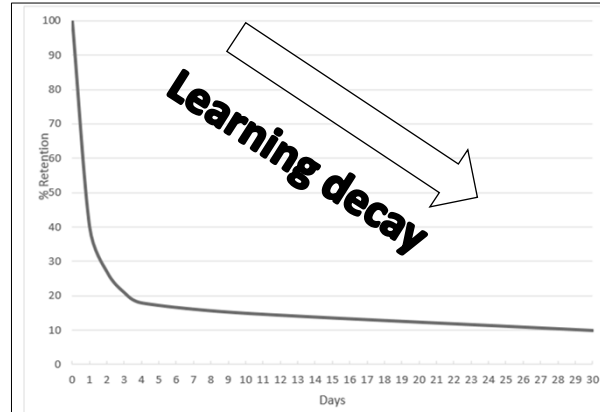
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## How Fast do “WE” Forget?

- Learning loss happens much faster than most educators realize—students can forget up to 80% of what they've learned within just 10 days.
- This rapid decline is especially concerning for students with disabilities.
- To slow this decay, we need to incorporate more **purposeful and carefully designed practice**.
- By doing so, **teachers can flatten the forgetting curve** and significantly boost long-term retention.

Forgetting Curve



Ebbinghaus, 1885

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## How do I Boost Retention?

What are the Key Mechanisms for Retention Activities?

- 1. Interleaving Practice** – Sequencing of Problems
  - Interleaving of skills vs blocking of skills
- 2. Practice Test Retrieval** - Free Recall paired with feedback
  - Regular and consistent recall without assistance paired with feedback in low stakes activities
- 3. Spaced Learning Over Time** - Windows of Time
  - Purposeful spacing for revisiting content is critical



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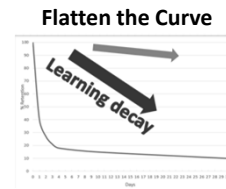
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# How do I Boost my Students' Retention?

What is the purpose of Practice?

- Identifying the “purpose” of a practice activity is critical to achieving the desired outcome
- Focus on the **PURPOSE** of practice in both core and intervention.
  - Is the purpose acquisition...or initial learning?
  - **Is the purpose retention...cumulative review?**
  - Is the purpose to build fluency and/or automaticity?
  - Is the purpose to promote generalization?
- Different practice activities have different purposes



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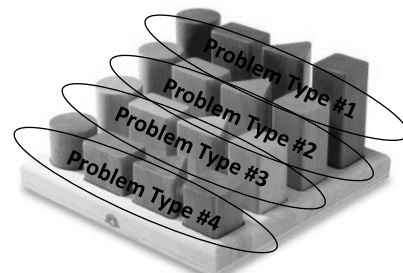
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# What is Blocked Practice?

**BLOCKED (MASS) Structure:**

- Problems of the same type are sequenced consecutively
  - aaaaaaaaaaaaaaaaaaaaa
  - aaaa, bbbb, cccc, dddd
- **Purpose:**
  - Promotes initial acquisition of understanding and accuracy
- **IMPORTANCE:**
  - Initially VERY IMPORTANT



**Blocked Practice =**



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# What does Blocked Practice Look Like?

90% of practice follows a blocked structure



Rohrer et al., 2020

### Order of operations

Grade 1 PEMDAS Worksheet

- The order of operations:  
 1. Parentheses ( )  
 2. Exponents  $^{\circ}$   
 3. Multiplication  $\times$  or Division  $\div$   
 4. Addition  $+$  or Subtraction  $-$

Solve the following using PEMDAS

- $3 \times 9 + 7$
- $32 + 36 \div 4$
- $9 \div 3 + 4 \times 6$
- $2 \times 11 - 12 \div 2$
- $8 \times 18 \div 4 + 15$
- $(67 - 18) \div 7 \times 3$
- $5^2 - 8$
- $2^3 \times 3^2$
- $4^2 \times (8 - 3)$
- $(7 \times 8 - 4) \div (6 - 2)$

### Grade 2/3

$73$ $+ 12$	$82$ $+ 33$
$55$ $+ 43$	$64$ $+ 23$

### Fractions

Circle

### Fill in the missing numbers

38, 42, 46, 50, 54, 58

Before After

78 93

### What Time is it?

$37$ $- 26$	$56$ $- 25$
$55$ $- 14$	$59$ $- 16$

### Mixed Math

I am an odd number.  
You can count me on one hand.  
If you rotate me, I look like a letter.  
What Number am I?

$1 \times 5 =$  \_\_\_\_\_  
 $6 \times 2 =$  \_\_\_\_\_  
 $3 \times 4 =$  \_\_\_\_\_

### Math Worksheets

#### Factoring Quadratics

20. Factor each completely.

1) $x^2 - 16x + 63 =$	20) $7x^2 - 31x - 20 =$
2) $m^2 - 9m + 8 =$	21) $6x^2 + 7x - 49 =$
3) $p^2 - 5p - 14 =$	22) $-6x^2 - 25x - 25 =$
4) $2x^2 + 17x + 21 =$	23) $6x^2 + 5x - 6 =$
5) $a^2 + 5a + 4 =$	24) $16x^2 + 60x - 100 =$
6) $a^2 + 2a - 15 =$	25) $4x^2 - 35x + 49 =$
7) $4x^2 + 12x + 9 =$	26) $5x^2 - 18x + 9 =$
8) $t^2 + 2t - 19 =$	27) $9x^2 + 66x + 21 =$
9) $3x^2 + 21x^2 + 36x =$	28) $3x^2 - 8x + 4 =$
10) $x^2 + 5x + 6 =$	29) $6x^2 - 36xy =$
11) $9x^2 - 5x - 10 =$	30) $-6x^2 - 23xy - 10y^2 =$
12) $30x^2b - 87ab + 30b =$	31) $9x^2 + 9ab - 4b^2 =$
13) $7x^2 - 32x - 60 =$	32) $4x^2 + 4xy - 35y^2 =$
14) $3b^2 - 5b^2 + 2b =$	33) $7x^2y - 27xy^2 + 18y^3 =$
15) $10a^2 + 89m - 9 =$	34) $-2x^2 + 8xy + 6y^2 =$
16) $4x^2 + 43x^2 + 30x =$	35) $25a^2b^2 - 45ab =$
17) $9x^2 + 7 - 5x =$	36) $14x^2 + 142x + 144 =$
18) $p^2 - 5p - 14 =$	37) $5x^2 + 85xy + 350y^2 =$
19) $x^2 - 7x - 18 =$	38) $7x^2 + 9xy =$

... So Much More Online! Please visit [www.EffortlessMath.com](http://www.EffortlessMath.com)

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# Interleaving Practice Format

## Interleaving Practice Format (IPF):

- Problems of the same type are sequenced in a mixed format (NOT Consecutively)
- Abc abc abc
- Abcd, abcd, abcd

### Purpose:

- Promotes long term **RETENTION** (DURABLE LEARNING)

### IMPORTANCE:

- VITAL
- Rarely occurs



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# What does IPF look like?

1) How long is the pencil?



\_\_\_\_\_ centimeters

2) Is 57 greater than (>) or less than (<) 118?

57  118

3) Solve the problem.

$32 + 5 =$  \_\_\_\_\_

4) How long is the scissors?



\_\_\_\_\_ inches

5) Is 22 greater than (>) or less than (<) 18?

22  18

6) Solve the problem.

$12 + 15 =$  \_\_\_\_\_



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# What does IPF look like?

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Block: \_\_\_\_\_

IPF – Segment Addition, Midpoints, Angle Pairs

<p>1. <math>AB = 12</math>, <math>BC = 7</math>. What is <math>AC</math>?</p>	<p>2. What is the midpoint between (2, 4) and (8, 6)?</p>
<p>3. Solve for <math>x</math>.</p>	<p>4. <math>AT = 3x + 1</math>, <math>TL = 15</math>, and <math>AL = 7x + 1</math>. Solve for <math>x</math>.</p>



<p>5. What is the midpoint between (-10, 2) and (16, -28)?</p>	<p>6. Solve for <math>x</math>.</p>
<p>7. What is <math>HJ</math>?</p>	<p>8. What is the midpoint of (-15, -7) and (2, 0)?</p>
<p>9. Solve for <math>x</math> and the measure of all 4 angles in the diagram.</p>	

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# Why is the Worked Solution Strategy Effective?

## Discuss the following Questions:

- Why does embedding worked solutions in an alternating format improve learning?
- How does seeing a worked solution make practice activities more effective for students?
- In what ways does interacting with a worked example strengthen students' mathematical reasoning?



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# Cognitive Process of Learning

Interleaving practice results in repeated retrieval throughout the entire practice activity



Activities must be designed in a way that requires students to **RETRIEVE** information **REPEATEDLY**

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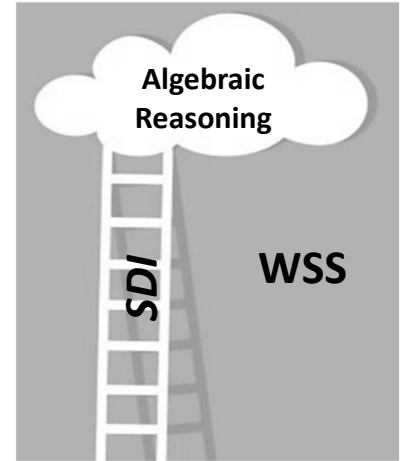
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## What is an Instructional Scaffold?

*Instructional scaffolding* is a process in which **a teacher adds supports** to an activity to **enhance learning** and aid in the mastery of tasks.

- Worked Solution Strategy (WSS)



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## What is the Worked Solution Strategy?

A worked solution is a **teacher-provided, fully or partially solved** problem designed for students to **engage with through a purposeful activity** that highlights both the **what and the why** behind the solution.



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## What is the Worked Solution Strategy?

- To strengthen learning, **ALTERNATE worked examples with unsolved problems** during instruction:
  - This means alternating between showing students a worked example (demonstrating one possible solution path) and giving them a similar problem to solve.
  - This approach significantly improves students' **engagement** and **mathematical reasoning and mathematical thinking**.



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## What is the Worked Solution Strategy?

Typical practice consists of students solving unsolved problems.

- Pg. 155 #1-21 odd
- Complete the worksheet
- Computer practice
- Work with a partner
- Games

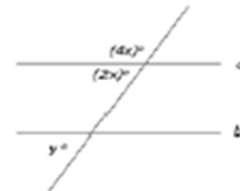
Students are solving unsolved problems

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Problem

---

Lines  $a$  and  $b$  are parallel.  
Find the values for  $x$  and  $y$ .



Riccomini & Morano, 2025

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# What is the Worked Solution Strategy?

Worked Solution activities means:

- Every other problem is solved for the student
- Students are told to study the solutions it will help you solve the next problem— focus on the What and why



Problem	Solution Steps Provided
<p>Lines <math>a</math> and <math>b</math> are parallel. Find the values for <math>x</math> and <math>y</math>.</p>	$4x + 2x = 180^\circ$ $6x = 180^\circ$ $x = 30^\circ$ $y = 2x$ $y = 2(30^\circ)$ $y = 60^\circ$ <p>Answer:</p> $x = 30^\circ \text{ and } y = 60^\circ$

Riccomini & Morano, 2025

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# Why is the Worked Solution Strategy Effective?

When students **interact with solutions** focusing on the process (what and why) before attempting to solve a problem from start to finish learning is enhanced.

- Interacting with a worked solution **off loads working memory** and supports a **higher-level processing** of mathematical concepts and processes.
- Interacting with a solution prompts, supports, and/or encourages **self-explanation**



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# How do I Develop WSS Activities?

## 6 Steps to Developing WSS Activities

- Step 1: Select Problem
- Step 2: Pre-Questioning
- Step 3: Solve Problem
- Step 4: Solution Questions
- Step 5: Answer/Solution
- Step 6: Ending Questionings



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# Worked Solution Activity



### Teacher Materials

Problem #1	Teacher Questions
<p>Sarah is building a ramp for her skateboard. The ramp will form a right triangle with the ground. The base of the ramp is 6 feet, and the height of the ramp is 8 feet. How long will the slanted part of the ramp be?</p> <p><math>a^2 + b^2 = c^2</math></p> <p><math>a</math> is the base of the triangle = 6 feet,  <math>b</math> is the height of the triangle = 8 feet  <math>c</math> is the hypotenuse = <math>c</math> (?)</p> <p><math>6^2 + 8^2 = c^2</math>  <math>36 + 64 = c^2</math>  <math>100 = c^2</math>  <math>c = \sqrt{100} = 10</math></p> <p>The length of the hypotenuse (slanted side of the ramp) is 10 feet.</p>	<p><b>Pre-Questions (Ask before giving problem):</b></p> <ul style="list-style-type: none"> <li>What is some important information about the PT that we have been learning?</li> <li>What might we solve for in a PT problem??</li> <li>What are the important math concepts we might need for this problem?</li> </ul> <p>Show students the problem and ask:</p> <ul style="list-style-type: none"> <li>What is important information in this problem?</li> </ul> <p><b>Solution Questions:</b></p> <p>What is important information in this problem?</p> <p>What did they do first? Why?</p> <p>Why is it important to draw and label a figure?</p> <p>Does that make sense for a skateboard ramp?</p> <p>What is this formula?                      Why did I write down this formula? Is there another formula that I can use?</p> <p>What is happening here?                      Why is this important? Where did this information come from?                      Why is there a question mark beside <math>c</math>?</p> <p>What did I do here? Why? Is there a different way?</p> <p>What happened here? Why?</p> <p>What happened here? Why?</p> <p>What happened here? Why? Does this make sense? How do you know?</p> <p><b>Ending Questions:</b></p> <p>What does this represent? Does this seem reasonable?                      Why are the units important? Could other units of measurement be used?                      Can we solve another problem like this one?</p>

Teachers guide students through a series of questions about the solution.

- Teacher you will ask your student Pre-questions, Solution question, and ending questions.
- Student, you will use the solution to answer the teacher questions

### Student Materials

Problem #1	Problem #2
<p>Sarah is building a ramp for her skateboard. The ramp will form a right triangle with the ground. The base of the ramp is 6 feet, and the height of the ramp is 8 feet. How long will the slanted part of the ramp be?</p> <p><math>a^2 + b^2 = c^2</math></p> <p><math>a</math> is the base of the triangle = 6 feet,  <math>b</math> is the height of the triangle = 8 feet  <math>c</math> is the hypotenuse = <math>c</math> (?)</p> <p><math>6^2 + 8^2 = c^2</math>  <math>36 + 64 = c^2</math>  <math>100 = c^2</math>  <math>c = \sqrt{100} = 10</math></p> <p>The length of the hypotenuse (slanted side of the ramp) is 10 feet.</p>	<p>A ladder is leaning against a wall. The base of the ladder is 9 feet away from the wall, and the top of the ladder reaches 12 feet up the wall. How long is the ladder?</p> <p>Your Solution:</p>

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## 3 Step Process



### The Plan

1. **Professional Development focused on Cognitive Based Instructional Practices**
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2. **In-District School Level Planning**
  - Math Coaches, Teachers, Principals, and District Supervisors
3. **Supporting teachers through Classroom Coaching & Debriefing Sessions**
  - Teachers coached on their use of the techniques

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## Step 2: In-District School Level Planning

### School Teams Accountability, Support, Follow Up, and Feedback: Prior to Coaching Visits

- IPF
  - School teams designed an implementation plan for IPF
  - PLC's were designed for ongoing teacher support
  - Instructional coaches supported planning and IPF design
  - Math learning specialist school visits supported the design and implementation of IPF
  - Teachers practiced the strategies
  - Executive Director walked classrooms with Principals and Instructional Coaches for feedback
- Work Solution Strategy was selected for specific teachers to implement
  - Math learning specialist visited and supported planning for implementation of WSS
  - Math learning specialist provided feedback
- Math Learning Specialist planned with math teachers at selected schools prior to Dr. Riccomini on site coaching visits



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## 3 Step Process



### The Plan

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## Step 3: Embedded Classroom Coaching

### Purpose:

- Embedded classroom coaching **bridges professional development** to classroom practice by supporting teachers in implementing evidence-based strategies, providing **individualized feedback**, enhancing instructional fidelity, and strengthening instructional decision making.

### Desired Outcome:

- The outcome of embedded classroom coaching is **increased implementation of evidence-based practices**, improved instructional effectiveness, and **greater teacher confidence** and self-efficacy in meeting students' academic needs.



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## Step 3: Embedded Classroom Coaching

### Coaching and Debriefing Structure

#### 1. Coaching Schedule is created at the school level well in advance of the coaching date.

- Specific strategy is selected
- 20-30 minutes for classroom coaching
- 10-15 minutes for debriefing

#### 2. Coaching Participants

- Teacher and External Coach
- Internal coach
- Other teachers
- Principals (at least in the debriefing Sessions)



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## Step 3: Embedded Classroom Coaching

### Coaching and Debriefing Structure

#### 3. Debriefing Sessions

- Immediately follows the classroom observation
- Best practice is a substitute teacher takes over as soon as the classroom activity is completed to allow the teacher to step out and debrief.
- Positive focus about what went well and discussion about considerations for future use
- Teachers and grade level teams can ask questions which allows for trouble shooting
- Principal involvement in the debriefing sessions are essential for sustainability



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## Lessons Learned

1. Accountability
2. Scaffolding Teachers
3. Starting small and building
4. Follow-up, Follow-up Follow-up!!!
  1. Within the school year
  2. Across school years



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Dr. Paul J. Riccomini  
Professor  
The Pennsylvania State University  
[pjr146@psu.edu](mailto:pjr146@psu.edu)

Candace W. Lane  
Executive Director of Middle Schools  
Horry County Schools  
[clane@horrycountyschools.net](mailto:clane@horrycountyschools.net)

Marie Holden  
Middle School Math Learning Specialist  
Horry County Schools  
[mholden@horrycountyschools.net](mailto:mholden@horrycountyschools.net)

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