

The Strength of Partnerships

Design and implementation of equity-oriented, cohesive, evidence-based mathematics professional learning models

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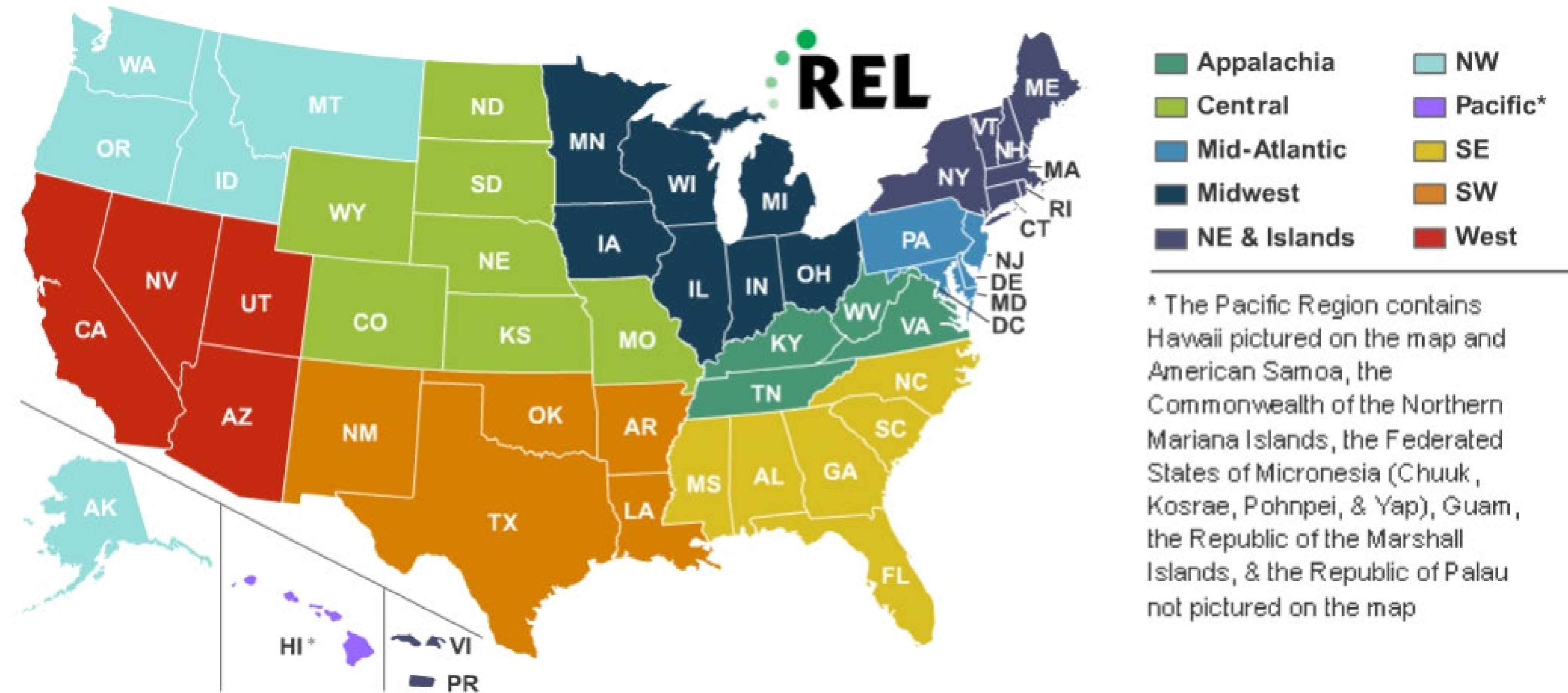


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The Regional Educational Laboratories



The 10 RELs work in partnership with stakeholders to support a more evidence-based education system.


Administered by the U.S. Department of Education, Institute of Education Sciences (IES)

Find us on the web! <https://ies.ed.gov/ncee/edlabs/regions/appalachia/>

Applied Research

Training, Coaching, and Technical Support


Dissemination



 Regional Educational Laboratory Appalachia
 At SRI International
 REL 2020-017
 U.S. DEPARTMENT OF EDUCATION


What Tools Have States Developed or Adapted to Assess Schools' Implementation of a Multi-Tiered System of Supports/Response to Intervention Framework?

A Publication of the National Center for Education Evaluation and Regional Assistance at IES




Supporting Your Child in Developing Math Skills For Future Success

Math success opens doors to college and careers.
 The technical and professional jobs of the future demand more mathematical knowledge and problem solving skills.




Children who believe they can be successful in math are more willing to put in effort, even when they struggle, and this results in better performance.¹

Success in elementary school math predicts future achievement in middle and high school math and other subjects.^{2,3}

Students who complete higher level math in high school earn higher incomes in the future.⁴

The number of STEM (science, technology, engineering, and mathematics) jobs is growing and half of all STEM jobs are available to workers without a four-year college degree. STEM jobs pay 10% more than other jobs available to these workers.⁵


Families can support children in developing math skills for the future by⁶:



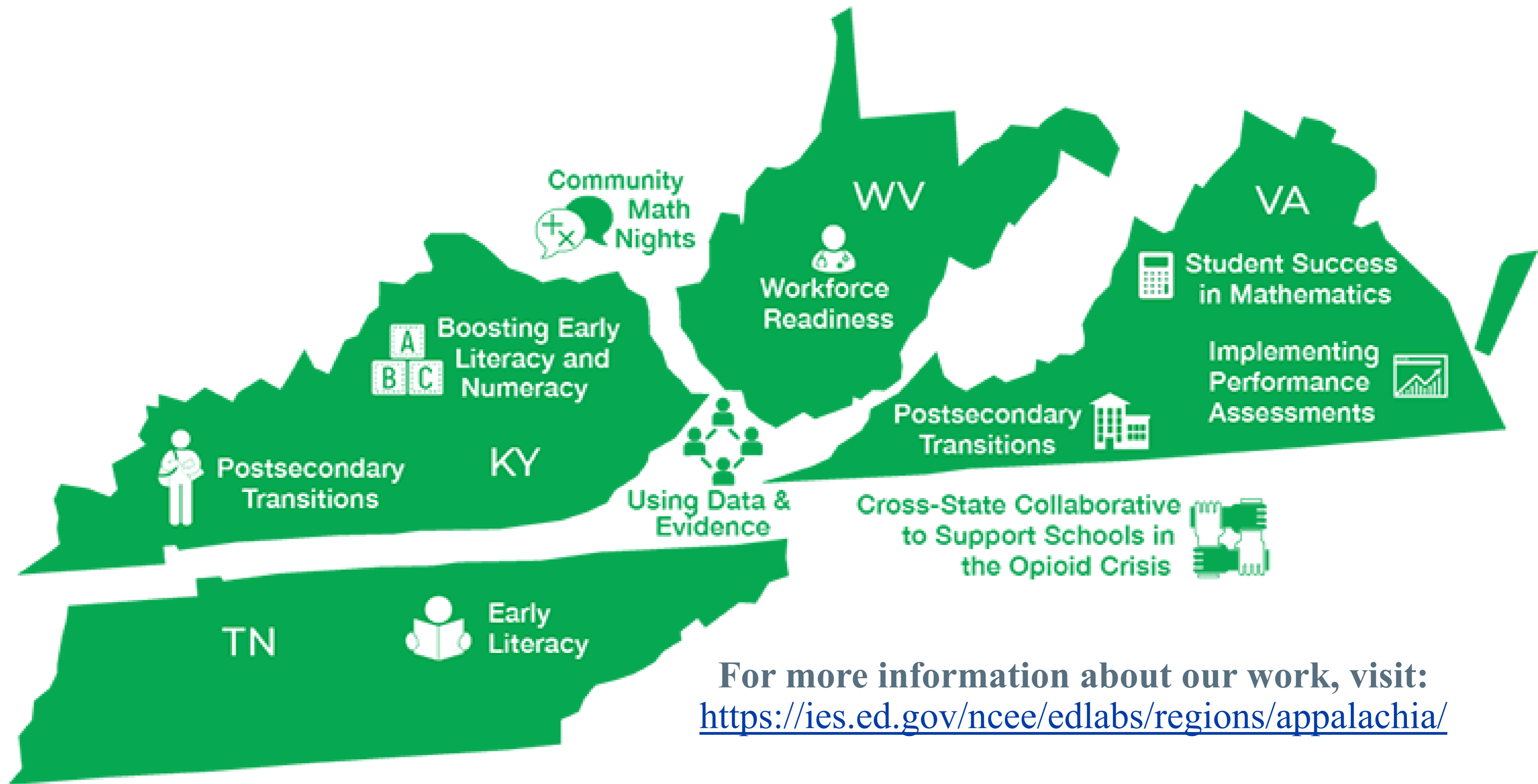
praising effort and modeling positive math attitudes.

encouraging children to seek help and try new strategies when they are stuck.

confronting stereotypes about who is good at math.


 1. Boaler, J. (2015). Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching. San Francisco, CA: John Wiley & Sons.
 2. Claessens, A., & Engel, M. (2013). How important is where you start? Early mathematics knowledge and later school success. *Teachers College Record*, 115(6), 1-29. <http://eric.ed.gov/?id=EJ1020177>
 3. Siegler, R. S., Duncan, G. J., Davis-Kean, J. E., Duckworth, K., Claessens, A., Engel, M., & Chen, M. (2012). Early predictors of high school mathematics achievement. *Psychological Science*, 23(7), 671-677.
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 6. Epstein, J.L. (2001). School, family, and community partnerships [1st ed.]. Boulder, CO: Westview Press.

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For more information about our work, visit:
<https://ies.ed.gov/ncee/edlabs/regions/appalachia/>

Professional Learning Models: Foundation

Overarching session goal

bit.ly/PLMhandouts

The session will increase mathematics teacher leaders' awareness of resources to support the design and implementation of a coherent professional learning model (PLM).



Session objectives

Session attendees will learn how district mathematics leaders and researchers can:

- Form partnerships to improve mathematics teaching and learning.
- Design, implement, and evaluate a cohesive professional learning model (PLM).
- Find evidence-based resources on the REL Appalachia (REL AP) and the What Works Clearinghouse websites.



Form collaborative partnerships

“Relationships are at the heart of effective partnerships. To be successful over the long term, partners need intentional focus on building mutual trust and respect—at the start and throughout. Valuing all stakeholder perspectives ensures the work is truly co-created.”

(Research + Practice Collaboratory, 2015)

Student Success in Mathematics partnership: Problem statement

Not all students have the depth of skills, knowledge, and understandings necessary for success in algebra and higher-level mathematics courses.

In particular, there are gaps in algebra readiness for English learner students, students of color, students with disabilities, and economically disadvantaged students.



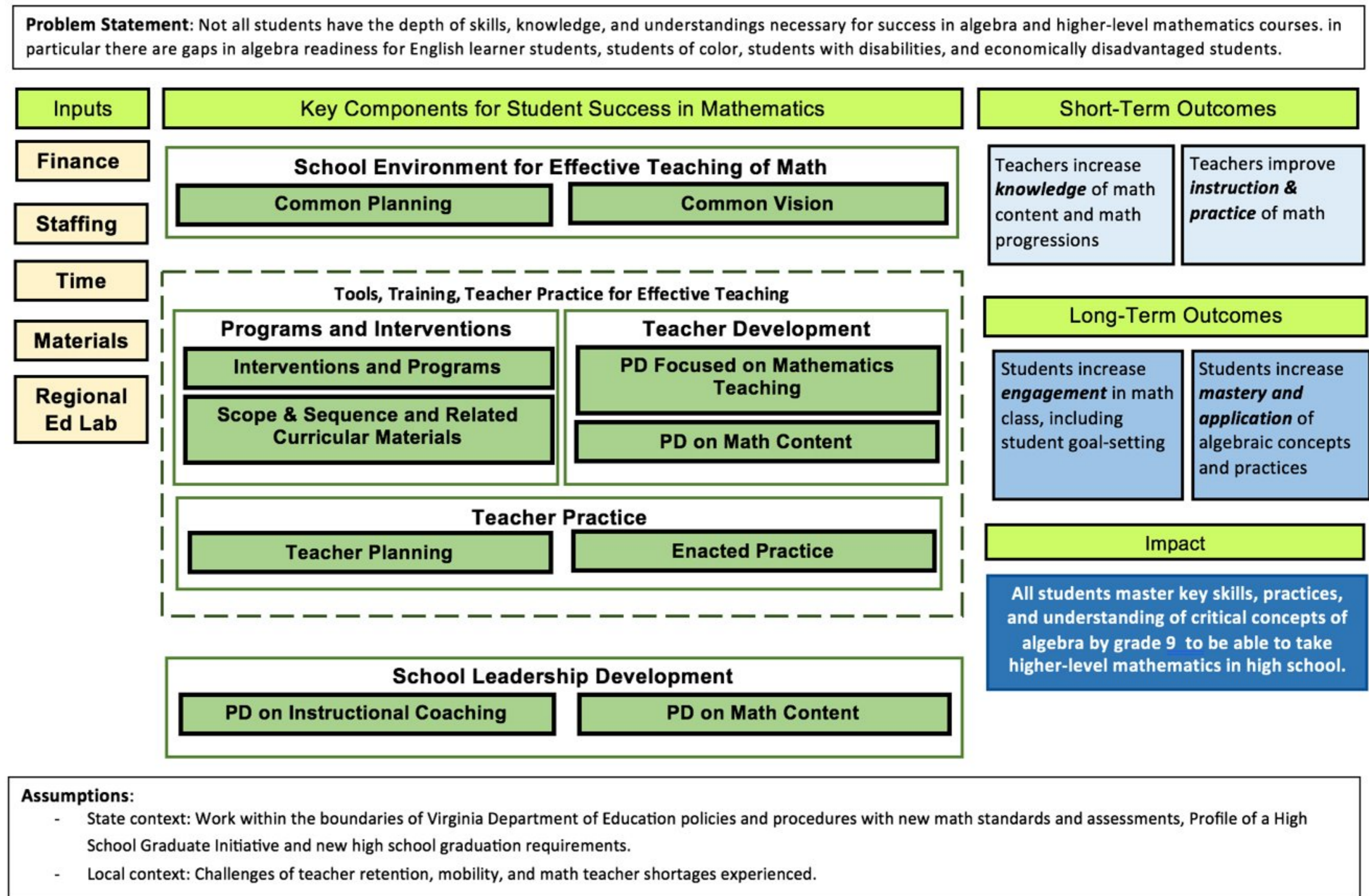
Student Success in Mathematics partnership goal

All students master key skills, practices, and understanding of critical concepts of algebra by grade 9 to be able to take higher-level mathematics in high school.



Partnership logic model

A major area of focus was on teacher professional learning.



Effective mathematics professional learning

What are some essential features of effective professional learning?



Effective teacher professional development

Professional development (PD) has been shown to impact student achievement positively when it:

- Focuses on specific content.
- Incorporates active learning.
- Supports collaboration.
- Uses models of effective practice.
- Provides coaching and expert support.
- Offers feedback and reflection.
- Is of sustained duration.
- Is job-embedded.



Effective
Professional
Development
Strategies

(Bill and Melinda Gates Foundation, 2014; Darling-Hammond et al., 2017)

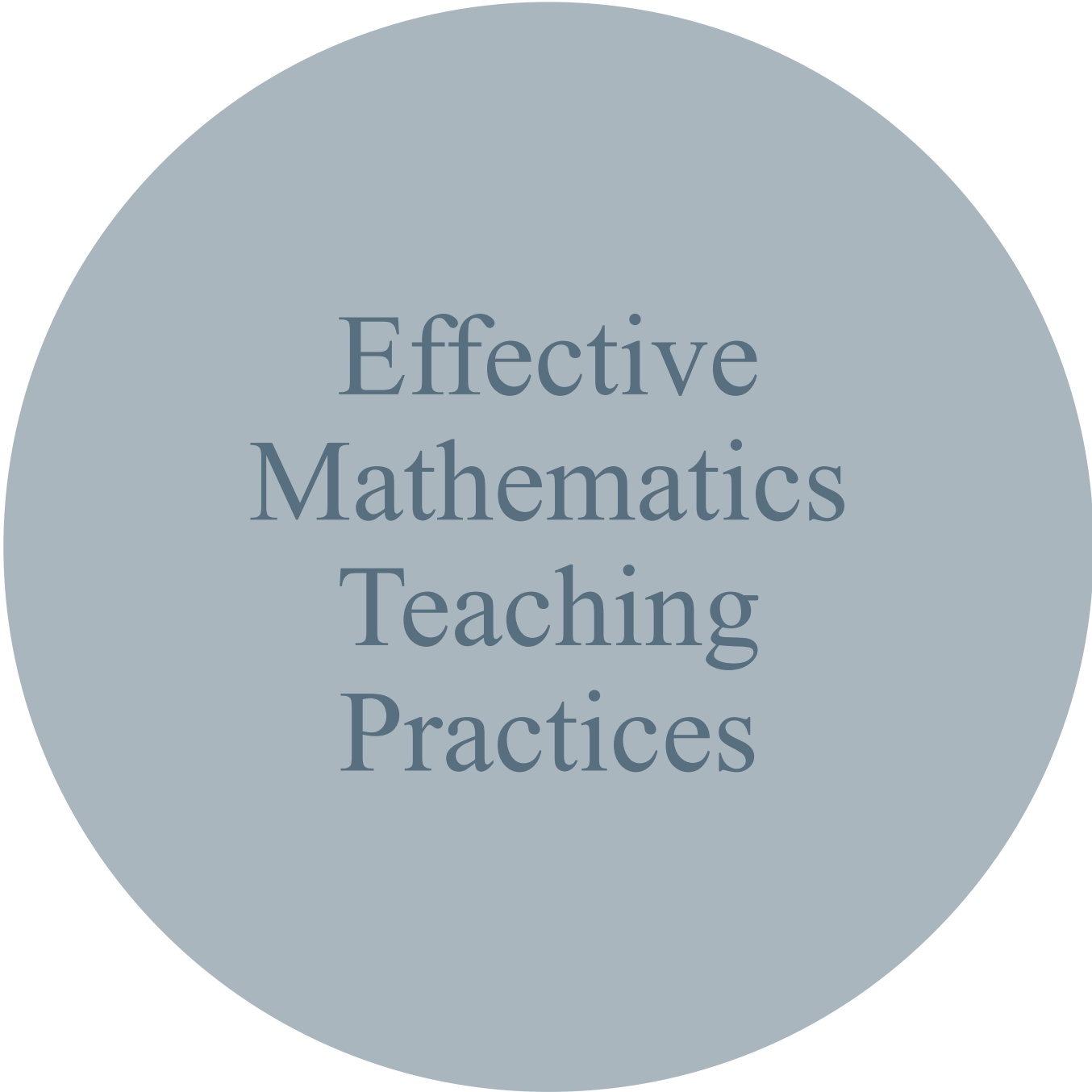
Effective mathematics teaching practices

What research-based, high-leverage mathematics teaching practices are needed to promote deep learning of mathematics in your local school or district?



Effective mathematics teaching practices

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.

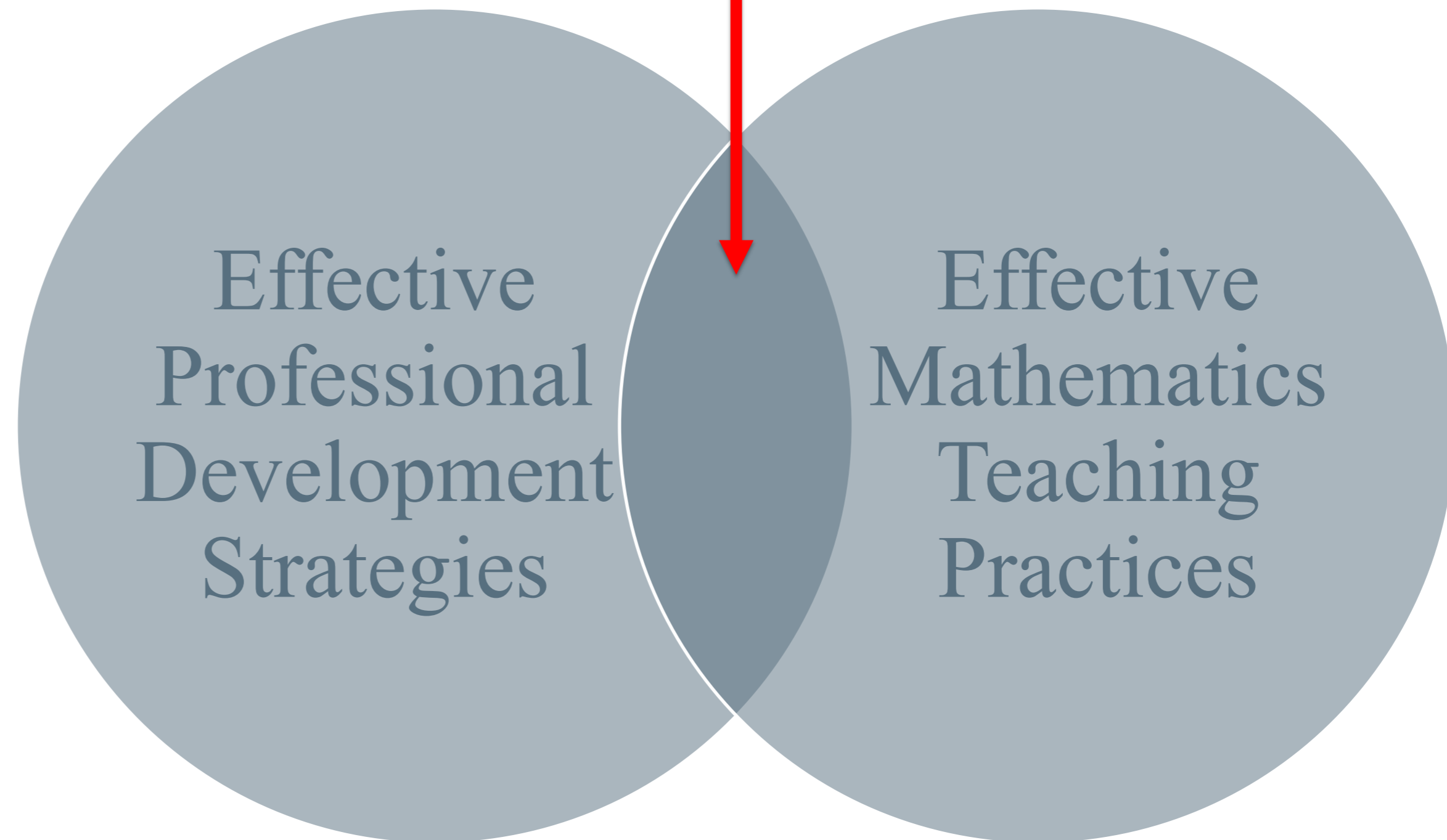


Effective
Mathematics
Teaching
Practices

(National Council of Teachers of Mathematics, 2014)

Research-informed mathematics professional learning

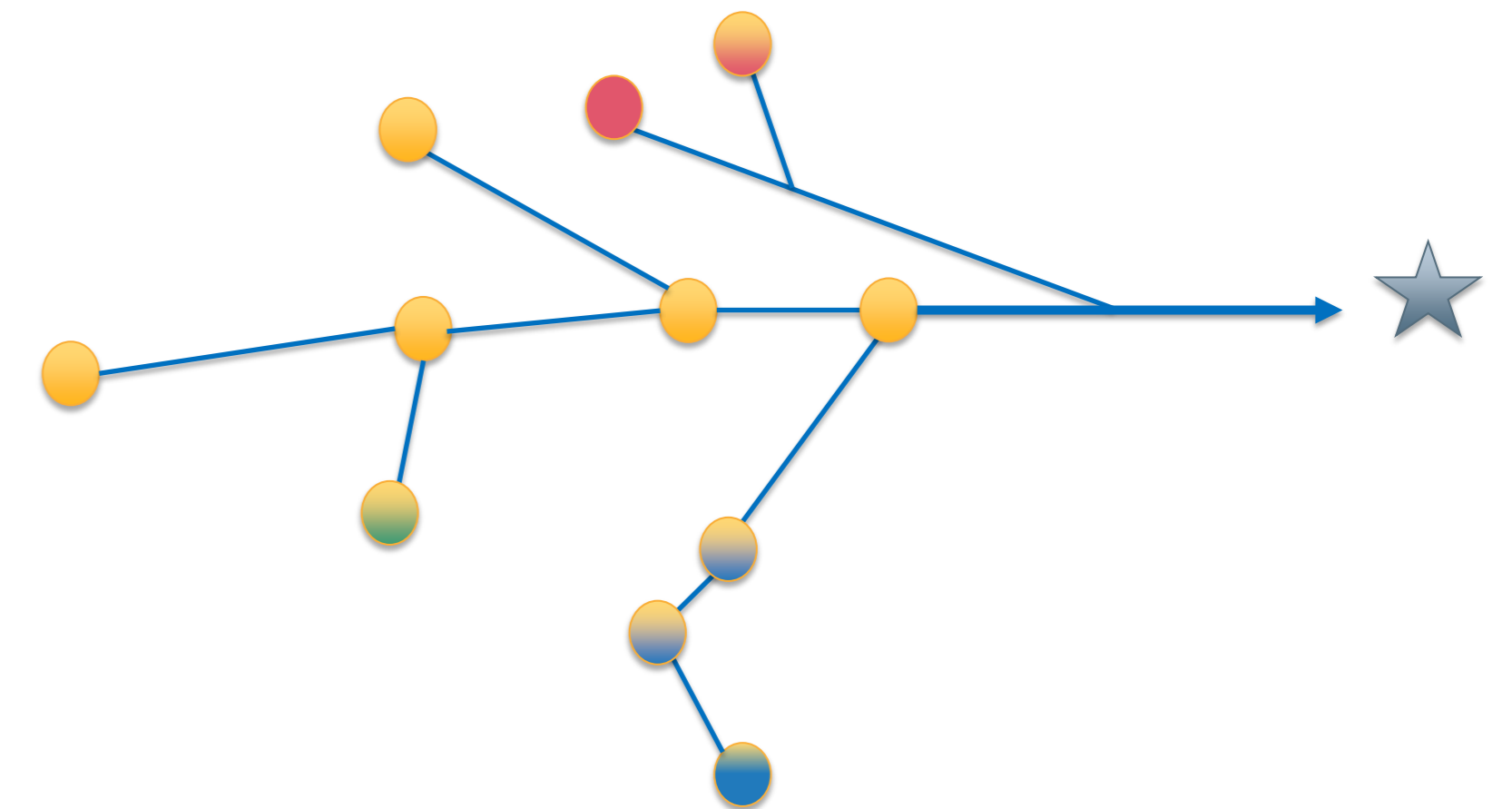
Optimum mathematics professional learning



Professional Learning Models: Key Components

Professional learning models (PLM)

A professional learning model (PLM) is a cohesive system of PD in which educator learning opportunities relate to each other and contribute to the same longer-term set of goals and vision for mathematics teaching and learning.



Professional learning models (PLM)

Planning for effective PD must include:

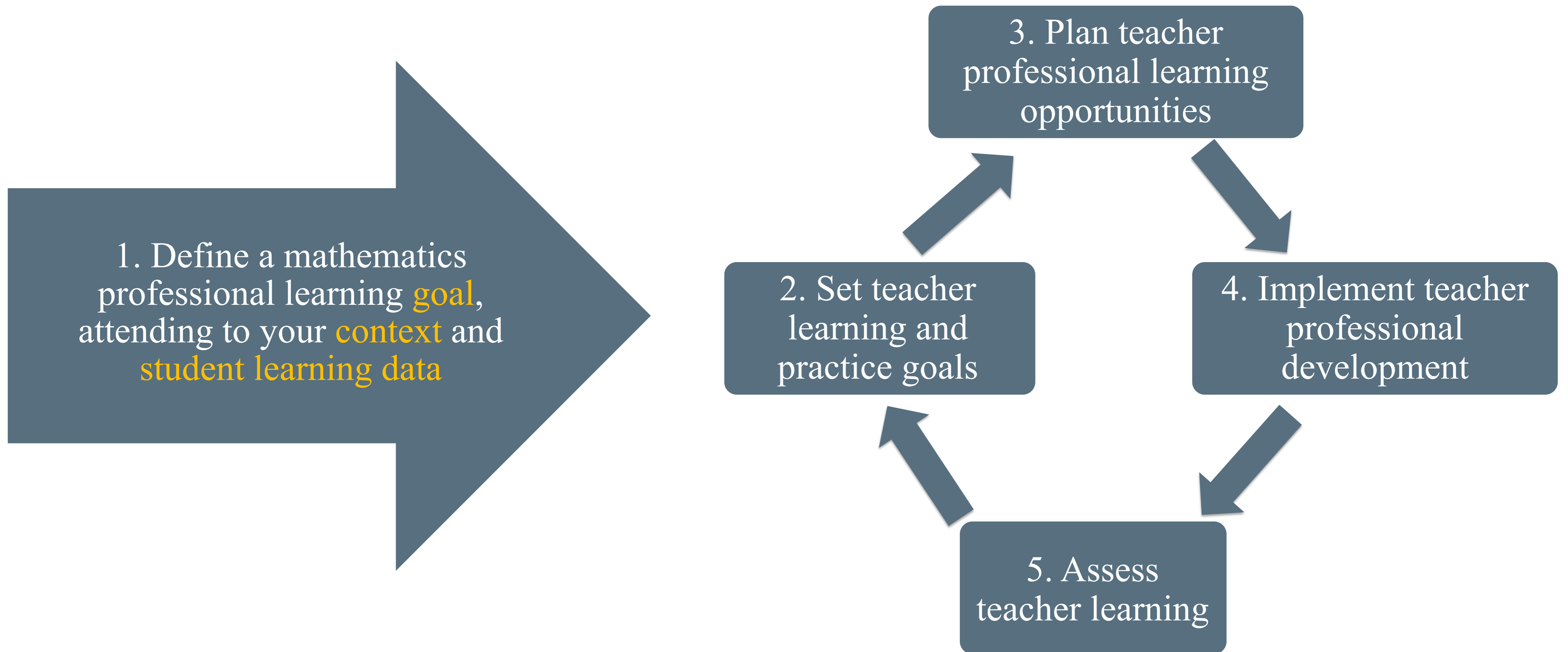
- Aligning PD with a common vision and district-level goals
- Connecting to standards and practices for mathematics teaching and learning
- Considering student data and learning needs
- Taking the school and district context into consideration.



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(Loucks-Horsley et al., 2010)

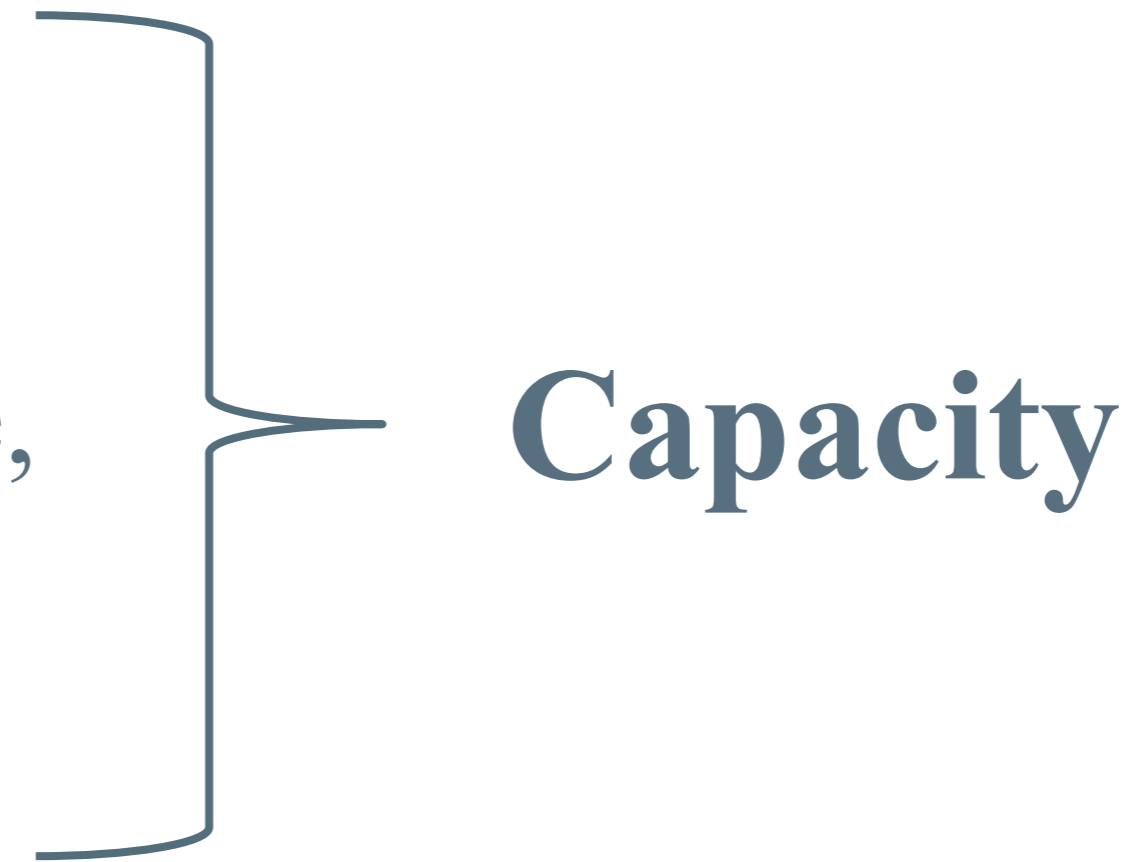
Professional learning models (PLM)



Build capacity around professional learning

To build capacity in your PLM, acknowledge and act on contextual factors within a mathematics professional learning culture by:

- Considering sustainability,
- Setting aside time for professional learning,
- Focusing on content and pedagogical knowledge,
- Covering strategies to address equity, and
- Building a professional learning culture.



(Loucks-Horsley et al., 2010)

Worked example

We will engage in the PLM planning process given the following scenario:

- The district wants to increase mathematics problem-solving across K–12.
- They plan to start in middle school (grades 6-8) where they see students beginning to struggle with complex problems, particularly those involving fractions.
- The teachers recognize the problem but don't have concrete strategies to apply.
- The teachers are relatively tech savvy.
- There is a district mathematics coach who is available to support the PD efforts.

Professional learning model (PLM)

1. Define a mathematics professional learning goal, attending to your context and student learning data

2. Set teacher learning and practice goals

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Handout 1: Professional Learning Model Planning Template

This template can be used to outline and develop a comprehensive plan for mathematics professional learning to support educators in your school division to help ensure that *all students* meet specific learning goals and can be successful in higher-level mathematics.

Part 1		
Division-wide mathematics professional learning goal		
The division will work towards....		
Define how you will integrate attention to one or more of the Guiding Principles for School Mathematics ¹ :	Describe which of the following Effective Mathematics Teaching Practices ² will be in the foreground of this Professional Learning Model Plan:	
<ul style="list-style-type: none"> Teaching and learning Access and equity Curriculum Tools and technology Assessment 	<ul style="list-style-type: none"> Establish mathematics goals to focus learning Implement tasks that promote reasoning and problem solving Use and connect mathematical representations Facilitate meaningful mathematical discourse 	<ul style="list-style-type: none"> Pose purposeful questions Build procedural fluency from conceptual understanding Support productive struggle in learning mathematics Elicit and use evidence of student thinking

¹ National Council of Teachers of Mathematics (NCTM). (2014). *Principles to action: Ensuring mathematical success for all*. NCTM.
² NCTM, 2014.

Implementing a Professional Learning Model to Improve Mathematics Teaching 1

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Part 2

Identify the professional learning strategies, related details, and steps you will take to implement the strategies in your school division.


Professional learning strategies (choose from below)	Grade(s) targeted	Contextual considerations	Technology tools and supports	Documentation and data
<ul style="list-style-type: none"> Examining student work and thinking Demonstration lessons Action research Coaching Mentoring Study groups Workshops or seminars Other 				
Strategy 1:				
3. Plan teacher professional learning opportunities				
Strategy 2:				
4. Implement teacher professional development				
Strategy 3:				
5. Assess teacher learning				

Implementing a Professional Learning Model to Improve Mathematics Teaching 2

Contextual factors influencing professional development

- Teachers
- Materials and instruction
- School culture and logistics
- Professional learning

(Loucks-Horsley et al., 2010)

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Handout 2: Contextual Factors Influencing Professional Development

Many contextual factors influence teacher professional development.¹ Review the four categories of contextual factors—teachers, materials and instruction, school culture and logistics, and professional learning—and the related prompts. Reflect on the factors that influence professional development in your school division and respond to the prompts in the table below. Consider focusing in on one grade span (i.e. PK-5, 6-8, 9-12) as you answer the questions. After working independently, we will share contextual factors influencing professional development across school divisions.

Table 1. Contextual factors influencing professional development

<i>Teachers</i>
1. What do you see as teachers' strengths in mathematics content?
2. What do you see as teachers' pedagogical strengths?
3. What specific barriers have teachers faced when implementing new practices in their classrooms?
4. What positive or negative experiences have teachers had with professional development?

Materials and instruction
1. Are there any issues with curricular materials being available to all teachers?
2. Are there concerns about whether the curricular materials are focused,

¹ Loucks-Horsley, S., Stiles, K.E., Mundry, S., Love, N., & Hewson, P.W. (2010). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: Corwin.

Implementing a Professional Learning Model to Improve Mathematics Teaching: Webinar Series 1

Professional learning model (PLM)

1. Define a mathematics professional learning goal, attending to your context and student learning data

2. Set teacher learning and practice goals

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Part 1

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² NCTM, 2014.

Implementing a Professional Learning Model to Improve Mathematics Teaching 1

Part 2

Identify the professional learning strategies, related details, and steps you will take to implement the strategies in your school division.

Professional learning strategies (choose from below)	Grade(s) targeted	Contextual considerations	Technology tools and supports	Documentation and data
<ul style="list-style-type: none"> Examining student work and thinking Demonstration lessons Action research Coaching Mentoring Study groups Workshops or seminars Other 				
Strategy 1:				
Strategy 2:				
Strategy 3:				

3. Plan teacher professional learning opportunities

4. Implement teacher professional development

5. Assess teacher learning

Implementing a Professional Learning Model to Improve Mathematics Teaching 2

Next: Set teacher learning and practice goals

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.



(National Council of Teachers of Mathematics, 2014)

Strategies for professional learning

Pick a strategy:

- Review the list of selected strategies for professional learning.
- Choose the strategy to support teachers to deepen their knowledge about mathematics problem solving.

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Handout 4: Selected Strategies for Professional Learning

Review the following professional learning strategies from *Designing professional development for teachers of science and mathematics* (Loucks-Horsley et al., 2010)¹ and the critical elements of the strategy. Reflect on the strategies listed: **Do current professional learning opportunities in your division match any of the strategies listed below? Or is there a strategy that you'd be most interested in implementing?**

- Examining student work and thinking. Critical elements include:
 - An experienced content expert guides collaborative experiences.
 - Teachers spend majority of time examining student work.
 - Discussion and examination of student work have a focused goal and purpose.
 - Structured protocols enhance the learning experience.
- Demonstration lessons. Critical elements include:
 - Teachers have available time and structures to meet with other teachers and to observe.
 - Groups of teachers (not individual teachers) observe each other.
 - There is a cycle of pre-discussion, observation, and post discussion.
- Action Research. Critical elements include:
 - Teachers contribute to or formulate their own questions and collect data to answer these questions.
 - Teachers use an action research cycle, specifically identifying a problem and a question, collecting data, analyzing data, and reformulating the problem and question to continue their action research.
 - Teachers have access to sources of knowledge and stimulation from outside their schools.

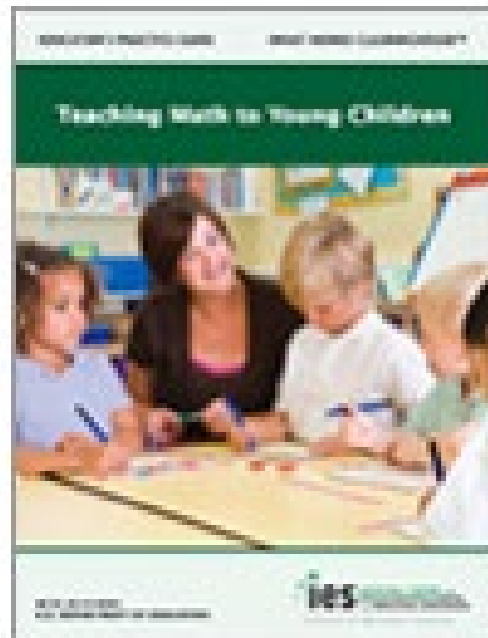
¹ Loucks-Horsley, S., Stiles, K.E., Mundry, S., Love, N., & Hewson, P.W. (2010). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: Corwin.

Implementing a Professional Learning Model to Improve Mathematics Teaching: Webinar Series

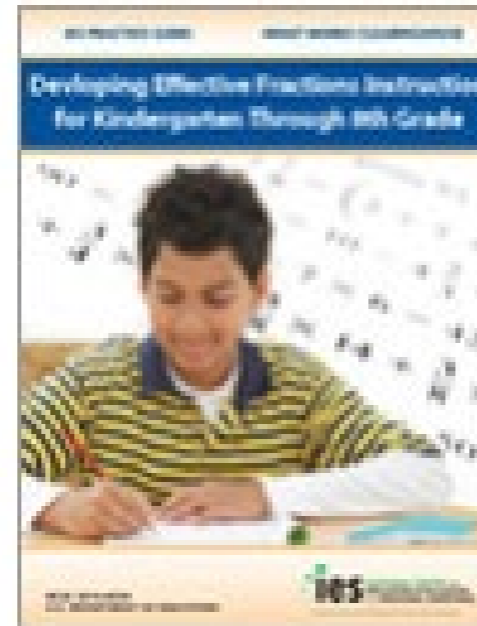
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Professional Learning Models: Integrating Research-Based Approaches

WWC practice guides



Teaching Math to Young Children



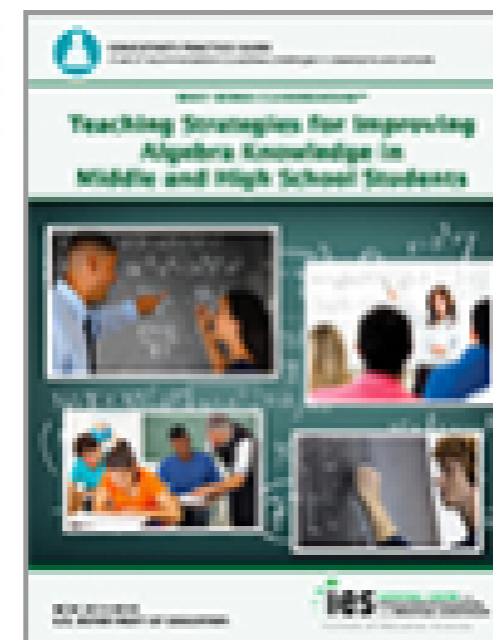
Developing Effective Fractions Instruction for Kindergarten Through 8th Grade



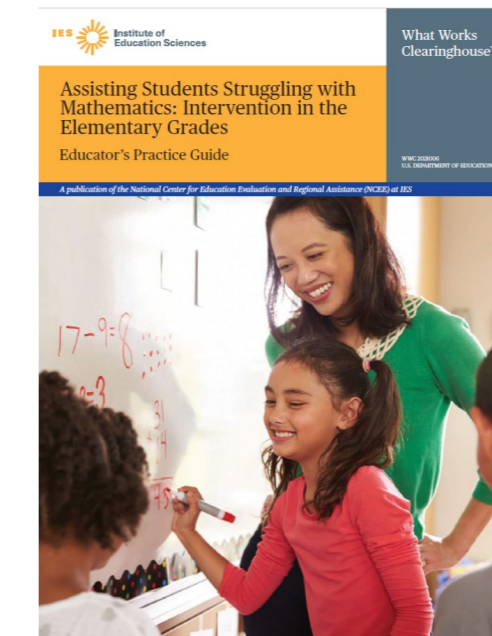
Improving Mathematical Problem Solving in Grades 4 Through 8



Encouraging Girls in Math and Science



Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students



Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades

*** Released March 2021**


ies.ed.gov/ncee/wwc/PracticeGuides

IES problem solving practice guide

- Consider the five recommendations when planning the professional learning.
- Review the instructional tips associated with the practice guide.

EDUCATOR'S PRACTICE GUIDE
WHAT WORKS CLEARINGHOUSE

Improving Mathematical Problem Solving in Grades 4 Through 8




Released: May 2012
(Revised October 2018)

[PDF \(5.8 MB\)](#)


Recommendations
Details
Panel

This practice guide provides five recommendations for improving students' mathematical problem solving in grades 4 through 8. This guide is geared toward teachers, math coaches, other educators, and curriculum developers who want to improve the mathematical problem solving of students.


<p>1 Prepare problems and use them in whole-class instruction.</p> <p><small>MINIMAL EVIDENCE</small></p> <p>Show More</p>	<p>2 Assist students in monitoring and reflecting on the problem-solving process.</p> <p><small>STRONG EVIDENCE</small></p> <p>Show More</p>	<p>3 Teach students how to use visual representations.</p> <p><small>STRONG EVIDENCE</small></p> <p>Show More</p>	<p>4 Expose students to multiple problem-solving strategies.</p> <p><small>MODERATE EVIDENCE</small></p> <p>Show More</p>	<p>5 Help students recognize and articulate mathematical concepts and notation.</p> <p><small>MODERATE EVIDENCE</small></p> <p>Show More</p>
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[Instructional Tips Based on the Educator's Practice Guide \(924 KB\)](#)




[Summary of Evidence for Instructional Tips Based on the Educator's Practice Guide \(560 KB\)](#)



[Additional Resources](#)

Click here for more resources related to this Practice Guide.

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Visualizing Fractions

Proper Fractions

Multiple Models for Proper Fracti...

Multiple Models for Proper Fracti...

Visualize Equivalent Proper Fract...

Improper Fractions

Fractions on a Number Line

Comparing Fractions

Adding Fractions

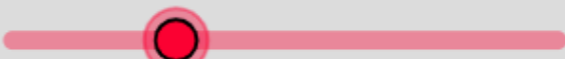
Multiplying Fractions


Dividing Fractions

Multiple Models for Proper Fractions

Author: EDC in Maine

Change

3 

8 

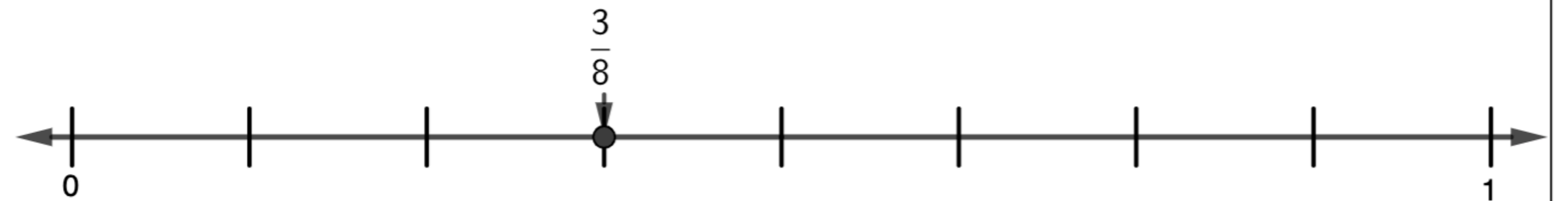
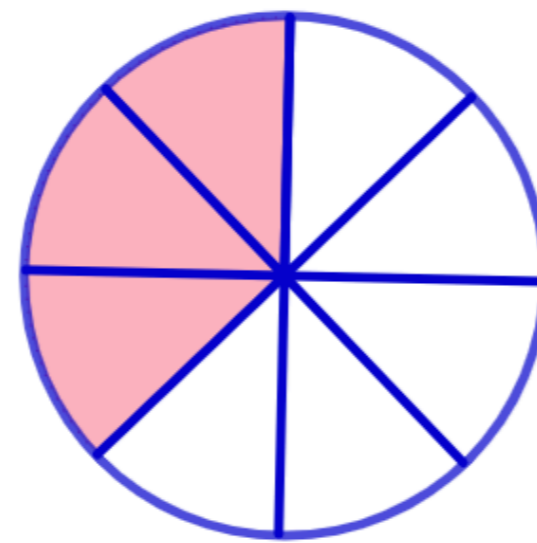
Area models 


Set models

Number line model

Decimal equivalent

Linear models



The interval size for the number line and linear models is: $\frac{1}{8}$ 

Practice planning to enact a practice guide recommendation

Choose a recommendation from the practice guide.

How would you design professional learning to enact the recommendation in the example district?

- What professional learning strategy would you choose and what steps would need to be taken to implement it?
- What grade(s) would you target?
- What are the current contextual considerations, and what technology tools or supports could be used?
- What data could be collected to determine if the professional learning was successful? How would you collect the data?

Share your thinking.

Part 2					
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<ul style="list-style-type: none"> • Examining student work and thinking • Coaching • Mentoring • Study groups • Demonstration lessons • Workshops or seminars • Action research • Other 					
Strategy 1:					
Strategy 2:					
Strategy 3:					

Professional Learning Model (PLM)

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(NCTM, 2014)

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Strategy 1:

3. Plan teacher professional learning opportunities

Strategy 2:

4. Implement teacher professional development

Strategy 3:

5. Assess teacher learning

(National Council of Teachers of Mathematics, 2014)

Professional learning that increases educator effectiveness and results for all students uses a variety of sources and types of student, educator, and system data to plan, assess, and evaluate professional learning.



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(Guskey, 2016, p. 33)

Levels of assessment for professional learning activities



Level 1: Participants' reaction

Level 2: Participants' learning

Level 3: Organization support and change

Level 4: Participants' use of new knowledge and skills

Level 5: Student learning outcomes

(Guskey, 2016; Loucks-Horsley et al., 2010; National Council of Teachers of Mathematics, 2014)

Closing

Thank you!



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tinyurl.com/subscribe-REL-AP



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[@REL_Appalachia](https://twitter.com/REL_Appalachia)



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Dr. Laura Kassner laura.kassner@sri.com

Anna Chiang anna.chiang@sri.com

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- National Council of Teachers of Mathematics.(NCTM). (2014). *Principles to action: Ensuring mathematical success for all*. NCTM.