



Student Success in Mathematics Partnership

Resource Collection

Regional Educational Laboratory Appalachia at SRI International

November 2021

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These materials were prepared under Contract No. ED-IES-17-C-0004 by the Regional Educational Laboratory Appalachia, administered by SRI International. The content does not necessarily reflect the views or policies of IES or the U.S. Department of Education, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

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Buffington, P., DePiper, J. N., Yamaguchi, R., Kassner, L., & Chiang, A. (2021). *Regional Educational Laboratory Appalachia: Student Success in Mathematics Partnership Resource Collection*. Regional Educational Laboratory Appalachia at SRI International.

https://ies.ed.gov/ncee/edlabs/regions/appalachia/events/materials/SSMP-resource-collection_acc.pdf

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Student Success in Mathematics Partnership Resource Collection Overview

From 2017 to 2021, the Regional Educational Laboratory (REL) Appalachia and leaders from five Virginia school divisions joined together in the Student Success in Mathematics (SSM) partnership to improve mathematics instruction and student academic achievement. Specifically, the partnership sought to ensure that all Virginia students master algebraic concepts no later than grade 9 and that teachers use evidence-based mathematics instruction, particularly to support students struggling in mathematics. To achieve these goals, REL Appalachia staff and division leaders carried out a number of research and dissemination projects as well as training, coaching, and technical support activities. SSM partnership members and other school division leaders also learned about and implemented professional learning models (PLMs) and evidence-based instructional practices and applied research results to local policy and practice.

This collection assembles the resources created for and implemented during the SSM partnership. SSM partnership members requested this collection to broaden the reach of their work within and across partner school divisions. SSM partnership members and other educational stakeholders in their school divisions can use these resources to continue improving mathematics teaching and learning and to support student success initiatives.

In creating this collection, partnership members identified specific resources they expect will help to maintain and expand their mathematics teaching and learning improvement efforts in a variety of ways. For example, division leaders and teachers may benefit from using the SSM materials to promote their collective inquiry into multiple aspects of teaching and learning, such as classroom routines, mathematical discussions, problem-solving practices, and teacher knowledge. Superintendents and other mathematics leaders in the SSM partnership divisions can use the resource collection to lead discussions on strengths and needs for mathematics teacher learning and other institutional supports with school boards or specialists who lead teacher professional development. School administrators and mathematics coaches also could use the collection to deepen their knowledge of evidence-based practices and school-level planning.

This collection includes SSM partnership resources on the following three topics:

- Planning and sustaining school division initiatives designed to improve mathematics teaching and learning.
- Implementing evidence-based professional learning experiences to enhance student success in mathematics, using the *Implementing a Professional Learning Model to Support Student Success in Mathematics* resource compendium to support mathematics teachers' ability to deliver high-quality mathematics instruction.
- Building content knowledge, practices, and processes to embed in a division-specific professional learning model, including resources and materials specific to:
 - Building teacher knowledge of research-based instructional strategies,
 - Supporting mathematics coaches,
 - Facilitating progress-monitoring, and
 - Making connections to and learning from research studies and brief readings related to mathematics teaching and learning in middle grades and high school.

Each section in the collection focuses on one of the three topics and provides an overview of how the SSM partnership members used these resources during the five years together. Each section also includes a table detailing available resources, how to use them, and with whom.

Planning and Sustaining School Division Initiatives

In order to plan and implement school division initiatives related to supporting long-term student success in mathematics, the Student Success in Mathematics (SSM) partnership members began by collaboratively developing a logic model. Logic models map relationships among components of a program or partnership and can support system-wide change. Research has found that when school leaders and division administrators use logic models and align initiatives and activities to school-specific factors, such as teacher needs, student data, curricular materials, and school culture, they may be better prepared to plan and sustain initiatives to improve student achievement (Garet et al., 2001; Jensen et al., 2016).

Working together, SSM partnership members created a logic model and identified possible pathways toward desired outcomes while also making explicit the assumptions and rationale behind their efforts. This visual theory of action served as a framework for change and helped mathematics leaders coordinate the partnership activities with other local division efforts. SSM partnership members also worked to uncover what data related to student and teacher mathematics knowledge were available within their divisions and who was collecting those data. Partnership members used the resulting inventory of data, referred to as a data catalog, to help measure the changes in outcomes they sought in their SSM logic model.

School leaders and division administrators can continue to use the SSM logic model and other resources (table 1) to further clarify or update objectives, align strategies, and identify student and teacher learning data. Administrators and school leaders from SSM partnership divisions can use logic models to guide their thinking about relationships among components of a program and to design other programs or policies that are aligned to outcomes of interest. By examining the logic model, educational leaders may be able to determine additional factors that need to be considered to meet the outcomes identified to positively influence improvement. SSM partnership members can also use these resources on logic model development to design new initiatives, to make their plans explicit when pursuing or implementing grants or other funding, and to seek out collaborations with other experts as needed. SSM partnership members can also replicate the process of developing a data catalog to identify data in other content domains. Once

partnership members develop new data catalogs, they can use the data to monitor changes related to school or division initiatives. Table 1 describes the logic model and data catalog resources and how to use them.

Table 1. Resources for planning and sustaining school-division initiatives

Resource	Description	How to use this resource
Logic model for the Student Success in Mathematics partnership	This logic model from REL Appalachia details partnership inputs, key components for student success in mathematics, short-term outcomes, long-term outcomes, and impacts.	Mathematics leaders can use the SSM partnership logic model to inform other mathematics improvement efforts. For example, leaders may want to begin an effort to increase numeracy skills of students in preK–3, and the SSM logic model will provide ideas for components to include. SSM partnership members can consider revising the SSM logic model annually to capture changes in teaching and learning contexts and available resources. This logic model also provides an example for others interested in developing logic models related to school culture, teacher instruction, and student learning outcomes.
Why Build a Logic Model?	This REL Appalachia blog post introduces what a logic model is and provides an overview of its elements. It details the benefits of a logic model and provides examples of logic models.	Division administrators and curriculum leaders can review this blog post to learn more about logic models and their importance. They can use this additional information on logic models as they study progress from the SSM partnership, revise the SSM partnership logic model, or embark on new initiatives.
REL Appalachia Logic Model Training Materials – Part 1	These logic model training materials from REL Appalachia detail the purpose of a logic model and its components as well as provide facilitator and participant resources for developing and using a partnership logic model. See also these related handouts from part 1: <ul style="list-style-type: none"> Early Childhood Workforce Research Alliance Case Narrative Inputs, Strategies, and Outcomes 	Superintendents or curriculum leaders can use the activities from the trainings to guide the design of logic models and the subsequent design of programs or policies within the logic models. Handouts include a blank logic model template , which division administrators or curriculum leaders can use to identify goals, timeline, and major activities associated with an initiative.

Resource	Description	How to use this resource
Develop a Research Agenda Associated with a Logic Model – Part 2	<ul style="list-style-type: none"> • Sample Logic Model from Early Childhood Workforce Research Alliance • Outcomes Development Chart • Strategies and Activities Assessment <p>And handouts from part 2:</p> <ul style="list-style-type: none"> • Student Success in Mathematics Partnership Logic Model • Potential Research Topics • Research Designs • Generating Research Questions 	
Partnership data catalog	<p>A data catalog documents what data are readily available and what data are needed to monitor progress toward stated goals. SSM partnership members created a data catalog to identify systematically collected, available data that corresponded to each component of their partnership logic model. The data catalog included the topic, domain, unit of analysis, number of years of available data, and features of the data (such as whether data can be linked to individual students).</p>	<p>Division administrators and curriculum leaders can complete the data catalog template to identify available data and data needed to measure inputs and outcomes listed in the logic model.</p> <p>For example, when SSM partnership members reviewed their data catalog, they noted that their divisions collected limited data on teacher learning. They decided to start collecting data on teacher learning to understand connections between teacher professional development opportunities and changes in classroom instruction or student outcomes.</p>

Implementing a Professional Learning Model

Teacher professional development has been shown to be positively associated with student achievement when it is content-focused, incorporates active learning, supports collaboration, is conducted in job-embedded contexts, uses models and modeling of effective teaching practice, and provides coaching and expert support (Darling-Hammond et al., 2017). A professional learning model (PLM) is a set of teacher professional development activities designed to support teachers' learning of effective teaching practices. A PLM in mathematics is a set of evidence-based professional development experiences for elementary and secondary mathematics educators that are aligned with both their needs and an overarching instructional goal. Over the course of the SSM partnership, partnership members engaged in coaching activities, trainings, and meetings to enhance their capacity to design and implement a cohesive PLM designed to increase mathematics teachers' ability to deliver high-quality mathematics instruction and support student achievement and success. The partnership members understood that without systematic coordination of professional learning opportunities, teacher professional development may not meet educator needs (Jensen et al., 2016) or support student achievement (Darling-Hammond et al., 2017; Loucks-Horsley et al., 2010).

The resource compendium, *Implementing a Professional Learning Model to Support Student Success in Mathematics*, provides resources to build the capacity of school and division leaders to design and implement a cohesive PLM (table 2). Individual mathematics teacher leaders, coaches, or curriculum leaders can use it for individual learning or as a training tool for teams of practitioners. The compendium includes two slide decks with talking points, facilitator notes, and references from the webinar series *Implementing a Professional Learning Model to Improve Mathematics Teaching* that can guide training and learning about PLMs. It also includes tables describing what is known from research and practice related to topics from the webinar slide decks; references to the associated slides, handouts, and resources on those topics; and questions to be used for individual reflection or group discussion. The compendium closes with reflections from practitioners who have implemented a PLM and an appendix with five handouts associated with the webinar series.

Table 2. Resources for implementing a professional learning model

Resource	Description	How to use the resource
Implementing a Professional Learning Model to Improve Mathematics Teaching Webinar Series	<p>The materials from this two-part webinar series includes PDF versions of each slide deck, five handouts to support the development and implementation of a PLM, and recordings of each webinar on the Institute of Education Sciences (IES) YouTube channel.</p>	<p>Mathematics leaders can download the handouts and use them to develop their own division-level PLM. Mathematics coaches can watch the full recordings for each webinar or just focus on key topics to improve aspects of their practice such as Webinar 1 slides 6–7, which are focused on deepening understanding of the mathematics teaching practices (National Council of Teachers of Mathematics, 2014).</p>
Implementing a Professional Learning Model to Support Student Success in Mathematics: Resource Compendium	<p>The resource compendium extends the two-part webinar series by offering two slide decks with talking points, facilitator notes, and references that can help users lead their own trainings about cohesive models for mathematics professional learning. The compendium also contains a series of tables that present research on key topics from the slides, sample reflection questions for PLM leaders and participants, and additional resources for continued learning.</p>	<p>Division administrators and curriculum leaders can review the background information, resources, and webinar slides and handouts to learn how to implement a professional learning model. Division administrators and curriculum leaders can also respond to reflection questions associated with each topic to help connect the resources to their local contexts.</p>

Building Content Knowledge, Practices, and Processes to Embed in your Professional Learning Model

The REL Appalachia Student Success in Mathematics (SSM) partnership members used the materials, resources, and readings described below to inform and enact the activities in their logic model and division-specific professional learning models (PLMs). The partnership members engaged in a variety of activities, including workshops and coaching sessions, while drawing from applied research and other evidence-based resources, to make progress toward the outcomes detailed in the logic model. For example, participants in the SSM partnership workshops learned about evidence-based strategies and how to implement them in their own classrooms, and mathematics coaches facilitated meetings and individual sessions to share evidence-based practices and to bring together classroom teachers to discuss their instruction as well. SSM partnership members also met with experts in mathematics education from local universities and other research organizations who then led workshops about specific teaching practices. SSM partnership members also reviewed research findings to better understand what was already known about mathematics instruction and mathematics coursetaking pathways.

Materials to support research-based algebra readiness instructional strategies

After SSM partnership members identified their need related to instructional strategies to improve algebra readiness, REL Appalachia staff coordinated workshops and provided resources focused on instructional strategies related to upper elementary and middle grades algebra readiness (see table 3).

SSM partnership members can use these materials to support teachers new to the school division or other teachers who have not yet participated in workshops on algebra readiness. Mathematics curriculum leaders or outside content experts can use these resources with educators to continue their learning and encourage their use of these classroom strategies. Mathematics curriculum leaders can also share these materials during in-person or virtual workshops, where educators could learn as a group and deepen their understanding of classroom

strategies and the underlying research base. Leaders can encourage collaboration and develop participants’ shared understandings of strategies and principles related to evidence-based instructional strategies.

Table 3. Resources related to research-based algebra readiness instructional strategies

Resource	Description	How to use the resource
Preparing All Students for Algebra: Applying Research-Based Strategies	This event focused on why algebra readiness in upper elementary and middle school matters for students’ success in subsequent mathematics coursework. During this event, facilitators shared specific strategies for teachers to use to support struggling learners and students who are English learners.	Mathematics coaches can review the slide deck to learn about the importance of algebra readiness, and they can facilitate teacher learning opportunities using the slides and the handouts linked on the event page. The handouts include mathematics tasks with embedded language-support strategies, problem-solving scaffolds, and a card-sort activity to share the research literature on algebra readiness and strategies. Teachers can use these handouts in their own classroom and share them with colleagues.
Algebra for All: Focus on Visual Representations	This recorded webinar presents research-based strategies that support all learners in preparation for Algebra I, including students who are English learners and students who are struggling with math. Presenters focused on the use of visual representations to support math content learning, such as understanding algebraic relationships, and highlight recommendations from IES practice guides.	Mathematics coaches can review the recorded webinar and use the resources and presentation slides to facilitate similar workshops. Teachers can also review the resources and tasks independently. Teachers can use the sample tasks described in the webinar to practice implementing research-based strategies related to using visual representations to teach proportional reasoning.

Instructional resources to support mathematics coaches

Mathematics instructional coaches in the SSM partnership divisions facilitated individual or group learning sessions to introduce evidence-based instructional strategies to classroom teachers. The coaches encouraged teachers to implement the strategies in their instruction and reflect on how the strategies could meet their students’ needs. To support teacher learning and facilitate additional teacher learning opportunities, coaches must be prepared with in-depth

content knowledge and expertise in meeting the needs of adult learners as well as be able to build a climate of trust and collegiality (Loucks-Horsley et al., 2010); table 4 presents resources that mathematics instructional coaches in SSM partnership can use to facilitate continued improvements in mathematics teaching and learning.

Table 4. Resources for facilitating mathematics coaching sessions

Resource	Description	How to use this resource
What Works Clearinghouse (WWC) practice guides	<p>The What Works Clearinghouse (WWC) practice guides, hosted on the WWC website and made available by the Institute of Education Sciences (IES) of the U.S. Department of Education, provide recommendations for educators based on in-depth reviews of research, the experiences of practitioners, and national experts.</p> <p>Two practice guides present research related to specific mathematics teaching practices and detail how to make the practices ready for classroom use. The <i>Improving Mathematical Problem Solving in Grades 4 Through 8</i> practice guide (Woodward et al., 2012) details five recommendations related to supporting student problem solving and describes about how to carry out each recommendation, complete with example problems and approaches. The <i>Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students</i> practice guide (Star et al., 2015) focuses on improving the algebraic reasoning and knowledge of middle grades and high school students.</p>	<p>To support teacher instructional practices related to problem solving, mathematics curriculum leaders, coaches, or professional development leaders can facilitate discussions with teachers on the Improving Mathematical Problem Solving in Grades 4 Through 8 practice guide (Woodward et al., 2012). Individually or as a group, mathematics teachers can review the instructional tips that translate the practice guide recommendations into classroom approaches.</p> <p>To focus on instructional strategies and research related to teaching and learning of algebra, mathematics curriculum leaders, coaches, or professional development leaders can lead educators through a review of the Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students practice guide (Star et al., 2015) and share a video that provides an overview of practice guide.</p> <p>All the practice guides describe potential roadblocks and solutions; professional development facilitators can incorporate the potential roadblocks and solutions into teacher learning activities and discussions.</p>
Professional Learning Community: Improving Mathematical Problem Solving for	<p>Professional learning communities (PLC) are regular group meetings of educators where educators share expertise and work collaboratively to improve teaching skills and the academic performance of students. Teachers' participation in strong learning</p>	<p>PLCs lead to stronger teacher learning when there are structures that support the PLC meetings and processes (Loucks-Horsley et al., 2010). To support teacher learning in the SSM school divisions, mathematics curriculum leaders can review the facilitator's guide for resources</p>

Resource	Description	How to use this resource
<p>Students in Grades 4 Through 8 Facilitator’s Guide</p>	<p>communities, ones that support collegial learning, have been shown to increase equitable student learning opportunities (Bannister, 2015; Horn, 2005).</p> <p>The REL Southeast <i>Professional Learning Community: Improving Mathematical Problem Solving for Students in Grades 4 Through 8 Facilitator’s Guide</i> (Schumacher et al., 2019) provides resources for leading a PLC based on the <i>Improving Mathematical Problem Solving in Grades 4 Through 8</i> practice guide (Woodward et al., 2012). The materials provide structures and templates for teachers to use in their PLC to compare student solutions, examine tasks, and prepare for instruction. Professional development that attends to mathematics content, teacher professional learning strategies, and students’ solutions is associated with greater learning gains for students and teachers than professional development that is focused solely on content (Jacobs et al., 2007).</p>	<p>for PLCs and share them with teachers. The guide provides a template for meetings and examples of how to apply the information and recommendations from the Improving Mathematical Problem Solving in Grades 4 Through 8 practice guide (Woodward et al., 2012). Teachers can use the accompanying activities to support their learning both during and after a PLC meeting.</p>
<p>Student Success in Mathematics partnership meeting focused on struggling learners</p>	<p>Teachers can benefit from learning about evidence-based practices specifically for teaching mathematics to students with disabilities. Research supports approaches that emphasize these students’ strengths rather than their deficits and that facilitate student learning and engagement in rigorous mathematics tasks. These REL Appalachia meeting materials include handouts and slides focused on equity by improving mathematics instruction for students with disabilities.</p>	<p>Mathematics curriculum leaders and coaches can use the full set of meeting materials to lead workshops or meetings to support teachers new to teaching students with mathematics disabilities. Coaches can also help teachers use the Mathematics Accessibility Planner that was described in the meeting materials to consider the goals and demands for their mathematics tasks and how to align accessibility to strategies to students’ strengths and needs.</p>

Materials to support data use in mathematics instruction and teacher professional development

As part of their PLMs, administrators and mathematics curriculum leaders in the SSM partnership divisions monitored and analyzed local data to better understand teacher and student learning as well as student coursetaking pathways. They also followed a continuous improvement cycle when revising their PLMs. Table 5 includes resources on the continuous improvement approach and how to conduct analyses related to student coursetaking pathways. To continue to improve mathematics teaching and learning and investigate student coursetaking and related outcomes, SSM partnership members can conduct a number of local analyses each year using the “how-to” analysis memo and template. They can apply strategies for monitoring progress to better understand teacher and student change and modify their protocols to collect data related to student outcomes. For example, during the SSM partnership, school division leaders carried out their own small-scale research on student placement into mathematics courses in middle school, and their subsequent outcomes including pass rates, later courses taken, and high school graduation.

Table 5. Resources to support monitoring progress of professional development and student and teacher learning

Resource	Description	How to use this resource
A Continuous Improvement Approach to Mathematics Professional Learning Models	A continuous improvement approach seeks to increase the effectiveness or efficiency of a system by making small-scale changes that are repeatedly evaluated. This memo describes using a continuous improvement approach to design, test, and analyze mathematics professional learning in a local context. It also details lessons learned about implementing this approach and considerations for future use.	SSM partnership members and other division administrators can review the memo to learn more about applying the continuous improvement approach to mathematics teacher learning as well as to reflect on lessons learned about committing time to planning, refining professional development plans, and collecting and using data. These lessons learned are relevant to both long- and short-term planning for teacher professional development, and SSM partnership members may find the lessons useful as they design and facilitate subsequent mathematics teacher learning opportunities.

Resource	Description	How to use this resource
“How-to” analysis memo: A review of high school mathematics coursetaking pathways among students who completed Algebra I in grade 7	This analysis memo provides step-by-step instructions for analyzing local data, specifically outlining the steps to answer the following questions among students who completed Algebra I in grade 7: (1) When did they complete their highest-level mathematics course, and (2) How did they perform on the geometry and Algebra II assessments?	<p>The analysis memo provides a guide to using school-level data related to coursetaking pathways. Database managers and analysts in SSM divisions can use the accompanying Excel template to enter data related to the student outcomes. The template automatically creates bar graphs from the data.</p> <p>With information produced from the “how-to” memo, database managers and analysts can support school division leaders and mathematics content experts to use data to inform and improve decisions about policy and practice related to mathematics coursetaking pathways.</p>

Research studies related to mathematics teaching and learning in middle grades and high school

Existing research can help education leaders learn from others, as the SSM partnership members did during the 2017–2022 REL Appalachia cycle. Table 6 presents selected applied research reports from across the REL program related to mathematics teaching and learning in middle grades and high school, studies that SSM partnership members referenced when planning and promoting changes to policies and practices.

Moving forward, division administrators and mathematics curriculum leaders as well as other educators who oversee mathematics teaching and learning can use empirical evidence in their work to select, design, and evaluate instructional programs, interventions, and other school- or division-level programming or procedures. Throughout the continuous improvement process, division leaders may identify research questions that can guide future studies; for example, the SSM partnership members were interested in understanding more about the coursetaking pathways of students who took Algebra 1 in Grade 7. As division leaders identify these research questions, they may decide to conduct small- or large-scale analyses, depending on the need, resources, and available data. Depending on the nature of the research questions, division leaders

may consider partnering with local universities and other research experts to carry out larger-scale research projects.

Table 6. Applied REL research reports related to mathematics teaching and learning

Reports	Abstract from Reports	How to use this report
Algebra I and College Preparatory Diploma Outcomes among Virginia Students Who Completed Algebra I in Grades 7–9	<p>“Education leaders in Virginia use early access to Algebra I as one method to provide students more time to take college preparatory courses in high school, thereby increasing students’ likelihood of graduating prepared for college and careers. Yet, little data are available for these leaders to examine whether their approach is warranted. Members of the Regional Educational Laboratory Appalachia Student Success in Mathematics partnership are interested in learning more about students who complete Algebra I in grades 7–9 and their outcomes. This study examined whether these students passed the Algebra I state assessment and whether they earned a college preparatory diploma. The study used administrative data to calculate descriptive statistics for one cohort of Virginia grade 5 students who completed Algebra I in grades 7–9. The results for the overall study population are presented by students’ proficiency level on the grade 5 math state assessment and disaggregated for economically disadvantaged students and English learner students.”</p>	<p>Division administrators can review the full report as well as the related infographic to understand more about relationships among student coursetaking pathways, demographics, and college preparatory diploma outcomes. Administrators can use the detailed analyses here to prompt conversations about local policies and practices related to student placement on mathematics coursetaking pathways and about mathematics instructional practices in courses before and after the Algebra 1 course.</p> <p>A blog post about this study provides an overview of the findings and how they can be used by school divisions; division administrators can share this with school leadership and school board members as they consider any changes to policy and practices related to coursetaking pathways.</p>
Math Course Sequences in Grades 6–11 and Math Achievement in Mississippi	<p>“Fewer than one in five grade 11 students in Mississippi are ready for college math, even though state high school graduation requirements include Algebra I and three additional math credits. Because the requirements do not specify what math courses must be taken to fulfill the additional three credits, students generally select from a list of approved courses, which raises the need to understand the extent to which math course sequences are related to college ready performance on the ACT. This study examined the sequences of math courses that Mississippi students who started grade 6 in</p>	<p>The report snapshot and the full report share the key findings on mathematics course sequences and the important role of upper-elementary mathematics achievement. Division administrators and mathematics curriculum leaders can review these findings and consider the implications for their own schools and divisions. As the findings emphasize the importance of elementary mathematics achievement, mathematics curriculum leaders and coaches can use this report to begin</p>

Reports	Abstract from Reports	How to use this report
	<p>2011/12 took in grades 6–11; the math achievement and demographic characteristics of students who took similar math sequences; and how math sequences, prior math achievement, and student demographic characteristics relate to college readiness in math.”</p>	<p>conversations about elementary mathematics achievement locally and encourage attention to elementary mathematics instruction and targeted professional learning opportunities.</p>
<p>Using Assessment Data to Guide Math Course Placement of California Middle School Students</p>	<p>“Are there effective ways to identify which students will be most likely to succeed in Algebra I in grade 8? This study finds that using results from the Mathematics Diagnostic Testing Project’s grade 7 test of algebra readiness can improve the probability of selecting students for Algebra I in grade 8 who will successfully complete the course. Depending on the assessment and the type of score used, the prediction accuracy of student placement decisions ranges from 69 percent to 78 percent.”</p>	<p>Division administrators and mathematics curriculum leaders can review the full report to learn more about evidence-based practices for student placement in Algebra 1 and consider how the implications relate to their current school and division contexts.</p>
<p>What Grade 7 Foundational Knowledge and Skills Are Associated with Missouri Students’ Algebra I Achievement in Grade 8?</p>	<p>“To increase opportunities for students to take more advanced math courses in high school, many school divisions enroll grade 8 students in Algebra I, a gateway course for advanced math. But students who take Algebra I in grade 8 and skip other math courses, such as grade 8 general math, might miss opportunities to develop the foundational knowledge and skills required for success in advanced math courses. This leaves educators to determine which students are ready for Algebra I in grade 8 and which are not. To inform strategies that address this challenge, this study examined whether student knowledge in five math domains in grade 7 was associated with Algebra I achievement in grade 8.”</p>	<p>Division administrators and mathematics curriculum leaders can read the full report to learn more about domains of mathematics knowledge and skills that were associated with Algebra 1 achievement. Mathematics coaches and educators can also read the blog post about this study to learn about the findings and the suggestions about how educators may apply the results of this study in practice.</p>

Research literature summaries

During the 2017–2022 REL cycle, the REL program hosted a collaborative reference desk—Ask A REL—that provided references, referrals, and brief responses in the form of citations in response to questions about available education research. SSM partnership members as well as

other stakeholders from across the REL Appalachia region submitted questions related to mathematics teaching and learning that were relevant to the student and teacher outcomes of interest to the SSM partnership. SSM partnership members found that these responses provided valuable research findings and evidence associated with a range of policies and practices. The questions and responses from the Ask A REL service are in table 7.

Division administrators and mathematics curriculum leaders can use these references to explore instructional strategies and polices to support student success. They can use the responses in their planning and implementation of professional learning, and they may also find that these questions and responses prompt additional analysis and inquiry.

Table 7. Examples of REL Appalachia Ask A REL questions and responses

Ask A REL question	Link
What does the research say about professional learning models and opportunities that equip teachers to promote early math skills, particularly early numeracy, for students in PreK through grade 3?	Response
What type of mathematical skills and knowledge predict success in Algebra I? What does the research say about strategies or interventions to improve algebra readiness (particularly in middle school)?	Response
What is the impact of tracking in mathematics in grades 5–8 on students’ mathematics achievement and future mathematics pathways?	Response
What evidence exists that assessment accommodations for English learners in the subjects of reading and math (a) are appropriate and effective for meeting individual students’ needs to participate in the assessments, (b) do not alter the constructs being assessed, and (c) allow for meaningful interpretations of results and comparison of scores for students who need and receive accommodations and students who do not need and do not receive accommodations?	Response
What are the outcomes for students who take Algebra I in grades 5, 6, 7, or 8 compared with students who take Algebra I in grade 9 or later?	Response

Brief readings and infographics

A wealth of research supports increased outreach to community members and other educational stakeholders to broaden mathematics instructional practices and shift attention to include more equitable learning opportunities for all students. Table 8 outlines REL Appalachia

blog posts and infographics that share the importance of algebraic reasoning, prompt conversations on equity in mathematics education, and encourage attention to mathematics pathways. SSM partnership members shared the readings and infographics with other mathematics curriculum leaders, educators, and school committee members to indicate their activities and what was learned.

Mathematics curriculum leaders and coaches can use these readings and infographics to provide others with background knowledge on particular mathematics principles and activities. SSM partnership members can also share the readings and infographics with school committees to present research on outcomes of students who complete Algebra I in grades 7–9 and ways to support children in achieving success in mathematics during elementary and middle grades.

Table 8. Brief readings and infographics on particular mathematics teaching and learning principles and strategies

Title	Description	How to use this resource
Algebra for All! Preparing Students for Success (blog post)	This blog post provides an overview of the importance of algebra readiness and highlights several evidence-based strategies to support students who are English learners. The post also describes and links to the activities in the Algebra for All webinar listed in table 4.	Mathematics coaches and educators can read the blog post for an overview of the materials; the blog post also links to the activities from the webinar, and both coaches and educators can review the activities together. Division administrators and mathematics curriculum leaders can read this post to learn more about specific instructional practices to prepare all students for success, particularly for students who are English learners.
Mathematics Instruction with an Equity Lens (blog post)	This blog post explores various ways to provide high-quality, evidence-based mathematics instruction with an equity lens, and it provides examples of how to promote conversations about equity in mathematics education.	Mathematics coaches and educators can review this blog post for specific practices that promote mathematics instruction with an equity lens. Mathematics coaches or mathematics curriculum leaders can also facilitate educator reflections using the included questions: <ul style="list-style-type: none"> • What is the range of ways that students can and do participate in the mathematical work of the class (including talking, writing, leaning in, listening hard, manipulating symbols, making diagrams, interpreting text, using manipulatives, connecting different ideas)? Which students participate in which ways? And when?

Title	Description	How to use this resource
<p>Shining a Light on Algebra I Access and Success: Embracing Equity at All Levels (blog post)</p>	<p>This blog post provides an overview of the research findings related to the students who complete Algebra I in grades 7–9 and their outcomes as well. The blog post also links to the full study, Algebra I and College Preparatory Diploma Outcomes among Virginia Students Who Completed Algebra I in Grades 7–9</p>	<ul style="list-style-type: none"> • What opportunities do various students have to make meaningful mathematical contributions? What teacher actions might expand students’ access to meaningful participation? • How are norms, interactions, lesson structures, task structure, and particular resources facilitating or inhibiting participation for particular students? <p>Division administrators and mathematics curriculum leaders can read this blog post to prompt further discussion of the research findings related to the students who complete Algebra I in grades 7–9 and their outcomes; in particular, reviewing the findings may prompt further investigations into Algebra 1 coursetaking patterns and student outcomes. Division administrators and mathematics curriculum leaders can also review the suggestions on how educational stakeholders—from teachers to division leaders to state policy leaders—can play a role in addressing equity and access to ensure student success.</p>
<p>Professional Learning Models to Support Student Success in Mathematics (blog post)</p>	<p>This blog post describes the importance of professional learning models and how to develop them. A professional learning model (PLM) in mathematics is a set of evidence-based professional learning experiences for elementary and secondary mathematics educators that are aligned with both their needs and an overarching instructional goal and will enhance their ability to deliver high-quality mathematics instruction to support student achievement and success.</p>	<p>Division administrators and mathematics curriculum leaders can learn more about the strategies that make up effective PD, evidence-based mathematics teaching practices, and how to connect them to support teacher learning. Through deepening their understandings of the PLM process, division administrators, mathematics curriculum leaders, and mathematics coaches can more readily relate teacher learning opportunities in service to teacher and student outcomes.</p>
<p>Examining educational inequities: How do Algebra I and</p>	<p>This infographic presents research on outcomes of students who complete Algebra I in grades 7–9. It</p>	<p>Division administrators and mathematics curriculum leaders can share this infographic with school board members and other leaders on how student outcomes differ for students who complete</p>

Title	Description	How to use this resource
high school outcomes differ for students who complete Algebra I in grades 7, 8, or 9? (infographic)	highlights inequities in student access to Algebra 1 courses and the role of classroom teachers, school and division education and policy leaders, and state agency and policy leaders in achieving equitable access and success for students in mathematics.	Algebra 1 in grades 7, 8, or 9. It references the full study Algebra I and College Preparatory Diploma Outcomes among Virginia Students Who Completed Algebra I in Grades 7–9 , and division administrators and mathematics curriculum leaders can present the details of the report as well.
Supporting your child in developing math skills for future success (infographic)	This infographic depicts how supporting children in achieving success in mathematics during elementary and middle grades can provide more college and career opportunities.	Educators and mathematics coaches as well as administrators and mathematics curriculum leaders can share this infographic with school boards and community members to outline the importance of student success in earlier grades and how it relates to student outcomes in high school and beyond.

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