Ohio's Plan for K-12 Mathematics

2025

Department of Education & Workforce

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Executive Summary

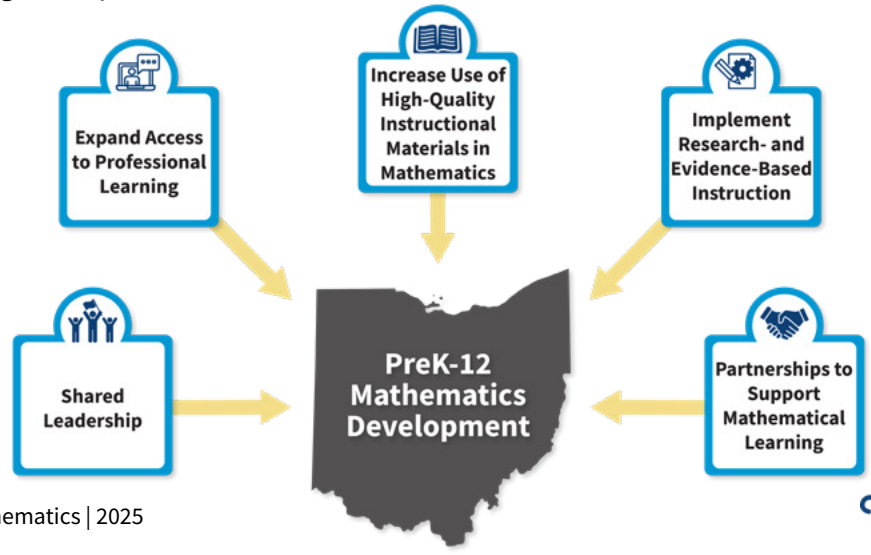
Ohio's Plan for K-12 Mathematics establishes a common statewide vision of high-quality, research- and evidence-based mathematics instruction, as well as guidance on the system-level conditions and structures needed to bring quality instruction to scale. The plan was crafted by an advisory group of more than 30 instructional experts and system leaders, with additional input from local stakeholders. It is intended to serve as an anchor for local, regional, and state education leaders, policymakers, partners, and others who can play a role in improving students' access to rigorous mathematics instruction and overall academic achievement.

Why a Comprehensive Mathematics Plan is Needed: In Ohio and nationally, K-12 students' mathematics performance has declined over the past decade, a pattern exacerbated by the COVID-19 pandemic.

- In the 2023-2024 school year, just over half of Ohio students in grades 3-8 (53.5%) achieved proficiency on the state math assessments for their grade levels.
- Fewer than 30% of Ohio eighth graders reached the National Assessment of Educational Progress (NAEP) proficiency target in 2022, and the state's average grade 8 NAEP score hit its lowest point in two decades.
- Math achievement has yet to fully return to pre-pandemic levels. As a result, achievement gaps have widened somewhat.
- While all grade levels lag behind pre-pandemic math proficiency, middle grade math is exceptionally down, along with geometry in high school.

Ohio's Mathematics Vision: Ohio's vision is to empower students with the confidence and ability to apply mathematical concepts, procedures, and reasoning, enabling students to thrive in a variety of contexts, life experiences, and career pathways. The Ohio Department of Education and Workforce recognizes that mathematics is an increasingly important factor in determining access to a full range of career pathways and college options. To address persistent learning gaps and accelerate the learning of all students in mathematics, Ohio schools must ensure all students have opportunities to advance their mathematical skills and understanding through a rigorous, grade-level curriculum. Ohio's mathematics vision builds on long-accepted research about how students learn mathematics. The central objective of this plan is to cultivate these best practices across all Ohio classrooms.

Ohio's Theory of Action: Improving mathematics outcomes for all Ohio students requires a thoughtful, multi-pronged strategy and the contributions of many stakeholders. *Ohio's Plan for K-12 Mathematics* builds upon existing math policies and initiatives in Ohio.



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This plan proposes five interdependent strands of action that, together, can encourage and sustain the implementation of high-quality, research- and evidence-based instruction across all K-12 classrooms.

- **Shared Leadership:** Responsibility for leading and supporting the successful implementation of research- and evidence-based strategies is the function of leadership at the district, building, and classroom levels. Shared leadership involves all educators in identifying challenges, analyzing underperformance, proposing solutions, and executing leadership tasks to support math improvement.
- **Expand Access to Professional Learning:** Build the capacity of educators and school leaders to implement high-quality instructional materials and research- and evidence-based instructional practices across all grades and classrooms in Ohio.
- **Increase Use of High-Quality Instructional Materials in Mathematics:** Prioritize the selection and implementation of high-quality instructional materials so all students have access to a rigorous, standards-aligned mathematics curriculum.
- **Implement Research- and Evidence-Based Instruction:** Cultivate instructional practices that support all students' access to a rigorous, grade-level curriculum and develop self-efficacy as users of mathematics.
- **Partnerships to Support Mathematical Learning:** Engage families, workforce partners, and the community in authentic partnership to support students' mathematical learning at home and in community settings.

The plan outlines specific strategies and activities for system leaders to utilize in service of Ohio students and educators. State leaders will provide guidance, coordination, and technical support for implementation; regional leaders will provide a continuum of support to districts, schools, and professionals across the state; and local leaders will develop the local policies, resources, and structures needed to support changes in classrooms and within communities.

Next Steps: *Ohio's Plan for K-12 Mathematics* outlines an ambitious vision and course of action for the state. Ohio districts are encouraged to review the plan carefully, assess their progress against the recommended strategies, and identify the next steps for improving mathematics learning as a part of their three-year planning cycle in ED STEPS, the Department's System of Tiered E-Plans and Supports. The Department will continue to engage with stakeholders across the state to build awareness of this new vision for mathematics learning and gather feedback that can guide implementation. Districts and partners can expect additional implementation guidance and resources to follow.

Introduction

The Department is dedicated to preparing students today for the challenges and opportunities of tomorrow. This begins with equipping every Ohioan with the skills and tools necessary to thrive in a rapidly changing world. Strengthening all aspects of a student's educational experience requires a focus on four core priorities: literacy achievement, accelerating learning, student wellness, and workforce readiness. By focusing on these areas, Ohio can ensure students have the knowledge, skills, and experiences necessary to achieve their goals following graduation, paving the way for a brighter future for both students and the workforce.

In 2018, the Ohio Department of Education and Workforce set forth a vision for literacy education from birth to grade 12. Since then, Ohio's Plan to Raise Literacy Achievement has served as a guide for districts and the state, spurring meaningful investments in curriculum, professional learning, and local schools and school systems that have contributed to marked improvements in students' literacy and language proficiency. While the Department and local entities have invested in promising mathematics initiatives, there has not been a similarly strategic focus to guide improvement in mathematics.

In early 2023, the Department initiated the development of Ohio's Plan K-12 Mathematics. An advisory group comprised of 33 experienced instructional experts and system leaders, including math teachers, instructional specialists, professional learning facilitators, and school administrators, convened six times from October 2023 to May 2024 and achieved the following objectives:

- Identified actions for mathematics teaching and learning in Ohio
- Generated ideas to inform math policy aligned to research-based practices
- Identified common language and high-leverage practices
- Identified shifts to state and local mathematics theories of action and strategic plans
- Recommended professional learning and support for educators

Ohio's Plan for K-12 Mathematics establishes a common statewide vision of what high-quality, research- and evidence-based math instruction looks like at the classroom level, as well as guidance on the system-level conditions and structures needed to bring these best practices to scale. This plan is intended to serve as an anchor for local, regional, and state education leaders, policymakers, partners, and others who can play a role in improving students' access to rigorous mathematics instruction and overall academic achievement.

The advisory group identified five priorities to ensure rigorous, high-quality mathematics instruction in every classroom and for every student:

- **Shared Leadership:** Responsibility for leading and supporting the successful implementation of research- and evidence-based strategies is the function of leadership at the district, building, and classroom levels. Shared leadership involves all educators in identifying challenges, analyzing underperformance, proposing solutions, and executing leadership tasks to support math improvement.

- **Expand Access to Professional Learning:** Build the capacity of educators and school leaders to implement high-quality instructional materials, research- and evidence-based instructional practices across all grades and classrooms in Ohio.
- **Increase Use of High-Quality Instructional Materials in Mathematics:** Prioritize the selection and implementation of high-quality instructional materials so all students have access to a rigorous, standards-aligned mathematics curriculum.
- **Implement Research- and Evidence-Based Instruction:** Cultivate instructional practices that support all students' access to a rigorous, grade-level curriculum and develop self-efficacy as users of mathematics.
- **Partnerships to Support Mathematical Learning:** Engage families, workforce partners, and the community in authentic partnerships to support students' mathematical learning at home and in community settings.

Ohio's Vision for K-12 Mathematics builds upon the foundation laid by the advisory group, articulates an immediate math research agenda, and outlines a plan to evaluate and implement effective teaching and support strategies grounded in evidence.

This plan does not supersede the Department's broader vision for instruction, the state's learning standards, or existing state and local initiatives in mathematics and school improvement — nor is it a prescription for how educators must teach math. Instead, this plan seeks to align efforts under a coherent vision and provide guidance to local, regional, and state K-12 leaders, equipping them to create conditions that support high-quality mathematics instruction in Ohio's public school districts and community schools.

The Department intends to amend and expand the plan based on the successes, challenges, and needs expressed by Ohio's educators and students. The Department also will provide more detailed guidance and resources to support the full implementation of the plan.

This plan is organized into five sections:

1. Why a Comprehensive Statewide Math Plan is Needed
2. Ohio's Mathematics Vision
3. Ohio's Theory of Action
4. Strategies and Activities
5. Next Steps

Section 1: Why A Comprehensive Statewide Math Plan Is Needed

Ohio districts and schools have a responsibility to deliver a strong foundation in mathematics that students need to thrive as adults. K-12 students' mathematics performance has languished over the past decade, a pattern exacerbated by the COVID-19 pandemic. As described in the Department's Data Insights series, statewide proficiency in mathematics plummeted by 15 percentage points on spring 2021 state testing. Setbacks were even more significant for Black and Hispanic students and students living in poverty.

The following section summarizes the state of Ohio's K-12 mathematics data and sets the stage for outlining immediate activities.

Math Proficiency in Ohio

Kindergarten Readiness

The Kindergarten Readiness Assessment (KRA) is administered to all kindergarten students at the beginning of the school year. This assessment is a global measure of students' readiness for instruction aligned to kindergarten standards specific to four areas of learning: social and emotional development, mathematics, language and literacy, and physical well-being and motor development. Pre-pandemic data indicated that approximately 41% of young students began school demonstrating skills and knowledge aligned to academic standards. This percentage decreased in the years immediately following the pandemic to approximately 36%. Although subscale scores specific to math are not calculated, the KRA provides a general assessment of children's preparedness for academic instruction prior to school entry. Considering that fewer than half of Ohio's young students are demonstrating the foundational skills to begin learning more rigorous academic content, it is clear that strong early instruction across all content areas, including math, is critical for charting a path toward academic success.

Elementary School

Unlike the mandatory testing for early literacy proficiency, Ohio's state testing requirements do not include a mathematics-based assessment for children in grades 1 or 2. As such, little is known about the typical development of math skills in Ohio's students or the overall effectiveness of early math instruction in Ohio's classrooms. Starting in grade 3, all students take the state math assessment that determines overall math achievement and proficiency.

Historical Trends, Grades 3-8

In the 2023-2024 school year, just over half of Ohio students in grades 3-8 (53.5%) achieved proficiency on the state math assessments for their grade levels. Altogether, more than 309,000 Ohio students in grades 3-8 did not demonstrate proficiency on the statewide math test in 2024 — a slight decrease from the 2022-2023 school year, when just over 315,000 students did not score at least proficient.

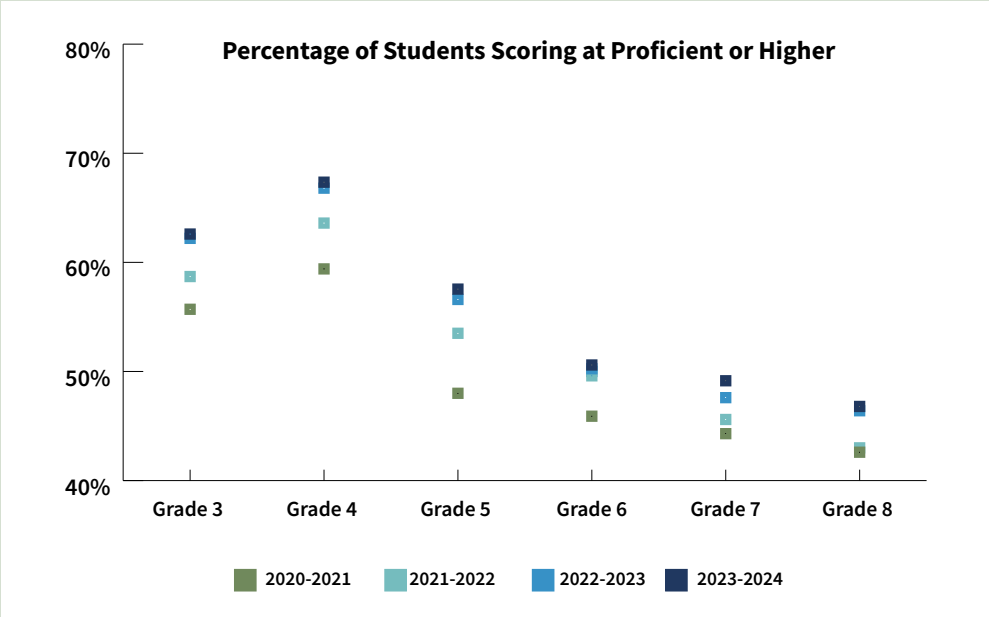


Figure 1. Percentage of students scoring at proficient or higher

When considered by grade level, the data shows a slow but steady increase in mathematics proficiency. As seen in Figure 1 above, there also appear to be clear grade-specific trends, such that proficiency is generally higher in the earlier grades but decreases as students progress through school. For example, as reported above, grade 4 proficiency is consistently higher than grade 3 proficiency across all years. However, starting in grade 5, proficiency rates decline significantly. Grade 8 proficiency is consistently the lowest among these grade levels for all the years reported. Considered altogether, these data indicate that as students progress through their elementary years, math concepts likely become more challenging, and many students struggle to maintain prior levels of proficiency, as measured by the state math tests. Such findings highlight the importance of strong and sustained math instruction that provides students with the foundational knowledge they need as they encounter more complex math concepts, and that effective math instruction is necessary throughout middle school grades to prepare students for high school math courses.

High School

Given the decrease in math proficiency rates, as students approach high school, it is unfortunately not surprising that the percentage of students meeting mathematics benchmarks for college and career readiness on the ACT has also declined over the past decade. Ohio experienced the greatest decline in 2018 when many more students began taking the ACT, due to the introduction of the statewide administration of college entrance exams. Proficiency rates have continued to fall since 2018 and hit an all-time low in 2022, with fewer than 30% of test-takers meeting the benchmarks (ACT Testing Service, 2023).

Another interesting trend emerges when examining proficiency rates in course-specific math assessments. As seen in Figure 2 below, the state average proficiency for algebra and geometry for the 2023-2024 school year was 55.9% and 39.8%, respectively. However, the difference is quite large when comparing proficiency levels between students who take those courses in earlier grades (grade 8 or below) compared to high school grades. Specifically, students who demonstrate strong early math skills and advance to high school level math courses in middle school or earlier have much higher proficiency rates compared to students who remain at grade level. As seen in the table below, students enrolled in accelerated math courses comprise approximately 20-23% of the total number of test-takers for those courses. These results suggest that districts appropriately identify students who are prepared for successful completion of advanced math courses.

Figure 2. 2023-2024 State Average Proficiency for Algebra and Geometry

School year 2023-2024	N (test-takers)	Proficiency Rate
Algebra – all	133,252	55.9%
Algebra – grade 8 and below	27,092	95.4%
Algebra – grade 9 and up	106,156	45.8%
Geometry – all	127,463	39.8%
Geometry - grade 9 and below	29,497	79.6%
Geometry - grade 10 and up	97,966	27.9%

Other Factors Impacting Math Performance

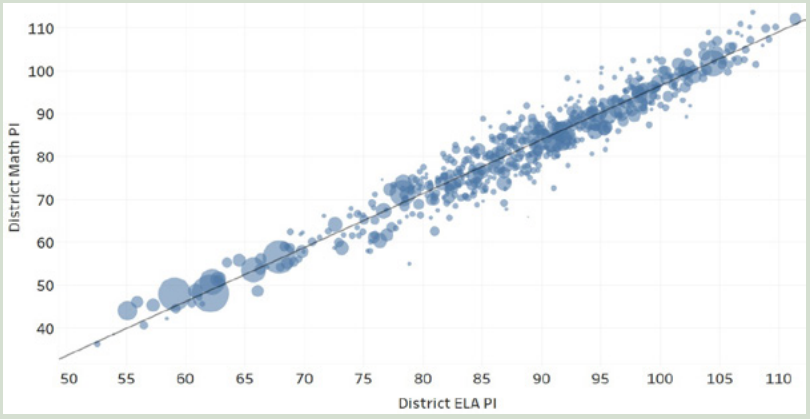
Chronic Absenteeism

Chronic absenteeism has a strong negative correlation with academic achievement in general and math in particular, according to the most recent data in Ohio (DEW, 2024). Chronic absenteeism rates remain high in many Ohio schools and districts following the pandemic, and districts with the worst chronic absenteeism rates tend to have the lowest academic results. Among districts with chronic absence rates above 40%, an average of only one in four students were proficient on their state mathematics assessments in the 2023-2024 school year (DEW, 2024).

Correlations Between Math and English Language Arts

Recent analysis of state test data highlighted the strong and positive correlations between math and English language arts skills. The data showed that not only are students' early math skills associated with their later math skills, even into high school, but that students' proficiency in math and English language arts remained strongly correlated at every grade level. Of additional note, results revealed that kindergarten students who were on track for reading at grade level were 2.7 times more likely to be

Correlation between districts' performance index on state ELA and math tests



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proficient in third grade math compared to their kindergarten peers who were not on track in reading. These odds progressively increased when considering first grade and second grade reading scores. Overall, data from Ohio's state testing suggests that reading and math scores are correlated over time, and that early reading ability is an important factor to consider within the context of math instruction.

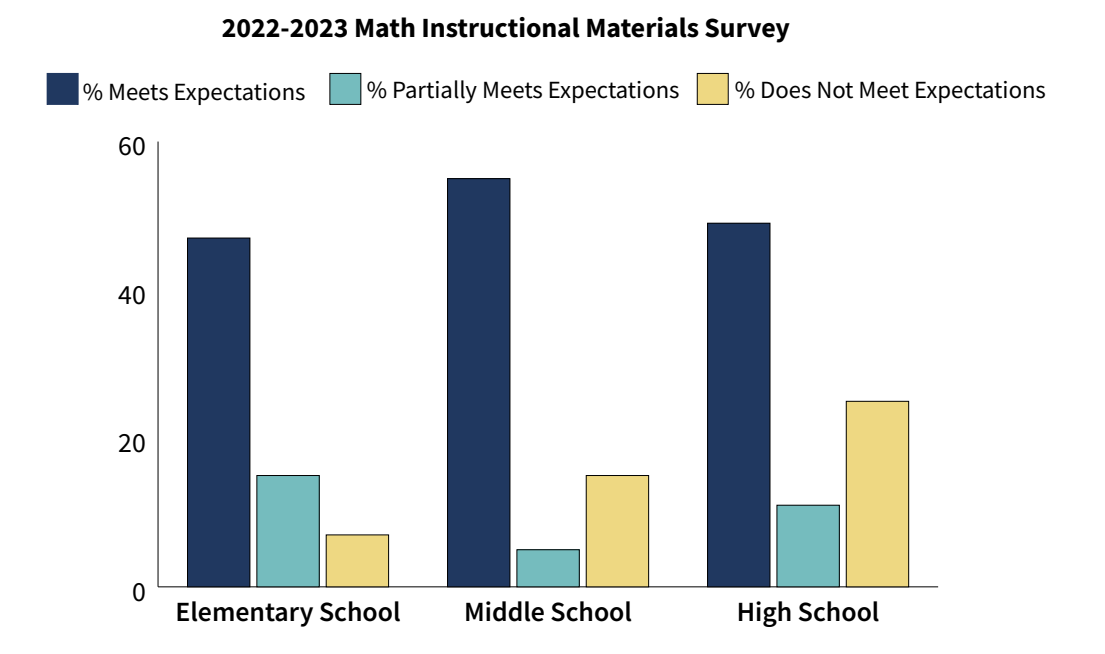
High-Quality Instructional Materials for Math Instruction

In the fall of 2023, the Department conducted a statewide survey to gather information regarding the adoption and use of high-quality instructional materials for reading and math instruction. High-quality instructional materials (HQIM) support educators with:

- Standards-aligned instructional content
- A coherent scope and sequence for grade-level lessons and unit plans
- Evidence-based instructional strategies and embedded formative assessments that support data-driven instruction
- Educative materials that provide implementation support for educators to ensure all students' learning needs are met

Ohio surveyed 1,007 districts and schools and collected 534 responses specific to the use of core instructional materials in mathematics. Districts and schools reported using a wide range of unique curriculum materials, with anywhere from 60 to 68 different curricula used, depending on the grade band. Because there is no list of approved math curricula in Ohio, the Department categorized the reportedly used materials according to the EdReports rating system of "Meets Expectations, Partially Meets Expectations, or Does Not Meet Expectations" to determine the extent to which districts are currently using high-quality instructional materials. Figure 3 shows a representation of districts using materials from each category in the elementary grades, middle school, and high school.

Figure 3. 2022-2023 Math Instructional Materials Survey



***Out of the 1,460 respondents, 534 completed the survey.**

As illustrated in Figure 3, approximately 50% or more of the instructional materials reported being used at each grade band are rated by EdReports as "Meets Expectations." Approximately 12% of responses identified instructional materials that EdReports had not reviewed, or the district did not respond. This suggests a strong need to support schools and districts in their adoption and usage of high-quality instructional materials for math instruction across all grade levels.

POSITIVE OUTLIERS IN OHIO

Despite the data reported above, some districts—rural, urban, high-poverty, average-poverty, and those of varying sizes—were identified as positive outliers. Among them, fifteen stood out for their significant gains in K-5 math proficiency. To better understand the factors driving these improvements, the Department engaged with district representatives to analyze the key contributors to their success.

Common themes were identified in the districts that showed gains in K-5 mathematics.

- **Use of high-quality instructional materials**: Ten of the fifteen districts reported using high-quality core instructional materials as rated by EdReports.
- **Professional learning:** Ten of the fifteen districts provided some form of professional learning in mathematics. Professional learning focused on specific mathematical topics and/or the implementation of the adopted high-quality instructional materials. The method of professional learning varied from virtual to job-embedded coaching.
- **Teacher supports:** Common planning time and professional resources were typical among these districts. Common planning time was used to analyze assessment data or coordinate upcoming intervention and enrichment sessions with students.
- **Integrated Multi-Tiered System of Supports for Mathematics:** Most districts acknowledged the use of data and/or screeners and some referenced enrichment or intervention time. In addition, some districts noted the use of building and teacher-based teams to review data. While most districts use some form of diagnostic or screener to drive the interventions or supports necessary to accelerate student learning, there was not one clear framework in place for an integrated multi-tiered system of supports in the context of mathematics.

Ohio's K-12 Mathematics Improvement Initiatives

Over the past two years, Ohio has launched initiatives grounded in Ohio's Learning Standards and research- and evidence-based teaching practices to enhance mathematics instruction and learning. These improvement efforts have concentrated significantly on the K-8 grade bands in response to data-driven needs.

FACILITATE SHARED LEADERSHIP

- **Ohio Math Initiative:** This collaborative effort of mathematics faculty members from the state's public colleges and universities and Ohio high schools reviewed mathematics courses and curricula and the relationship of mathematics to other disciplines. The goal was to promote each of Ohio's public colleges and universities to offer pathways in mathematics that yield increased success for students in the study of mathematics, a higher percentage of students completing degree programs, and effective transferability of credits for students moving from one Ohio public institution to another. A central component of this work is aligning postsecondary expectations and high school practice.

EXPAND ACCESS TO PROFESSIONAL LEARNING

- **HQIM and Math Specialists:** In partnership with the Educational Service Centers, 68 HQIM specialists and 34 math specialists (.20 FTE) worked with districts to support math instruction and the selection and implementation of high-quality instructional materials. The HQIM specialists were responsible for facilitating learning and supporting the implementation of HQIM. A total of 327 coaching sessions were completed with the 34 Math Specialists and 173 individual coaching sessions with 35 administrators in the participating districts. The math specialists focused on strengthening the implementation of the Ohio Learning Standards for Mathematics, Standards for Mathematical Practices, and the Effective Mathematics Teaching Practices.
- **Mathematics Professional Learning:** The Department has invested in various professional learning initiatives focusing on Ohio's Learning Standards, Standards for Mathematical Practice, and Effective Teaching Practices. These efforts supported over 1,900 educators with practices to provide rigorous standards-aligned instruction.

INCREASE OHIO'S USE OF HIGH-QUALITY INSTRUCTIONAL MATERIALS

Through the funding provided by the Elementary and Secondary School Emergency Relief (ESSER), Ohio has made significant investments in supporting districts to select and implement high-quality instructional materials for mathematics. Three activities specific to instructional materials are outlined below.

- **Zearn:** The Department, in partnership with Zearn, is providing online differentiated learning to students in grades K-8. This support can be used across instructional times as a support in the core math block or during intervention time, tutoring, and after-school programming. Professional learning is provided to support the implementation. To date, over 1,500 educators and leaders across Ohio have been trained. In FY25, approximately 1,800 schools have opted to participate, with approximately 500,000 students and 13,500 educators across Ohio schools accessing Zearn Math. This includes elementary and middle school students.

- **Smart Adoption Training for Math:** Grounded in Ohio's Curriculum Support Guide, the Department provided multiple two-day professional learning opportunities to the Educational Service Centers and State Support Team members to guide districts in selecting high-quality instructional materials for mathematics grounded in the Ohio Curriculum Support Guide and EdReports Adoption Process.
- **K-8 Mathematics HQIM Implementation Supports:** In partnership with Instruction Partners, Educational Service Centers (ESCs) and the Department provided one year of intensive coaching to districts focused on K-8 Mathematics HQIM. Coaching included instructional rounds, action planning, and professional learning.
- **High School Algebra 2 Equivalent Math Pathways:** Ohio Math Pathways initiative offers high school students multiple options to fulfill their math requirements, including alternatives to Algebra 2. The pathways are designed for flexibility and relevancy to students' career interests and academic goals, ensuring they gain applicable skills while meeting graduation requirements.
- **State-Funded High-Dosage Tutoring Programs:** The Department provided funding and support for the implementation of high-dosage tutoring programs in Ohio districts and schools. Tutoring focused on math and literacy, with over 24,000 students receiving tutoring (9,000 receiving math tutoring).

STRENGTHEN PARTNERSHIPS TO SUPPORT MATHEMATICAL LEARNING

Statewide Mathematics and Literacy Tutoring Program: In partnership with Ohio colleges and universities, the statewide tutoring program connects pre-service educators and other trained college students to K-12 students to provide high-dosage tutoring in literacy and mathematics.

Other Factors Influencing Math Performance

The Advisory Group identified several additional drivers of underperformance in math beyond school attendance.

- **Attitudes and beliefs:** Many students expressed math-related anxiety and lack of confidence in their abilities in math. Interviewed students suggested that teachers' beliefs and attitudes about their potential can influence their attitudes and confidence. Advisory group members agreed there is a need to cultivate more positive and productive dispositions toward mathematics among students, which also requires a shift in the perspectives and teaching practices of many educators.
- **Relevance and motivation:** Students crave more connections between mathematics curricula and the real world and their future goals, which they say motivates them to learn. More specifically, they are interested in clearer connections to careers and life skills.
- **An imbalance of mathematics proficiencies:** Students report learning more when they understand "why," instead of simply memorizing procedures. Several adults echoed this point and noted an overemphasis on procedural mathematics ("doing math") at the expense of other important mathematics proficiencies ("understanding and using math") in most schools and classrooms.

- **Engaging, developmentally appropriate pedagogy:** Students and educators discussed the need for more engaging approaches to teaching and learning math, such as hands-on activities, challenging tasks, and discussion. Educators and advisory group members also talked about the need for research- and evidence-based, developmentally appropriate instructional practices that provide entry points for all students.
- **Student-teacher relationships:** Most of the students interviewed identified their relationships with teachers as a major factor in how they feel about math and their success as learners.
- **Student wellness support:** Advisory group members noted a simultaneous drop in attendance and math performance in the developmentally critical middle school years when a change in schedule and school routines can exacerbate students' needs for more wellness support.
- **Formative assessment:** Students and teachers need quality formative assessments from kindergarten onward that can be used immediately to inform the next steps for mathematics instruction.
- **Teacher capacity:** Multiple educators and advisory group members spoke to the need for more professional learning in mathematics, particularly in early grades. Teachers asked for more state guidance to address standards while meeting the diverse needs of students. They want guidance and practical examples of how to deliver "just-in-time" support to students with unfinished learning from earlier grades.
- **Teacher preparation:** Elementary educators do not receive the necessary content knowledge and knowledge of math practices in the educator preparation programs.
- **Parent engagement:** Parents want to help their children but often struggle with math themselves. They fear passing their math insecurities to their children.

Advisory group members noted a simultaneous drop in attendance and math performance in the developmentally critical middle school years when a change in schedule and school routines can exacerbate students' needs for more wellness support.

Section 2: Ohio's Mathematics Vision

Ohio's vision is to empower students with the confidence and ability to apply mathematical concepts, procedures, and reasoning, enabling students to thrive in a variety of contexts, life experiences, and career pathways.

The Importance of Mathematics

The Department defines mathematics as the human activity of reasoning and problem-solving with numbers, quantities, patterns, and shapes.

Mathematics is a powerful tool for communication, critical thinking, understanding the world, and solving real-world problems. The Department recognizes that students' mastery of mathematics — as outlined in Ohio's Learning Standards — is an increasingly important factor in accessing a full range of career pathways and college options (including two-year, four-year, and technical programs). High school graduates who have a robust understanding of mathematics principles and concepts and who can apply those ideas to their work are in high demand by employers across a growing number of fields.

Mathematics is valuable in other aspects of life as well. Mathematics empowers users to understand and critique the world in all its facets (such as economic, ecological, social, political, historical, and more), make sense of the world around them, and participate as informed members of a democratic society. Mathematics is also a practical tool needed for many aspects of adult daily life, such as budgeting, scheduling time, and home repair. Lastly, mathematics, like other modes of creative expression, can be a way to experience joy, wonder, and beauty.

For all these reasons, Ohio students deserve access to the full array of opportunities and methods of thinking that mathematics provides.

A Shift Toward Rigor

Instruction is rigorous when students use mathematical language to communicate effectively and describe their work with clarity and precision. Students demonstrate how, when, and why their procedures work and why they are appropriate. Students can answer the question, "How do we know?"

Ohio's Learning Standards for Mathematics further describe three aspects of mathematics rigor that educators should pursue with equal intensity in every grade:

- **Conceptual understanding:** Educators support students' abilities to access concepts from several perspectives so students can see math as more than a set of mnemonics or discrete procedures.
- **Procedural skills and fluency:** Educators embed a variety of opportunities for students to practice grade-level mathematical procedures and develop both accuracy and fluency in their use.
- **Application:** Educators provide an abundance of opportunities for students to apply math in meaningful student contexts, including other content areas and real-world situations.

It is not enough for some students to participate in a rigorous math curriculum. To ensure a full array of college and career opportunities for every graduate, all Ohio students must have opportunities to develop and advance their conceptual understanding, procedural skills and fluency, and application of mathematics. That requires a shared commitment to the following principles in all Ohio mathematics classrooms:

- **Learning acceleration:** Every student accelerates their learning in math and has access to the proactive, evidence-based, and individualized support they need to succeed. All students must have the opportunity to engage in grade-level core instruction, regardless of ability, which requires the replacement of remediation (the practice of teaching below grade-level content) with the just-in-time intervention that allows students to complete unfinished learning and access grade-level instruction (or above).
  (Note: Learning acceleration is not equivalent to grade-level or course acceleration, which occurs when advanced learners move ahead an entire grade level in one or more subject areas.)
- **Just-in-time intervention:** Current learning data is used to identify gaps that would prevent students from accessing grade-level instruction, plan scaffolds to provide that access, and then remove those scaffolds as soon as they are no longer needed.
- **Access:** Providing learning "access" means removing or accommodating any barriers that would prevent a student from successfully engaging with the grade-level curriculum. Ohio commits to providing access to a grade-level (or above) curriculum for all learners.

The next section provides more detail on what rigor looks like in a mathematics classroom.

Ohio's Vision for Mathematics Instruction

The Ohio Learning Standards for mathematics were updated based on a review process led by educators and the Department in 2017. The revised standards define what learners should know and be able to do and guide districts in selecting local curricula, instructional plans, and materials to ensure all students have access to coherent, rigorous, grade-level instruction.

Ohio's mathematics vision builds on long-accepted research about how students learn mathematics and the instructional practices that cultivate rigor.

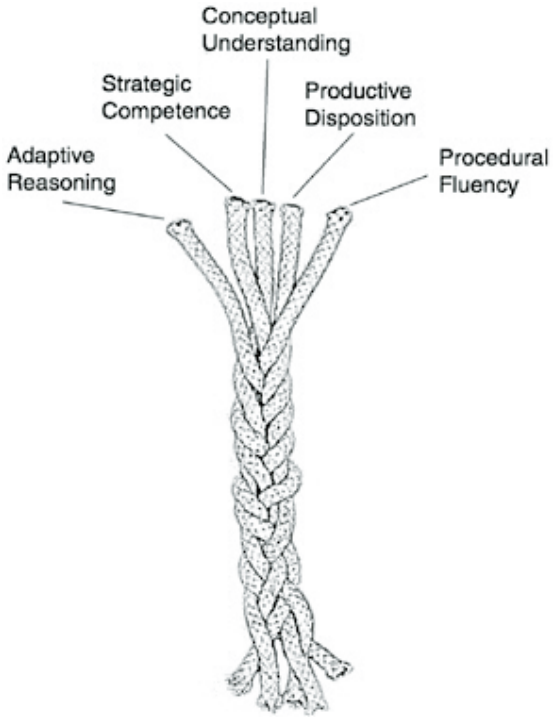
The following table outlines major topics and themes that should inform the instructional focus of each grade level and can similarly inform priorities for professional learning.

Grade Level	Recommended Instructional Focus
Preschool	The mathematics domain in Ohio's Early Learning and Development Standards includes standards within the strands of Number Sense, Number Relationships and Operations, Geometry, and Measurement. It is essential that children leave preschool having developmental experiences with counting using the number sequence, as numbers are central to all of mathematics. Mathematics has many connections to the other domains of growth and development, such as language and the ability to recall information from memory. Mathematical ideas and skills developed through everyday experiences in early childhood serve as a foundation for later learning and everyday life.
Kindergarten	In kindergarten, instructional time should focus on two critical areas: (1) representing and comparing whole numbers, initially with sets of objects; and (2) describing shapes and spaces.
Grade 1	In Grade 1, instructional time should focus on four critical areas: (1) developing understanding of addition, subtraction, and strategies for addition and subtraction within 20; (2) developing understanding of whole number relationships and place value, including grouping in tens and ones; (3) developing understanding of linear measurement and measuring lengths as iterating length units; and (4) reasoning about attributes of, and composing and decomposing geometric shapes.
Grade 2	In Grade 2, instructional time should focus on four critical areas: (1) extending understanding of base-ten notation; (2) building fluency with addition and subtraction; (3) using standard units of measure; and (4) describing and analyzing shapes.
Grade 3	In Grade 3, instructional time should focus on five critical areas: (1) developing understanding of multiplication and division and strategies for multiplication and division within 100; (2) developing understanding of fractions, especially unit fractions (fractions with numerator 1); (3) developing understanding of the structure of rectangular arrays and of area; and (4) describing and analyzing two-dimensional shapes. Students should be provided with abundant opportunities to explore these concepts using both manipulatives and mathematical symbols; and (5) solving multi-step problems.
Grade 4	In Grade 4, instructional time should focus on three critical areas: (1) developing an understanding and fluency with multi-digit multiplication and developing understanding of dividing to find quotients involving multi-digit dividends; (2) developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers; and (3) understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, and particular angle measures.

Grade Level	Recommended Instructional Focus
Grade 5	In Grade 5, instructional time should focus on five critical areas: (1) developing fluency with addition and subtraction of fractions and developing an understanding of the multiplication of fractions and of division of fractions in limited cases (unit fractions divided by whole numbers and whole numbers divided by unit fractions); (2) extending division to 2-digit divisors, integrating decimal fractions into the place value system, and developing understanding of operations with decimals to hundredths, and developing fluency with whole number and decimal operations; (3) developing an understanding of volume; (4) modeling numerical relationships with the coordinate plane; and (5) classifying two-dimensional figures by properties.
Grade 6	In Grade 6, instructional time should focus on five critical areas: (1) connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting, and using expressions and equations; (4) developing understanding of statistical problem-solving; and (5) solving problems involving area, surface area, and volume.
Grade 7	In Grade 7, instructional time should focus on five critical areas: (1) developing an understanding of and applying proportional relationships; (2) developing an understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; (4) drawing inferences about populations based on samples; and (5) investigating chance.
Grade 8	In Grade 8, instructional time should focus on four critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence and understanding and applying the Pythagorean Theorem; and (4) working with irrational numbers, integer exponents, and scientific notation.
High School	High school instructional time should continue to focus upon the six major conceptual categories: (1) number and quantity; (2) algebra; (3) geometry; (4) functions; (5) modeling; and (6) statistics and probability. The degree of focus upon any specific topical area should correspond to the specific high school math course and the standards established for that subject area.

Five Strands of Mathematical Proficiency

To learn mathematics successfully, students need to become mathematically proficient. The National Research Council described the five strands of mathematical proficiency as conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. These strands are interwoven and interdependent, and all need to intentionally be emphasized to the students.



National Research Council. 2001. *Adding It Up: Helping Children Learn Mathematics.* Washington, DC: The National Academies Press.

Standards for Mathematical Practice (What Students Must Do)

The eight Standards for Mathematical Practice outlined in Ohio's Learning Standards for Mathematics describe varieties of expertise that mathematics educators at all grade levels should seek to develop in their students.

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

[For a more detailed description of these mathematical practices, see Appendix A.]

To effectively build students' mathematics conceptual understanding, procedural skills and fluency, and application across units and grade levels, educators must have a strong understanding of mathematics themselves, as well as how students learn math.

These eight mathematical practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. This includes the process standards of problem-solving, reasoning, communication, representation, and connections described by the National Council of Teachers of Mathematics and the five strands of mathematical proficiency described by the National Research Council.

Effective Mathematics Teaching Practices (What Educators Must Do)

Advancing students' abilities to engage in the eight Standards for Mathematical Practice identified above requires a different kind of instruction from what many Ohio students and educators may have experienced in the past. To effectively build students' mathematics conceptual understanding, procedural skills and fluency, and application across units and grade levels, educators must have a strong understanding of mathematics themselves, as well as how students learn math. That includes a strong understanding of mathematics progressions or trajectories. Ohio's Learning Standards for Mathematics are not a group of discrete skills and concepts. Rather, the standards build upon one another and grow in sophistication over time. High-quality instructional materials in mathematics are designed with these progressions in mind and can help teachers plan coherent lessons and identify when students need just-in-time interventions to support success. Teachers must have a strong grasp of the connections among mathematics standards within and across grade levels to support students' growth over time.

The Department encourages all Ohio mathematics educators to master and employ the research-informed Effective Math Teaching Practices defined by the National Council of Teachers of Mathematics. These teaching practices, which reflect more than 25 years of accumulated research in mathematics instruction, describe instructional actions that are critical for students to become confident and proficient mathematical thinkers and problem-solvers, prepared for any academic path or professional career they choose. The following instructional practices should be grounded in high-quality instructional materials and developed through daily classroom activities and ongoing assessment.

Effective Math Teaching Practices

- **Practice 1: Establish mathematics goals to focus learning.** Effective mathematics educators establish clear goals for the mathematics that students are learning, situate goals within learning progressions, and use the goals to guide instructional decisions.
- **Practice 2: Implement tasks that promote reasoning and problem-solving.** Effective mathematics educators engage students in solving and discussing tasks that promote mathematical reasoning and problem-solving and allow multiple entry points and varied solution strategies.
- **Practice 3: Use and connect mathematical representations.** Effective mathematics educators engage students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.
- **Practice 4: Facilitate meaningful mathematical discourse.** Effective mathematics educators facilitate discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
- **Practice 5: Pose purposeful questions.** Effective mathematics educators use purposeful questions to assess and advance students' reasoning and sense-making about important mathematical ideas and relationships.
- **Practice 6: Build procedural fluency from conceptual understanding.** Effective mathematics educators cultivate student fluency with procedures based upon a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve mathematical problems in real world applications.
- **Practice 7: Support productive struggle in learning mathematics.** Effective mathematics educators consistently provide students, individually and collectively, with opportunities and support to engage in productive struggle as they grapple with new mathematical ideas and relationships.
- **Practice 8: Elicit and use evidence of student thinking.** Effective mathematics educators use evidence of student thinking (formative assessment) to assess progress toward mathematical understanding and adjust instruction continually in ways that support and extend learning.

Section 3: Ohio's Theory of Action

Improving mathematics outcomes for all Ohio students — across districts and grade levels and with special attention to those who are furthest behind — requires a thoughtful, multi-pronged strategy. *Ohio's Plan for K-12 Mathematics* leverages multiple strands of activity and investment into one coherent theory of action. This theory builds upon existing math-related policies and initiatives in Ohio and proposes additional strategies to cultivate rigorous, high-quality mathematics instruction in every classroom and for all students. Ohio's theory of action combines five interdependent strands of action. It is important to emphasize that these five strands of work are not sequential but should interact with and support one another in service of improved student learning.

- **Shared Leadership:** Responsibility for leading and supporting the successful implementation of research- and evidence-based strategies is the function of leadership at the district, building, and classroom levels. Shared leadership involves all educators in identifying challenges, analyzing underperformance, proposing solutions, and executing leadership tasks to support math improvement.
- **Expand Access to Professional Learning:** Build the capacity of educators and school leaders to implement high-quality instructional materials and research- and evidence-based instructional practices across all grades and classrooms in Ohio.
- **Increase Use of High-Quality Instructional Materials in Mathematics:** Prioritize the selection and implementation of high-quality instructional materials so all students have access to a rigorous, standards-aligned mathematics curriculum.
- **Implement Research- and Evidence-based Instruction:** Cultivate instructional practices that support all students' access to rigorous, grade-level curriculum and develop self-efficacy as users of mathematics.
- **Partnerships to Support Mathematical Learning:** Engage families, workforce partners, and the community in authentic partnership to support students' mathematical learning at home and in community settings.

Section 4 provides more detail on the strategies and activities.

A State Approach to Mathematics Improvement

Achieving our vision for Ohio students and the five strategies and activities to meet that vision will require many stakeholders' contributions, including local, regional, and state education leaders. Collaboration among these entities will be needed to fulfill the ambitious action steps outlined in this plan.

While individual educators can and should take inspiration from ideas outlined in this document, the work does not fall on educators alone. *Ohio's Plan for K-12 Mathematics* takes a statewide view, proposing actions that K-12 system leaders (such as school and district instructional leaders, regional support entities, and state administrators) must take on behalf of Ohio students and educators to create the conditions for improving instruction in every classroom. To create broad-scale improvement in all classrooms for all Ohio students, education leaders must work together across local, regional, and state systems to engage with and learn from stakeholders, invest in the highest-quality instructional materials, build the capacity of educators, and foster family and community partnerships that help drive and sustain student success. This ongoing iterative work will require responsive and collaborative leadership structures within communities and across institutions.

This plan identifies three groups of leaders who have critical roles to play in initiating and sustaining the instructional change process across Ohio.

Local Leaders — District and school leaders (superintendents, principals, other instructional leaders) are ultimately responsible for providing educational services to Ohio students. With support from state and regional partners, they will lead this work in local communities by engaging stakeholders, crafting a local mathematics vision aligned with this plan, and developing the local policies, resources, structures, and accountability needed to support change in classrooms.

Regional Leaders — State support teams, educational service centers, and higher education partners — will provide a continuum of differentiated support to local districts, schools, and groups of professionals throughout Ohio. This work will occur in the Department collaboration with professional organizations including the Ohio Mathematics Initiative, Ohio Council of Teachers of Mathematics, Ohio Mathematics Education Leadership Council, American Mathematical Association of Two-Year Colleges, Ohio section of the Mathematical Association of America, Ohio Association for Career and Technical Education, and Buckeye Association of School Administrators.

State Leaders — In addition to communicating a statewide vision for mathematics, Department leadership will provide guidance, coordination, and technical support to help carry out the vision and strategies outlined in this plan.

Aligned Policies and Systems

The five strategies described are supported by and must align with several foundational policies and systems that guide learning and school accountability in Ohio.

Regional Improvement System: Ohio's educational service centers provide districts and community schools in each region of the state with professional development, technical assistance, and administrative services that help improve student learning, enhance the quality of instruction, expand equitable access to resources, and maximize operating and fiscal efficiencies. In partnership with the educational service centers, the Department operates 16 regional support teams whose expert consultants assist districts and schools in improving student outcomes. State support team consultants incorporate a focus on leadership, team development, and inclusive instructional practices.

Early Childhood: In 2022, Ohio introduced a new set of Early Learning and Development Standards that define essential areas of learning and development in early childhood education across nine domains, including mathematics. The mathematics domain includes standards related to number sense, number relationships and operations, geometry, and measurement. These early mathematics skills and concepts provide an important foundation for learning math in kindergarten and beyond. As the Department rolls out *Ohio's Plan for K-12 Mathematics*, continued collaboration with the Ohio Department of Children and Youth will ensure alignment of standards from early childhood through high school, as well as coordination of strategies (such as professional learning and family engagement) that support mathematics learning across the prekindergarten to 12 continuum.

Higher Education: Professional organizations and networks and regional leaders that support educator preparation programs should continue to collaborate to strengthen educator preparation programs to ensure teachers are prepared to teach effective math practices. In addition, a focus on placing candidates from Ohio's Teacher Apprenticeship Program with effective math teachers will create a future generation of strong math educators.

Career Pathways: The Department's focus on workforce readiness for all Ohio students encourages educators to consider a student's future career pathway throughout their K-12 experience. The Department has developed guidance for schools demonstrating how they can bring opportunities to explore careers to students, supporting students to pursue viable career pathways across dozens of high-demand occupational areas. Every Ohio school district is required to be part of a Business Advisory Council, which can support decision making about offerings and design of career pathway experiences.

The Department's offices of Graduate Success and Career-Technical Education encourage schools to consider career exploration, career planning, and career pathway design in every aspect of their school's decision-making, including in the design of coursework (in math and other content areas) that is tailored to prepare students for future careers.

Section 4: Strategies and Activities

This section outlines the five strategies and activities of *Ohio's Plan for K-12 Mathematics* in detail, along with context and research. They are interdependent and meant to be implemented as elements of a complete strategy.

Shared Leadership

This plan will require strong collaborative leadership to provide vision, energy, and resources for K-12 mathematics improvement. While the primary engine of the work is local — occurring at the school and district levels — most of the strategies outlined in this plan require careful coordination among state, regional, and local entities.

Shared leadership is a critical component of effective and lasting change. Distributed leadership in schools supports both student achievement and teacher satisfaction (Curtis, 2013; Robinson et al., 2008). At the local level, research suggests that school-based teacher leadership is a key practice for supporting student success (Killion et al., 2016), and school leadership can play an important role in decreasing math anxiety among students and educators (Horne, 2022). Bold coordinated leadership at all levels can support student access to strong mathematics instruction (NCSM, n.d.; NCTM, n.d.). The most effective and equitable leadership teams regularly engage with stakeholders most proximate to the challenges (like students, classroom educators, and families) in setting and refining a course for improvement (Ortiz Guzman, 2017).

In a local shared leadership structure, district leaders, building administrators, and classroom educators all hold responsibility for implementing high-quality, research- and evidence-based mathematics instruction that meets the needs of students in their community. All these education professionals are involved in the identification of challenges, causes of underperformance, and solutions to be implemented, as well as in the implementation of actions that support improvement. In Ohio, this work is typically accomplished through leadership teams (district leadership teams, building leadership teams, and teacher-based teams). These teams share accountability for data-driven strategic planning, implementation, feedback, and continuous improvement.

This plan requires similar thoughtful coordination at the state and regional levels. To achieve the vision described in this plan, the Department will elevate the voices of local educators, students, and leaders in its own decision-making and provide districts with guidance for forming local mathematics advisory groups to support implementation. In addition, the Department will strengthen and expand upon existing regional leader partnerships (like the Ohio Mathematics Initiative, Ohio Council of Teachers of Mathematics, Math Pathways network, Ohio Mathematics Education Leadership Council, the Mathematical Association of America, and American Mathematical Association of Two-Year Colleges) in support of this plan, and will work with regional and higher education partners to align roles and activities to support and sustain the work in each region.

With input from various educators and community stakeholders, each district will be responsible for developing its local mathematics vision that is aligned with *Ohio's Plan for K-12 Mathematics* and addresses the unique needs of its community. A district's mathematics vision should become a part of its One Plan and be treated as a core part of the district's work.

Shared Leadership

Responsibility for leading and supporting the successful implementation of research- and evidence-based strategies is the function of leadership at the district, building, and classroom levels. Shared leadership involves all educators in identifying challenges, analyzing underperformance, proposing solutions, and executing leadership tasks to support math improvement.

State Strategies

Elevate the voices of students, families, educators, and school leaders when making statewide decisions about mathematics.

- Model for districts the importance of including a variety of educators in decision-making and the importance of including stakeholder input.
- Invite input into the problem-solving model at multiple points, not just the final stage of a decision.
- Demonstrate how to value a wide range of expertise, including all end users of mathematics.
- Seek input on implementation of Ohio's K-12 Plan for Mathematics and next steps with early education, higher education partners (including educator preparation programs), and key mathematics networks.

Regional Strategies

Develop a comprehensive communication and engagement plan to support the alignment of mathematics strategies from early education through higher education and across key mathematics education networks.

- Convene partners to analyze programs and examine data.
- Create a group representing participants from early education through higher education and mathematics networks to periodically review the status of implementation goals and coordinate a common agenda.

District Strategies

Develop a shared mathematics vision for the district that is aligned to its One Plan and *Ohio's Plan for K-12 Mathematics*. This vision should be created with input from a committee of educators (such as teachers, early childhood providers, counselors, aides, and instructional coaches), community stakeholders (such as families, students, postsecondary leaders, business industry leaders, educational service center team members, higher education faculty, and former students).

- Ensure the local mathematics vision and One Plan are consistent with a broader vision of teaching and learning within the district and address the specific needs of students and educators in the local community.
- Build collective efficacy by determining concrete roles and responsibilities across stakeholder groups to support the district's mathematics vision.

- Regularly engage district, school, early childhood, and community stakeholders to continuously improve the district's implementation of its mathematics vision.
- Include measurable math-related goals and outcomes (student and adult) in the One Plan.

Establish a process to elevate the voices of educators and students in district decisions about mathematics.

- Ensure educator and student voices are present on any committee, curriculum selection, or decision-making body related to mathematics.
- Ensure authentic input is valued and taken into account.

RESOURCE ED STEPs One Plan

Expand Access to Professional Learning

Expanding professional learning opportunities is a major focus of *Ohio's Plan for K-12 Mathematics*. Extensive research identifies the qualities that make professional learning most impactful across subject areas and in mathematics specifically.

"Investing in educator capacity with effective professional learning is one of the most powerful ways to improve student outcomes"

(McGraner et al., 2011; Short & Hirsh, 2020).

This plan emphasizes four research-informed themes that have the greatest likelihood of improving mathematics learning outcomes in Ohio. Going forward, the Department and partners will prioritize professional learning for mathematics educators and school leaders that:

- **Is grounded in high-quality instructional materials:** Professional learning needs to be anchored in high-quality instructional materials with intentional opportunities for reflection on learning and instruction; high-quality instructional materials and professional learning cannot be treated separately (Short and Hirsh, 2023). Abundant research shows the most effective professional learning is content-focused (Darling-Hammond, 2017; Hill, 2020). It supports the use of rigorous, grade-level instructional materials and related assessments, helps teachers use and adapt these materials to advance the learning of all students, and helps leaders facilitate the skillful implementation of high-quality instructional materials (Blazar et al., 2019; CCSSO, n.d.; Learning Forward, 2018).
- **Develops educators' mathematics content knowledge and pedagogical knowledge:** Student performance in mathematics is directly related to teachers' own understanding of mathematics (Faulkner & Cain, 2013; Stewart et al., 2019; Wiener & Pimentel, 2017). Therefore, professional learning must deepen teachers' own content knowledge, as well as their understanding of how students learn math, including the learning progressions that link standards across and within grade levels. Many educators are more familiar with procedural mathematics and will need opportunities to deepen their conceptual understanding of mathematics and the application of mathematics to real-world problems. Ohio educators also will need opportunities to explore and practice the research- and evidence-based instructional strategies outlined under the Expand Access to Professional Learning section. High-quality instructional materials can be part of this educative process, guiding effective teacher implementation and providing annotated support for meeting the needs of individual learners (Short and Hirsh, 2023).
- **Is collaborative, job-embedded, and ongoing:** Educators are more likely to retain and effectively implement new professional learning when they have opportunities to learn in collaboration with colleagues and in job-embedded structures — such as professional learning communities and classroom-based coaching — that allow them to apply what they learn to ongoing instruction (Patterson & Xu, 2020; Sarama et al., 2016; Schumacher et al., 2019). High-quality professional learning should assist educators with early use of new instructional materials and strategies and provide ongoing support and capacity building (Short and Hirsh, 2023).

- **Differentiates learning for all student needs and grade levels:** Just like students, educators have unique and varied professional learning needs, and professional learning must be differentiated to meet them. Some educators, especially in the early grades, may need more opportunities to deepen their own conceptual understanding of mathematics, whereas other educators may need more time to learn and practice engaging instructional practices that are connected to high-quality instructional materials. Educators' learning needs will also depend on the grade level, courses they teach, and student needs. The section on Ohio's Vision for Mathematics Instruction contains recommended instructional foci that can be used for mathematics professional learning by grade level. Administrators, instructional leaders, and other professionals who support educators will need differentiated professional learning opportunities that address a similar scope.

The Department's plan for expanding professional learning in mathematics relies on coordinated efforts among state, regional, and district entities. The following strategies build on pre-existing work to expand the use of high-quality instructional materials across the state, as well the work initiated by a team of regional math specialists who provide job-embedded professional development and coaching in participating districts. Going forward, the Department will provide additional guidance and support to regional partners, leaders in higher education, and district leaders to build their capacity to lead pre-service and in-service professional learning that addresses the use of high-quality instructional materials and research- and evidence-based instructional strategies.

Importantly, the intent of the following strategies and activities is not to add to classroom educators' responsibilities but to revise and reallocate existing professional learning time and resources to align with Ohio's vision of effective mathematics instruction.

Ohio's Standards for Professional Development

Ohio's Standards for Professional Development align with the research on effective professional learning. In Ohio, all educator professional learning should:

- Occur within a collaborative environment in which all share collective responsibility for continuous improvement.
- Be data-based and use data for planning, assessment, and evaluation.
- Represent best practice models and theories of adult learning and active engagement.
- Be research-based, using what is known about change to sustain implementation.
- Focus on specific goals and align outcomes with existing educator and student standards.
- Be advanced by leaders who prioritize professional learning and develop the capacity and structures to support it.
- Be supported by resources.

Expand Access to Professional Learning

Build the capacity of educators and school leaders to implement high-quality instructional materials aligned to Ohio's Learning Standards in Mathematics and research- and evidence-based instructional practices across all grades and classrooms.

State Strategies

Provide districts, state support team members, educational service centers, and educator preparation providers with guidance and support on implementing research- and evidence-based instructional practices within the context of high-quality instructional materials in mathematics.

- Collaborate with state support teams, educational service centers, and educator preparation providers to develop preservice and in-service professional learning that builds teacher and leader content knowledge in mathematics and an understanding of how students acquire conceptual understanding, procedural fluency, and problem-solving skills in mathematics.
- Collaborate with state support teams, educational service centers, and educator preparation providers to develop training for mathematics coaches and specialists that builds administrators' capacity to support the implementation of research- and evidence-based instruction, with an emphasis on the Effective Mathematics Teaching Practices from the National Council of Teachers of Mathematics.

Regional Strategies

Provide opportunities for district leaders to engage in professional learning that builds their expertise and capacity to lead the implementation of key components of mathematics instruction.

- Build district leadership's capacity to understand how all students develop proficiency in mathematics concepts, procedures, and applications.
- Build district leadership's capacity to support the skillful implementation of high-quality instructional materials and research- and evidence-based teaching practices.
- Assist in identification of building-level professional learning needs and assist in identifying appropriate opportunities for professional learning.

District Strategies

Align the mathematics professional learning scope and sequence to support educators in the implementation of a balance of conceptual, procedural, and applied mathematics in connection with their use of high-quality instructional materials.

- Ensure educators and leaders have access to ongoing professional learning in various formats (such as workshops, coaching, professional learning communities) with a continuous mathematical thread.
- Prioritize building teachers' content knowledge in mathematics and their understanding of how mathematics knowledge and skills progress from grade to grade so they can better differentiate and scaffold lessons.
- Collect data and regular feedback on professional learning and adapt based on stakeholder needs.

Collaborate with regional partners (state support teams, educational service centers, and educator preparation providers) and professional organizations (such as the Ohio Council of Teachers of Mathematics, Ohio Mathematics Education Leadership Council, Ohio Association of Elementary School Administrators, Ohio Association of Secondary School Administrators, and others) to prioritize professional learning on high-quality instructional materials in mathematics.

- Partners ensure that professional learning experiences support pre-service and in-service educators to more skillfully implement high-quality instructional materials by emphasizing how to differentiate and scaffold learning without lowering the grade-level standard of the material.
- Partners build a plan to support educators in the implementation of a balance of conceptual understanding, procedural skills, and meaningful application of mathematics lessons, and to understand the importance of creating such a balance.
- Partners tailor professional learning by role (such as pre-service teacher, current teacher, leader, specialist, and special education) while cultivating a common vision, language, and culture of high expectations to ensure all students engage with grade-level curricula via research- and evidence-based mathematics practices.

Build a team of mathematics educators and school leaders who can skillfully train and support others to implement research- and evidence-based mathematical practices.

- Build the capacity and expertise of teacher leaders, coaches, specialists, and principals on the effective implementation of selected high-quality instructional materials.
- Explore partnerships with educator preparation programs and the Math Pathways network to leverage the expertise of the most skilled cooperating teachers and pathways instructors to model best practices.
- Build the capacity and expertise of teacher leaders, coaches, specialists, and principals to identify and cultivate research- and evidence-based mathematics practices.
- Build the expertise of educators, leaders, coaches, specialists, and principals in conceptual and applied mathematics and in facilitation of opportunities for students to advance their conceptual understanding, procedural fluency, and problem-solving skills.

RESOURCE Professional Learning for Mathematics

Increase Use of High-Quality Instructional Materials in Mathematics

All students deserve access to effective, standards-aligned mathematics instruction, which is only possible with high-quality instructional materials. The Department introduced the Ohio Materials Matter initiative to support the selection and implementation of high-quality instructional materials across the state. This plan for mathematics builds on that important foundation.

High-quality instructional materials help create more equitable access to rigorous, grade-level instruction by providing:

- Consistent, standards-aligned instructional content across classrooms.
- A coherent, grade-level scope and sequence for lessons and unit plans.
- Embedded formative assessments that support data-driven instruction.
- Instructional guidance for teachers to ensure all students' learning needs are met.

High-quality instructional materials lessen the burden of lesson design for educators, providing a foundation for instruction that allows educators to focus their time on customizing lessons to their own students and classrooms, analyzing data, and addressing the learning needs of every student. This is both a more effective use of educators' professional capacities and a necessary trade-off to ensure more equitable outcomes for students with diverse learning needs.

Several major studies indicate that providing teachers with high-quality instructional materials can have significant positive impacts on student achievement (Boser et al, 2015, CCSSO, n.d.; Chingos et al., 2012). One of those studies found that implementing more rigorous elementary school math curricula delivers far more return on investment than other reforms (Boser et al, 2015). A 2018 research review affirms: "The research is increasingly clear that quality curriculum matters to student achievement. What's more, there is emerging evidence to suggest that quality curriculum has a larger cumulative impact on student achievement than many common school improvement interventions — and at a lower cost" (Steiner et al, 2018).

"Adopting a high-quality curriculum is not enough on its own, however. Educators need high-quality professional learning (HQPL) embedded in high-quality instructional materials to ensure effective use of the materials."

(Hirsch & Allison, 2020; Wiener & Pimentel, 2017)

High-Quality professional learning includes opportunities to develop pedagogical knowledge specific to mathematics and strong data analysis skills. Professional learning support should include coaching that is embedded in high-quality instructional materials. Support should also help educators shift their use of common planning time for lesson and unit internalization and to identify scaffolds and interventions based on current student learning data.

Ohio districts have already made important headway in adoption of high-quality instructional materials, particularly in English language arts. The Ohio Materials Matter initiative supports districts and educators with tools and professional learning opportunities that build capacity to select and implement high-quality instructional materials among educators, school leaders, district administrators, and regional services providers.

Under this new, mathematics-specific plan, the Department will build on that foundation with more specific emphasis on math. Specifically, the Department will provide guidance and resources to support districts in the review, selection, and implementation of high-quality instructional materials that are aligned with the Standards for Mathematical Practice and the shifts outlined in Ohio's Learning Standards (see p.19).

Districts, meanwhile, will be responsible for selecting and implementing high-quality instructional materials with integrity, providing ongoing and differentiated job-embedded professional learning and coaching for educators and local leaders. Learning and coaching should build educators' and local leaders' content and pedagogical knowledge, as well as their effective implementation of high-quality instructional materials, and should align the district's assessment strategy to prioritize the use of high-quality instructional materials-embedded assessments.

Increase Use of High-Quality Instructional Materials in Mathematics

Prioritize the selection and implementation of high-quality instructional materials so all students have access to instruction that is rigorous and aligned to Ohio's Learning Standards for Mathematics.

State Strategies

Provide guidance, resources, and support for districts to review, select, and implement high-quality instructional materials for universal (Tier 1) instruction aligned to Ohio's Learning Standards.

- Provide guidance for districts on how to identify high-quality instructional materials in mathematics that includes standards-aligned content, coherent scope and sequence, and embedding of research- and evidence-based instructional practices that support data-driven instruction. Additionally, they should be educative, supporting teachers in meeting the diverse learning needs of all students.
- Provide guidance for districts on how to effectively implement high-quality instructional materials and monitor impact on student achievement.

Regional Strategies

Provide districts with professional learning and support on best practices in implementing high-quality instructional materials in mathematics.

- Provide professional learning opportunities for district leaders to build systems and structures for the implementation and monitoring of high-quality instructional materials.

- In partnership with regional partners, develop communities of practice centered on high-quality instructional materials so district leaders across the state can learn from one another.

District Strategies

Select and implement high-quality instructional materials with integrity across all Tier 1 instruction.

- Lead a review and selection process to determine which high-quality instructional materials for mathematics will be piloted (or field-tested) and adopted.
- Set goals and plans for monitoring the effectiveness of high-quality instructional materials implementation and analyzing the impact on student achievement.
- Create time for lesson internalization and rehearsal for teachers and support staff.
- Take stock of and refine supplemental learning structures (such as small groups) to ensure all additional instructional time (such as intervention blocks and enrichment) are grounded in high-quality instructional materials and aligned resources.

Provide ongoing, differentiated, job-embedded professional learning and coaching for all district educators and leaders on the implementation of high-quality instructional materials.

- Provide multiple professional learning tracks (such as those for educators, leaders, and coaches) on how to implement and support the selected high-quality instructional materials.
- Provide guidance to instructional coaches on providing curriculum-embedded coaching, while moving away from curriculum-agnostic coaching.
- Create collaborative planning time structures when educators can internalize high-quality lessons and plan for interventions.
- Ensure professional learning is job-embedded, curriculum-based, and ongoing throughout the year.

Align the district's assessment strategy to prioritize the use of high-quality instructional materials-embedded assessments to support the development of conceptual understanding of mathematics, formative assessment, and data-driven instruction.

- Integrate curriculum-embedded assessments into the district's assessment strategy and track this data through districtwide systems to promote their use.
- Adjust assessment calendars to align with a curriculum-embedded assessment scope and sequence.
- Focus data-driven instruction meetings on curriculum-embedded assessment, student work analysis, and planning for just-in-time supports (Tier 1) and more intensive interventions or enrichment (Tier 2 or 3).

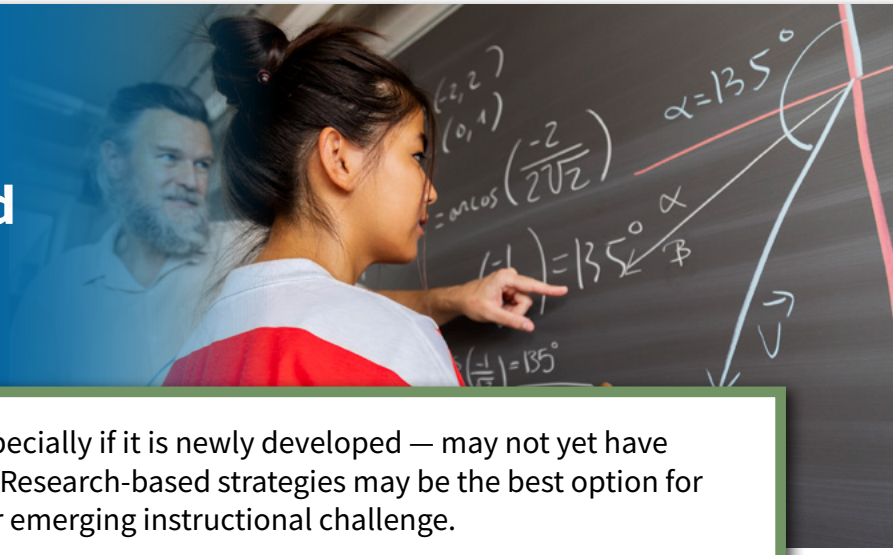
RESOURCES

Ohio Curriculum Support Guide
Ohio Materials Matter
High-Quality Instructional Materials K-12 Mathematics Rubric

Implement Research - and Evidenced-based Instruction

Supporting all students to engage in a rigorous curriculum and advance in mathematics requires the use of proven, developmentally appropriate instructional strategies. *Ohio's Plan for K-12 Mathematics* prioritizes the use of research- and evidence-based instructional strategies, specifically the Effective Mathematics Teaching Practices identified by the National Council of Teachers of Mathematics (see Ohio's Vision for Mathematics Instruction section), in combination with an integrated multi-tiered system of supports that ensures universal access to grade-level curriculum.

What is the difference between research-based and evidence-based?



A **"research-based"** program or strategy — especially if it is newly developed — may not yet have an evidence base that affirms its effectiveness. Research-based strategies may be the best option for schools that are innovating to address a new or emerging instructional challenge.

The gold standard for instructional strategies is one that is **"evidence-based"** — essentially, one that has been evaluated and proven to improve student outcomes through rigorous external evaluation. These strategies are likely to yield the maximum return for students with diverse needs.

Ohio's focus on advancing all learners via a rigorous, universally available grade-level curriculum is based on extensive research that shows students who experience engaging grade-level curriculum, strong instruction, and high expectations struggle less and learn more than students taught via remediation (TNTP, 2018; TNTP, 2021).

An integrated multi-tiered system of supports provides a framework for designing and delivering appropriate instructional interventions within a grade-level curriculum. It is a structure that is strongly supported by research (Student Achievement Partners, n.d.; TNTP, 2018; NCSM Leadership in Mathematics Education, n.d.). An integrated multi-tiered system of supports includes a continuum of supports which is characterized by universal access to grade-level instruction (known as Tier 1), with integrated scaffolds that support student success within a whole-class setting. Some students will need additional support via targeted (Tier 2) and/or intensive instruction (Tier 3). Each tier adds a level of instructional intensity that is designed to accelerate a learner's progress and resolve individual challenges or learning gaps as quickly as possible.

Movement within the tiers is meant to be fluid and data informed. The continuum of supports requires frequent data-based monitoring to inform instructional decision-making to empower each learner to achieve grade-level standards (Sansosti & Noltemeyer, 2008; Shores & Chester, 2008). Educators should prioritize diagnostic and formative assessment data and analyses of student work to inform students needs.

Both the National Council of Teachers of Mathematics' research-based teaching practices and an integrated multi-tiered system of supports approach to learning acceleration will be familiar to many Ohio educators. This plan recommends strong statewide communication and professional learning to deepen educators' familiarity with these concepts and increase their effective implementation in mathematics classrooms. Districts have an important role to play in adopting high-quality instructional materials that prioritize research- and evidence-based mathematics instructional strategies, developing systems and structures to build understanding and collective responsibility for the implementation of an integrated multi-tiered system of supports, and embedding opportunities to learn and practice research- and evidence-based mathematics instructional strategies into districts' professional learning scopes and sequences.

The Department intends to provide additional guidance and resources on providing math instruction within an integrated multi-tiered system of supports framework.

INTEGRATED MULTI-TIERED SYSTEM OF SUPPORTS

An integrated multi-tiered system of supports framework is designed to accelerate all students' rate of learning and proactively address obstacles to learning. Three instructional tiers represent a continuum of supports that provides increasingly intense levels of instruction to address student need.

- **Tier 1 Core Instruction** is provided to all students; uses high-quality instructional materials, evidence-based programs and practices, and research-based practices that align to grade level expectations and standards; and includes the use of effective and efficient academic and non-academic supports that assist students in accessing and engaging with core instruction.
- **Tier 2 Targeted Instruction** is provided to (a) at risk students to cause them to catch up to grade-level expectations and standards, and (b) students demonstrating proficiency to cause them to experience greater depth and complexity of grade-level expectations and to prevent underachievement in academic areas; included targeted use of high-quality instructional materials and evidence-based programs and practices; and includes the use of effective and efficient academic and non-academic supports that assist students in accessing and engaging with targeted instruction.
- **Tier 3 Intensive Instruction** is provided to (a) at risk students to address severe and persistent learning difficulties in academic areas, and (b) students demonstrating proficiency to prevent underachievement in academic areas; includes the intensified use of high-quality instructional materials and evidence-based programs and practices; and includes use of effective and efficient academic and non-academic supports that assist students in accessing and engaging with targeted instruction.

Implement Research- and Evidence-based Instruction

Cultivate instructional practices that support all students to access a rigorous, grade-level curriculum and develop self-efficacy as users of mathematics.

State Strategies

Promote research- and evidence-based effective mathematics teaching practices (such as the National Council of Teachers of Mathematics' Effective Mathematics Teaching Practices and Standards for Mathematical Practice defined in Ohio's Learning Standards).

- Communicate and illustrate what research- and evidence-based teaching and instructional practices in mathematics look like across all grade levels.
- Collaborate with regional partners to build coherent support and effective communication about these practices.
- Provide professional learning opportunities on the Effective Mathematics Teaching Practices and the eight Standards for Mathematical Practice.
- Clearly define and prioritize tiered instruction with an emphasis on the collective responsibility of ensuring all students have access to grade-level (Tier 1) instruction.
- Establish a clear definition of tiered instruction and the related integrated multi-tiered system of supports processes that allow all learners to access grade-level instruction and access to enrichment opportunities for students ready to advance.

Regional Strategies

Partner with regional entities (such as educational service centers and state support teams), higher education, and district leadership to align professional learning around research- and evidence-based teaching practices and an integrated multi-tiered system of supports processes.

- Provide ongoing professional learning to help educators understand how to implement quality Tier 1 core instruction in mathematics and how to use qualitative and quantitative student learning data to design Tier 2 targeted instruction and Tier 3 intensive instruction..
- Engage in collaborative learning opportunities with partners to ensure coherence in understanding, communication, professional learning, and support related to research- and evidence-based instruction.
- Create coherence in mathematics improvement strategies with an understanding of tiered instruction across all entities that support districts and schools.

District Strategies

Select and implement curriculum resources that support the use of the National Council of Teachers of Mathematics' Effective Mathematics Teaching Practices in classrooms.

- Ensure all educators have access to high-quality instructional materials that support research- and evidence-based instruction.

- Provide opportunities for educators and leaders to observe research- and evidence-based mathematics instruction.
- Provide instructional coaching support to develop consistency of research- and evidence-based practices in Tier 1 core instruction.

Develop explicit systems and structures to build understanding and collective responsibility in providing tiered instruction and support schools' implementation of an integrated multi-tiered system of supports processes and mathematics intervention.

- Support educators in reviewing student learning data, such as formative assessment, to plan for student needs to access the content being delivered.
- Support educators to understand and implement high-quality, grade-level, Tier 1 core instruction.
- Support educators to provide appropriate scaffolds so all students can successfully access grade-level instruction every day and access enrichment opportunities as appropriate.
- Work with support staff to develop a schedule and a system for additional support for students needing Tier 2 or 3 instruction.

Embed opportunities to learn and practice research- and evidence-based tiered instruction in mathematics into the district's professional learning scope and sequence.

- Ensure all staff receive consistent and ongoing professional learning on their Tier 1 core instruction materials, as well as how to scaffold for students needing extra support.
- Ensure all staff receive consistent and ongoing professional learning on Tier 2 and 3 mathematics instructional strategies that support conceptual understanding of mathematics, procedural fluency, and real-world application.
- Create planning time and structures (such as data meetings or student work analysis) for teachers to collaboratively plan Tier 2 targeted instruction and Tier 3 intensive instruction for students who need support to access Tier 1 core instruction.

Partnerships to Support Mathematical Learning

Improving mathematics performance across the state can and should involve contributions from families and a variety of community partners. By communicating a shared understanding about why math is important, offering developmentally appropriate resources and guidance for math practice at home and in community settings, tapping the expertise and assets that exist within families and communities, and cultivating strategic partnerships, Ohio educators can create the conditions for families and partners to become active supporters of children's mathematical development from prekindergarten though grade 12.

While Ohio families are frequently engaged in schools' and districts' literacy efforts, there has been less emphasis on family engagement in mathematics. Studies show that family engagement interventions tied to mathematics have positive impacts on students' mathematics achievement (Henderson & Mapp, 2002; Misretta, 2017; Van Voorhis et al., 2013; WestEd, 2015.) It is important that family engagement be connected to the mathematics content students are learning; it should also address families' attitudes and beliefs about mathematics (Eason et al., 2020; Harris et al., 2017).

Ohio educators can also support students' growth in mathematics by collaborating directly with community-based education partners, such as YMCAs, PTOs/PTAs, public libraries, afterschool and summer learning partners, and tutoring providers. These organizations already play a role in providing care and educational support outside of school hours. The Department and local leaders can engage these partners more strategically in this statewide vision for mathematics by tapping into community providers' expertise in creating engaging, real-world learning opportunities, sharing resources for supporting mathematics learning beyond school, offering shared professional learning opportunities for out-of-school-time educators and convening partners to periodically align strategies and monitor impacts.

Employers are another important group of community partners. When schools engage employers in designing and delivering career-relevant instruction, students show increased self-efficacy and engagement in learning, which is often a precursor to improved attendance and academic performance (Orthner et al., 2013). Employers can partner with schools in a variety of ways, from lighter-touch career exploration opportunities (such as career fairs, interviews, and field trips) to more intensive career mentorships and work-based learning opportunities. It is important that these career learning opportunities draw explicit connections to the mathematics curriculum, allowing students to see how math applies to the real world, how employer role models use math in their day-to-day work, and what future opportunities can look like for students who graduate with a full range of proficiencies in mathematics.

The strategies and activities outline how state, regional, and local entities can develop goals and strategies for engaging with families and community partners in children's mathematics development. The Department will play a lead role in providing guidance to districts and schools on best practices in partnering with families and communities in mathematics and in highlighting effective district models. Districts, meanwhile, will be responsible for creating and executing local community and family engagement plans in mathematics.

This section also outlines a strategy for engaging other key community partners, including workforce partners, in creating career connections and supporting community-wide efforts to engage families and improve mathematics performance.

Partnerships to Support Mathematical Learning

Engage families, workforce partners, educational partners, and community in authentic partnerships to support students' mathematical learning at home and in community settings.

State Strategies

Provide guidance to districts and schools on best practices for engaging families and the community in mathematics.

- Describe the types of partners (such as higher education, early childhood, after-school, and business) that districts should engage with to build an interconnected community that supports mathematics achievement.
- Provide guidance on how to better engage with families and community members around mathematics.
- Highlight district models of family and community engagement efforts to support mathematical learning.

Regional Strategies

Spotlight career opportunities, internships, and workforce initiatives that integrate or prioritize mathematics.

- Encourage engagement and alignment with existing Department and employer partnerships.
- Engage employers as a key stakeholder group in planning for mathematics career planning.

District Strategies

Develop family and community engagement initiatives that are aligned with school and district achievement goals and connect to mathematics content.

- Integrate mathematical thinking and activities across family and community engagement programs.

- Support families in how to engage children in mathematics in their everyday lives, emphasizing practices that go beyond counting.
- Provide families and community-based education partners with resources such as websites and applications they can use to support students' mathematics learning at home.
- Develop programming to build parents' and caregivers' mathematics content knowledge at times and locations that are convenient to families and with compensation for educators and staff.
- Invite community providers to attend professional learning programs where they can build their mathematics content knowledge and exchange instructional best practices with K-12 educators.
- Consider implementing home visit programs to better connect families to their children's math educators and help families feel more welcome in schools.

Create school environments in which families feel welcome and that build positive mathematical identities.

- Provide professional learning for school staff so they understand and can help build a welcoming environment.
- Provide opportunities for families to overcome anxiety about math in ways that are tailored to families' languages and cultures.
- Identify and integrate resources from the workforce and other community partners into engagement strategies.
- Identify workforce and other community partners in local areas that can contribute to and support the vision of mathematical achievement.
- Develop an engagement plan to learn from partners and to access their expertise in serving students.
- Host family math events to promote mathematics at locations in the community that families frequent.
- Educate families and provide students with opportunities to take Algebra 2 equivalence courses, leading to postsecondary and career success.
- Reduce barriers to family engagement in school events by engaging families in their preferred language, by including language supports in the family's first language, and addressing needs such as childcare, transportation, and meals, when possible.
- Develop "parent-to-parent" math outreach, for example, by establishing math parent ambassador roles throughout the district.

Section 5: Next Steps

Ohio's Plan for K-12 Mathematics establishes an ambitious vision and course of action for the state. As noted throughout this report, achieving a vision of mathematics opportunity and excellence for all Ohio students will require the contributions of many over a sustained period.

The creation of the plan marks an important step in that process. The plan draws on the collective expertise of 30+ mathematics education professionals and articulates a vision that can guide local and statewide efforts in the coming years. Ohio districts are encouraged to review the plan carefully, assess their own progress in mathematics against the recommended strategies, and identify their own next steps for improving mathematics learning outcomes as part of their annual One Plan cycle.

In the meantime, the Department and the advisory group will continue to engage with stakeholders across the state to build awareness of this new vision for mathematics learning and gather additional feedback that can guide implementation. Districts can expect additional implementation guidance and resources to come, including the launch of mathematics-focused professional learning series for leaders and district exemplars that illustrate best practices in mathematics instruction.

The Department welcomes the input of colleagues and stakeholders across the state and looks forward to engaging with many partners in enacting this important work on behalf of current and future Ohio students.

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The Advisory Group provided partnership, direction, and guidance during the 2023-24 school year for *Ohio's Plan for K-12 Mathematics*. The individuals and organizations recognized were critical in developing the plan.

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Appendix A: Standards for Mathematical Practice (What Students Do)

The eight Standards for Mathematical Practice outlined in Ohio's Learning Standards for Mathematics describe varieties of expertise that mathematics educators at all grade levels should seek to develop in their students.

Math Practice 1: Make sense of problems and persevere in solving them. Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals, make conjectures about the form and meaning of the solution, and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary.

Math Practice 2: Reason abstractly and quantitatively. Mathematically proficient students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Students use quantitative reasoning to create a coherent representation of the problem at hand, consider the units involved, attend to the meaning of quantities, flexibly use different properties of operations and objects.

Math Practice 3: Construct viable arguments and critique the reasoning of others. Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases and can recognize and use counterexamples. They justify and communicate their conclusions and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is.

Math Practice 4: Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. They are comfortable making assumptions and approximations to simplify a complicated situation, and they are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts, and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

Math Practice 5: Use appropriate tools strategically. Mathematically proficient students consider and make sound decisions about the uses of available tools when solving a mathematical problem, including pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Students are able to identify relevant external mathematical resources, such as digital content located on a website, to pose or solve problems, and they are able to use technological tools to explore and deepen their understanding of concepts.

Math Practice 6: Attend to precision. Mathematically proficient students try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently and express numerical answers with a degree of precision appropriate for the problem context.

Math Practice 7: Look for and make use of structure. Mathematically proficient students look closely to discern a pattern or structure. They also can step back for an overview and shift perspective. They can see complex things, such as some algebraic expressions, as single objects or as being composed of several objects.

Math Practice 8: Look for and express regularity in repeated reasoning. Mathematically proficient students notice if calculations are repeated and look both for general methods and for shortcuts. As they work to solve a problem, they maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

[Excerpted from: Ohio Department of Education and Workforce. (2017). Ohio's Learning Standards for Mathematics.]

Appendix B: Glossary

- **Acceleration:** In this report, "learning acceleration" means that students learn more in a given period than they may have in the past via proactive, evidence-based, and individualized supports. In Ohio, the aim is to provide all students with the opportunity to engage in grade-level core instruction regardless of ability and replace remediation (the practice of teaching below grade-level content) with just-in-time intervention that allows students to complete unfinished learning and access grade-level instruction. (Note: This term is not synonymous with enrichment or grade-level acceleration — when advanced learners move ahead an entire grade level in one or more subject areas.)
- **Access:** Access means removing or accommodating for any barriers that would prevent a student from successfully and equitably engaging with the grade-level curriculum.
- **Curriculum:** Curriculum is the design teachers use to plan, implement, and assess the learning outcomes for students. A high-quality curriculum includes standards-aligned instructional materials that teachers use, as well as resources that states and districts provide to support instruction, such as standards, frameworks, scope and sequences, district instructional guidance, and interim assessments.
- **Differentiation:** Differentiated instruction allows students to access the same high-quality classroom curriculum by providing various entry points, challenging learning tasks, processes that can be expanded or compacted, rich content to build on, and outcomes that are tailored to student's needs.
- **Evidence-based:** Evidence-based strategies are programs, practices, or activities that have been evaluated and proven to improve student outcomes. For a strategy to be considered "evidence-based," its efficacy must have been evaluated by someone other than just the people or organizations that developed the strategy. Districts can have confidence that the strategies are likely to produce positive results when implemented.
- **High-quality instructional materials (HQIM):** High-quality instructional materials provide a coherent scope and sequence for grade-level lessons and unit plans, standards-aligned instructional content, evidence-based instructional strategies, and formative assessments that support data-driven instruction and implementation materials that support educators to ensure all students' learning needs are met.
- **Just-in-time intervention:** In place of remediation, the practice of teaching below grade-level content before grade-level content, with just-in-time intervention, where current learning data is used to identify gaps that would prevent students from accessing grade-level instruction and plan scaffolds to provide that access and remove them when they are no longer needed.
- **Integrated Multi-Tiered System of Supports:** An integrated multi-tiered system of supports framework is designed to accelerate all students' rate of learning and proactively address obstacles to learning. Three instructional tiers represent a continuum of supports that provides increasingly intense levels of instruction to address student need.
    - » **Tier 1 Core Instruction** is provided to all students; uses high-quality instructional materials, evidence-based programs and practices, and research-based practices that align to grade level expectations and standards; and includes the use of effective and efficient academic and non-academic supports that assist students in accessing and engaging with core instruction.
    - » **Tier 2 Targeted Instruction** is provided to (a) at risk students to cause them to catch up to grade-level expectations and standards, and (b) students demonstrating proficiency to cause them to experience greater depth and complexity of grade-level expectations and to prevent underachievement in academic areas; included targeted use of high-quality instructional materials and evidence-based programs and practices; and includes the use of effective and efficient academic and non-academic supports that assist students in accessing and engaging with targeted instruction.
    - » **Tier 3 Intensive Instruction** is provided to (a) at risk students to address severe and persistent learning difficulties in academic areas, and (b) students demonstrating proficiency to prevent underachievement in academic areas; includes the intensified use of high-quality instructional materials and evidence-based programs and practices; and includes use of effective and efficient academic and non-academic supports that assist students in accessing and engaging with targeted instruction.
- **Progressions:** Mathematics progressions or trajectories describe the connections among mathematics concepts within and across grade levels. Mathematics standards are not discrete skills and concepts, but related ideas that build upon one another and grow in sophistication over time.
- **Research-based:** A program or strategy that — especially if it is newly developed — may not have an evidence base that affirms its effectiveness. Research-based educational strategies are considered the next-best option to evidence-based strategies and may be the best option in new or emergent areas.
- **Scaffolding:** Modifications made while designing and teaching group lessons that allow all students to be successful in learning the same content. Modifications may include additional modeling, pre-teaching of vocabulary, and checks for understanding.