K-8 MATH POLICY: IT ADDS UP TO ALGEBRA I READINESS

Fundamental Principles
ExcelinEd Policy Toolkit

INTRODUCTION

The United States has relinquished its mathematical prowess enjoyed in the 20th century with trending declines in performance on international and national measures and must make a concerted effort to regain this standing in the 21st century. Success in mathematics education also is important for individual citizens because it gives them college and career options, increases prospects for future income, and improves later in life outcomes[1].

K-8 MATH POLICY FUNDAMENTAL PRINCIPLES

The National Mathematics Advisory Panel serves as the basis for Excel*in*Ed's K-8 Math Policy and Fundamental Principles. The K-8 Math Policy provides the foundation to ensure all students are prepared to succeed in Algebra which has been has long been cited as a predictor of postsecondary future success[2], especially for students pursuing career paths in Science, Technology, Engineering and Math (STEM).

Unfortunately, there are not quick fixes. A comprehensive K-8 mathematics strategy includes daily math instruction with high quality content and instructional materials; support for teachers; assessments and parent notification; interventions; and resources for families and caregivers.

Instructional Materials

Adopt high-quality instructional materials grounded in the National Mathematics Advisory Panel findings and aligned to state standards. Arithmetic is to math what phonics is to reading- high-quality instructional materials include the study of traditional operations on numbers.

Support for Teachers

Ensure all teachers are prepared to use instructional math strategies that work.

- **Statewide math training** for K-8 teachers and administrators with ongoing, job-embedded math professional development and **support for teachers via math coaches**.
- Ensuring Teacher Preparation Programs at the state and local levels are **preparing teacher candidates** to have the knowledge and skills to teach all kids math based on the National Mathematics Advisory Panel findings.

Assessments and Parent Notification

Regularly monitor student progress and adjust instruction using proven strategies for closing opportunity gaps according to student need.

- **Administer math screening** within the first 30 days of school and progress monitoring for K-8 students throughout the year.
- **Notification** when math difficulty is identified and continued caregiver engagement with each progress report.

Instruction and Intervention

Provide **daily core math instruction**, ideally for 60 minutes.

Provide **targeted intervention** to students who demonstrate persistent difficulty in math.

- **Evidence-based interventions** and **extended learning time** for students experiencing math difficulty during the school day and/or before/after school.

[1] Kane, T., Doty E., Patterson, T., Staiger, D., (2022) What Do Changes in State Test Scores Imply for Later Life Outcomes? Cambridge, MA: Center for Education Policy Research, Harvard University
[2] Predictors of Postsecondary Success (ccrscenter.org)

- **Individual math plans** for K-8 students identified with a math difficulty.
- **Summer activities** provided to all K-8 students struggling in math.
- Math interventions that address social, attitudinal, and motivational factors.

Families and Caregivers

Math-at-Home Plan for students identified with a math difficulty and a list of vetted online resource hubs for all parents to support math at home.

Instructional Materials

The math curriculum in Grades PreK–8 should be streamlined and emphasize a well-defined set of the most critical topics in the early grades. A focused and coherent progression of math learning with an emphasis on proficiency must be the norm in elementary and middle school math content. Any approach that continually revisits topics year after year without closure is to be avoided.

Adopt high-quality instructional materials grounded in the National Mathematics Advisory Panel findings and aligned to state standards

The major goal of K-8 math education is proficiency with whole numbers, fractions, and aspects of measurement and geometry providing sufficient time to ensure acquisition of conceptual and procedural knowledge - most important in the foundations of fractions and algebra. Math instructional materials should be evaluated based on[3]: Focus and Coherence[4], Rigor and Mathematical Practices[5] and Instructional Supports [6]and Usability[7].

Arithmetic is to math what phonics is to reading - high-quality instructional materials include the study of traditional operations on numbers. The materials chosen for math instruction greatly impact student learning and teacher practice. Investing in and adopting high-quality materials gives teachers access to quality content and quality assignments, significantly reducing the need for teachers to search for lower quality, and sometimes disconnected, assignments online. The adoption must be accompanied by professional development that allows teachers to explore the materials, learn about the shifts in practice, and increase their knowledge of high-leverage best practices for using the materials.

Materials must simultaneously develop conceptual understanding, computational fluency, and problem-solving skills. Instructional materials should assist teachers to emphasize these interrelations; taken together, conceptual understanding of mathematical operations, fluent execution of procedures and fast access to number combinations (like 9 + 4 or 5 x 8) jointly support effective and efficient problem solving. Automatic recall and fluency with addition, subtraction, multiplication and division facts and a solid understanding of core concepts of the communicative, distributive and associative properties are necessary.

Teachers and education leaders should consistently help students and parents understand than an increased emphasis on the importance of effort is related to improved math performance. Much of the public's self-evident resignation

[3] EdReports
[4] Materials assess grade-level content and give all students extensive work with grade-level problems to meet the full intent of, and coherent and consistent with, grade-level standards.
[5] Materials reflect the balances in the Standards and help students meet the Standards' rigorous expectations by giving appropriate attention to: developing students' conceptual understanding; procedural skill and fluency; and engaging applications. And, meaningfully connect standards with practices.
[6] Includes opportunities for teachers to effectively plan and utilize materials with integrity and to further develop their own understanding of the content and include assessments for teachers to collect, interpret, and act upon the data.
[7] Degree to which materials are consistent with effective practices for use and design, teacher planning and learning, assessment, and differentiated instruction.

about math education – and common tendencies to dismiss weak achievement and give up early – seems rooted in the idea that math success is an inherent talent rather than effort.

Support for Teachers

Our citizens and their educational leadership should recognize mathematically knowledgeable classroom teachers as having a central role in mathematics education and should encourage rigorously evaluated initiatives for attracting and appropriately preparing prospective teachers, and for evaluating and retaining effective teachers.

Ensure all teachers are prepared to use instructional strategies that work.

The relationship between teachers' mathematical knowledge and students' achievement confirms the importance of teachers' content knowledge. Teachers cannot teach what they do not know.

Provide statewide professional learning opportunities, aligned to the recommendations of the National Mathematics Advisory Panel, for K-8 teachers and administrators (to ensure support of teachers in the classroom) in grades K-8.

Professional learning should focus on math proficiency which is a blending of:[8]

- Concepts – Understanding concepts, operations, and relations
- Procedures – Using procedures flexibly, accurately, and efficiently
- Strategies – Formulating, representing, and problem solving
- Reasoning – Reflecting, explaining, and justifying
- Disposition – Seeing math as sensible, useful, and worthwhile

High-quality research supports the contention that instruction should be a combination of "student centered" (inquiry based) and "teacher directed" (explicit instruction) opportunities that are bidirectional and depending on the needs of the students.

Teacher education programs and licensure tests should fully address the topics on whole numbers, fractions, and the appropriate aspects of geometry and measurement. Early career support and professional development programs should follow suit – teachers should be given ample opportunities to learn mathematics for teaching.

Fund math coaches to support teachers with ongoing, job-embedded professional development.

Math coaches are an important support mechanism for teachers in the classroom. Regional or school-based math coaches work closely with teachers to improve classroom practice and, ultimately, student math achievement. Math coaches: facilitate teacher training on evidence-based instruction and data-based decision making; demonstrate lessons; co-teach and/or observe teaching and provide immediate feedback. Math coaches serve as a stable resource for professional development throughout the school.

Departmentalize math instruction with a highly effective math teacher.

While research is sparse, departmentalized instruction, where each teacher specializes in teaching one subject to multiple classes of students instead of teaching all subjects to a single class of students is a strategy that can be used to limit the number and expanse of recruiting, retaining, and training, math teachers. While nearly ubiquitous in secondary schools, departmentalization has only recently become more popular in upper elementary grades. Using this strategy would reduce the number of highly effective math teachers needed at each grade and school.

[8] Kilpatrick, J., Swafford, J., & Findell, B. (2001). Adding It Up: Helping Children Learn Mathematics. Washington, DC: National Academy Press.

Assessment and Parent Notification

Administer universal K-8 math screener within the first 30 days of school to identify students with math difficulty.

Math screenings help to identify students that may have a math difficulty. A universal screening assessment is a "first alert" that a student may need extra help. It also helps teachers tailor instruction to meet individual student needs. The screening should occur as soon as school begins to ensure students receive the initial core instruction and interventions - if experiencing difficulty - they need immediately.

Monitor progress for all students and more frequently for students identified as having a math difficulty.

Universal math progress monitoring assessments should be administered three times per year for all K-8 students and more frequently for students identified as having a math difficulty. Teachers' regular use of a progress monitoring assessment improves their students' learning, especially if teachers have additional guidance on using the assessment to design and to individualize instruction.

Notify parents or families of any student identified with a math difficulty in grades K-8.

Involving parents from the beginning is critical to student success. Parents should be notified immediately if their child has been identified with a math difficulty, so they can be part of instructional decisions for their child and receive support on how to help their child with numeracy skills at home. Engage families throughout the school year by communicating the student's progress with each progress report.

Instruction and Intervention

In addition to traditional learning in the classroom during daily core instruction, states should offer extended learning time, including summer programming and high impact evidence-based tutoring in small groups that meet for 30 minutes, 2-3 times a week that can be implemented at scale. This encourages continuous improvement with grade level content during core instruction – ideally 90-minutes daily- with acceleration opportunities to fill in knowledge and skills gaps. Schools could also leverage local resources otherwise untapped like college students or retired educators to volunteer as mentors.

Provide targeted intervention to students who demonstrate persistent difficulty in math.

States should consider removing any barriers to implementation or funding by supporting evidence-based accelerated learning options for school districts through state appropriations for ongoing support.

Explicit instruction with students who have mathematical difficulties has shown consistently positive effects on math performance, including computation and word problems. Explicit instruction means teachers provide clear models for solving a problem using an array of examples, students receive extensive practice in the use of newly learned strategies, and students are provided extensive feedback. However, some of this time should be dedicated to ensuring students possess the foundational skills and conceptual knowledge necessary for understanding the mathematics they are learning at their grade level.

Provide interventions during/before/after school for students having difficulty with math.

Research conducted by the National Academy Press and the Office of Educational Research and Improvement points to the importance of instructional time with a highly effective teacher. Providing interventions during/before/after school gives struggling students time with targeted instruction to catch up with their peers. To ensure the quality of

the extra learning time, states should offer centralized, comprehensive, and ongoing professional development which includes the basics of tutoring and academic best practices.

Provide summer math activities to all K-8 students having difficulty with math.

According to the Harvard Graduate School of Education, on average, students lose approximately 2.6 months of learning in math over the summer[9]— and teachers have to give up weeks of class time, or more, to make up for that loss. The rate of summertime-math-loss continues to grow by the time a student enters middle school.

When the school year ends, kids may have very few opportunities to engage in any type of mathematical thinking during the summer. It is likely that most of the resulting loss involves procedural learning, not general conceptual learning. An incoming fifth grader may retain the conceptual idea that division means separating things out into equal groups, but it is easy for them to forget the set of steps to solving a long division problem. But getting students to remember those procedures isn't as easy as just assigning them summer math homework. Instead, it requires more engaged opportunities.

Develop individual math plans with the parent, prescribing research-based math interventions.

Individual math plans are created, in collaboration with the parent, for any student identified with a math difficulty. The plan includes the intervention services the student will receive above and beyond regular math instruction. It should also include strategies for parents to use at home with their child. This provides a tangible document that can and should be adjusted as the student makes progress.

Family and Caregiver Resources

Most children acquire considerable knowledge of numbers and other aspects of mathematics before they enter kindergarten.

For caregivers of students in the earliest grades, they should have a rich "home numeracy environment" for children. This involves reading books about math, playing math games, etc. The research is less obvious as students move into the later elementary grades - as the mathematics gets more difficult, schools tend to rely on caregivers less and less. But it remains important for caregivers to continue to play math-focused games, read math-focused books, highlight math in everyday activities, find small ways to practice math at home because exposure, practice, and effort improve math skills.

Provide Math-at-Home Plans with vetted online resources for parents to support their child.

Home math strategies or programs for parents help them support their child's math skill development at home. These strategies/programs and resources include Khan Academy, Zearn, an Individual Math Plan from the school, participation in parent training workshops and/or regular parent-guided home reading activities. These home math strategies/programs should be provided to all parents.

Resources

Understanding K-8 Math

In April 2006, the President created the National Mathematics Advisory Panel, with the responsibilities of relying upon the "best available scientific evidence" and recommending ways "…to foster greater knowledge of and improved

[9] Summer Math Loss | Harvard Graduate School of Education

performance in mathematics among American students." The Panel's findings serve as the basis for ExcelinEd's K-8 Math Policy.

- The Final Report of the National Mathematics Advisory Panel -- March 2008 (MS Word) (ed.gov)

The Science of Math is a movement focused on using objective evidence about how students learn math to make educational decisions and to inform policy and practice.

- https://www.thescienceofmath.com/
- Printables — The Science of Math

Instructional Materials

Materials Matter. Ed Reports provides free reports that help you evaluate instructional materials because high-quality content matters to teachers, to kids and our collective future.

- EdReports

For more than a decade, the WWC has been a central and trusted source of scientific evidence on education programs, products, practices, and policies. WWC reviews the research, determines which studies meet rigorous standards, and summarizes the findings. WWC focuses on high-quality research to answer the question "what works in education?"

- WWC | Teaching Math to Young Children (ed.gov)
- WWC | Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades (ed.gov)
- WWC | Developing Effective Fractions Instruction for Kindergarten Through 8th Grade (ed.gov)
- WWC | Improving Mathematical Problem Solving in Grades 4 Through 8 (ed.gov)
- WWC | Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students

Math Nation is a dynamic online, or printed workbook, resource that helps students master middle and high school mathematics.

- Welcome - Math Nation

Intervention Materials

The National Center for Intensive Intervention at the American Institutes for Research publishes the Academic Intervention Tools Chart which presents information and ratings on the technical rigor of the studies for the Quality of Design & Results, Quality of Other Indicators, Intensity, and Additional Research. They also put together a free math course about best practices for math intervention.

- Academic Intervention Tools Chart (intensiveintervention.org)

Intensive instruction was recently identified as a high-leverage practice in special education, and data-based individualization is a research based approach to delivering intensive instruction across content areas. The course provides learners with an opportunity to extend their understanding of intensive instruction through in-depth exposure to DBI in mathematics, complete with exemplars from actual classroom teachers.

- Intensive Intervention in Mathematics Course Content | NCII

Learning with Zearn gives kids more opportunity to learn math, always connected to core instruction. Students explore math through pictures, visual models, and real-life examples — and the content is free.

- https://about.zearn.org/getting-started

Instructional Assessments

The National Center for Intensive Intervention at the American Institutes for Research publishes the Universal screening that can be used to identify which children will need the most intensive intervention. This site provides ratings on the technical rigor of the tools Classification Accuracy, Technical Standards, and Usability Features.

- Academic Screening Tools Chart (intensiveintervention.org)

The National Center for Intensive Intervention at the American Institutes for Research publishes the Academic Progress Monitoring Tools Charts that presents information about academic progress monitoring tools by rating the technical rigor of the tools' Performance Level Standards, Growth Standards, and Usability.

- Academic Progress Monitoring Tools Chart (intensiveintervention.org)

Parent and Caregiver

Khan Academy is a nonprofit with the mission of providing a free, world-class education for anyone, anywhere. Students practice at their own pace, first filling in gaps in their understanding and then accelerating their learning.

- https://KhanAcademy.org

Four fun ways for parents to help their children practice math skills.

- Mixing in Math Downloads | TERC
- Family Math | Early Childhood Education | PBS SoCal
- Math is fun when we can do it together!! (math-talk.com)
- Early Learning - ZERO TO THREE
- Summer Math Loss | Harvard Graduate School of Education

Math Experts

- Sarah Powell, Ph.D., Associate Professor and Associate Director of the Meadows Center for Preventing Educational Risk at the University of Texas at Austin. : Sarah R Powell | College of Education | UT Austin | (utexas.edu)
- Russell Gersten, Ph.D., Managing Director of the Instructional Research Group, former professor at the University of Oregon. https://scholar.google.com/citations?user=J1jG-9UAAAAJ Russell Gersten - Google Scholar
- Sybilla Beckmann, Ph.D. Josiah Meigs Distinguished Professor of Mathematics, Emeritus, at the University of Georgia Sybilla Beckmann-Kazez | Department of Mathematics (uga.edu)
- Tom Loveless, Ph.D., education researcher and former senior fellow at the Brookings Institution (1999–2014) and member of the president's National Mathematics Advisory Panel (2006-2008), Home — Tom Loveless
- Uri Triesman, Ph.D., University Distinguished Teaching Professor, professor of mathematics, and professor of public affairs at The University of Texas at Austin and founder and executive director of the Charles A. Dana Center. Uri Treisman, Ph.D. | UT Dana Center
- Kristen DiCerbo, Ph.D., Chief Learning Officer, Khan Academy, About Our Leadership Team | Khan Academy and Kristen DiCerbo