

Connecticut State Department of Education Evidence-Based Practice Guide
Supporting Local Education Agencies' (LEA) Use of ESSA Title Funds

Mathematics

DRAFT

Under ESSA, there are four tiers, or levels, of evidence. Throughout this guide, the level indicator key is used to identify the evidence level at a quick glance.

Tier	Evidence Level	Evidence Descriptor
1	Strong Evidence	Supported by one or more well-designed and well-implemented randomized control experimental studies.
2	Moderate Evidence	Supported by one or more well-designed and well-implemented quasi-experimental studies.
3	Promising Evidence	Supported by one or more well-designed and well-implemented correlational studies.
4	Demonstrates a Rationale	Practices that have a well-defined logic model or theory of action , are supported by research, and have some effort underway to determine their effectiveness.

Interventions applied under Title I, Section 1003 (School Improvement) are required to have strong, moderate, or promising evidence (Tiers 1-3) to support them. All other programs under Titles I-IV can rely on Tiers 1-4.

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Systems

The Connecticut State Department of Education adheres to research supporting schoolwide, systemic, multi-tiered approaches to mathematics instruction, including screening, intervention, progress monitoring and fidelity of implementation.

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Utilize universal screening.</p> <p><i>Screening all students will assist in identifying those at risk for potential mathematics difficulties so that interventions to students identified as at risk can be provided.</i></p>	<p>PreK-3 4-5 6-8</p>	<p>Tier 2, Moderate</p> <p>Source: Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools (NCEE 2009-4060).</p>
<p>Provide peer-assisted instruction to students.</p> <p><i>Cross-age peer tutoring and within-class peer-assisted instruction, where a student explains concepts to another student, is beneficial to students at risk.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Jayanthi, M., Gersten, R., Baker, S. (2008). Mathematics instruction for students with learning disabilities or difficulty learning mathematics: A guide for teachers. Portsmouth, NH: RMC Research Corporation, Center on Instruction.</p>
<p>Teach number and operations using a developmental progression.</p> <p><i>Early experience with number and operations is fundamental for acquiring more complex math concepts and skills.</i></p>	<p>PreK-3</p>	<p>Tier 1, Strong</p> <p>Source: Teaching Math to Young Children (NCEE 2014-4055).</p>

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Use progress monitoring.</p> <p><i>By continually monitoring a child's progress, teachers can gather the information they need to match lessons to an individual child's knowledge level.</i></p>	<p>PreK-3</p> <p>PreK-3 4-5 6-8</p> <p>9-12</p>	<p>Tier 1, Strong</p> <p>Source: Teaching Math to Young Children (NCEE 2014-4055).</p> <p>Tier 3, Promising</p> <p>Source: Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools (NCEE 2009-4060).</p> <p>Tier 4, Demonstrates a Rationale</p> <p>Source: Rethinking High School: Supporting All Students to be College-ready in Math (2008).</p>
<p>Dedicate time each day to teaching math, and integrate math instruction throughout the school day.</p> <p><i>Current math objectives should be coordinated with activities in the classroom and lessons in other subject areas so children can master skills and extend concepts.</i></p>	<p>PreK-3</p>	<p>Tier 1, Strong</p> <p>Source: Teaching Math to Young Children (NCEE 2014-4055).</p>
<p>Provide explicit and systematic intervention instruction.</p> <p><i>Struggling students should receive explicit instruction to ensure that they have the foundational skills and conceptual knowledge necessary for understanding grade-level content.</i></p>	<p>PreK-3 4-5 6-8</p>	<p>Tier 1, Strong</p> <p>Source: Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools (NCEE 2009-4060).</p>

Instructional Practice

The Connecticut State Department of Education adheres to research that supports the explicit instruction practices of conceptual understanding, procedural skill and fluency and application in mathematics.

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Provide metacognitive strategy instruction.</p> <p><i>Metacognitive strategies can help students plan, monitor, and modify their mathematical problem-solving. Self-instruction and self-monitoring help students to become better independent problem solvers.</i></p>	<p>PreK-3 4-5 6-8</p>	<p>Tier 1, Strong</p> <p>Source: The IRIS Center. (2017). High-quality mathematics instruction: What teachers should know. Retrieved from https://iris.peabody.vanderbilt.edu/module/math/</p>
<p>Apply Schema Theory Instruction</p> <p><i>Teaching students how to solve word problems by identifying word problem types is more effective than teaching them only to identify key words</i></p>	<p>6-8</p>	<p>Tier 2, Promising</p> <p>Source: Jitendra, Asha & DiPipi-Hoy, Caroline & Perron-Jones, Nora. (2002). An Exploratory Study of Schema-Based Word-Problem Solving Instruction for Middle School Students with Learning Disabilities: An Emphasis on Conceptual and Procedural Understanding. Journal of Special Education - J SPEC EDUC. 36. 23-38. 10.1177/00224669020360010301.</p>
<p>Use teacher modeling.</p> <p><i>Modeling with unambiguous explanations and strong demonstrations that use clear and concise language, variety and active student participation makes instruction more explicit.</i></p>	<p>PreK-3</p>	<p>Tier 2, Moderate</p> <p>Source: Doabler, C. T., Cary, M. S., Jungjohann, K., Clarke, B., Fien, H., Baker, S., . . . Chard, D. (2012). Enhancing Core Mathematics Instruction for Students At Risk for Mathematics Disabilities. Teaching Exceptional Children, 44(4), 48-57. Retrieved May 7, 2018.</p>
	<p>PreK-3</p>	<p>Tier 2, Moderate</p>

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Use visual representations.</p> <p><i>Visual models allow students who have difficulty grasping the relationship between math representations and abstract symbols to understand this across math concepts and ideas.</i></p>	<p>4-5 6-8</p>	<p>Source: Doabler, C. T., Cary, M. S., Jungjohann, K., Clarke, B., Fien, H., Baker, S., . . . Chard, D. (2012). Enhancing Core Mathematics Instruction for Students At Risk for Mathematics Disabilities. Teaching Exceptional Children, 44(4), 48-57. Retrieved May 7, 2018.</p> <p>Tier 2, Moderate</p> <p>Source: Improving Mathematical Problem Solving in Grades 4 Through 8 (NCEE 2012-4055).</p>
<p>Plan frequent student practice.</p> <p><i>Providing effective practice opportunities that are both guided and independent helps students develop math proficiency.</i></p>	<p>PreK-3</p>	<p>Tier 2, Moderate</p> <p>Source: Doabler, C. T., Cary, M. S., Jungjohann, K., Clarke, B., Fien, H., Baker, S., . . . Chard, D. (2012). Enhancing Core Mathematics Instruction for Students At Risk for Mathematics Disabilities. Teaching Exceptional Children, 44(4), 48-57. Retrieved May 7, 2018.</p>
<p>Provide instructional scaffolding.</p> <p><i>Teachers provide support that facilitates students' development of math proficiency.</i></p>	<p>PreK-3</p>	<p>Tier 2, Moderate</p> <p>Source: Doabler, C. T., Cary, M. S., Jungjohann, K., Clarke, B., Fien, H., Baker, S., . . . Chard, D. (2012). Enhancing Core Mathematics Instruction for Students At Risk for Mathematics Disabilities. Teaching Exceptional Children, 44(4), 48-57. Retrieved May 7, 2018.</p>
<p>Prepare problems for use in whole class instruction.</p> <p><i>Include both routine and non-routine problems to develop proficiency in mathematical problem-solving, which better prepares students for advanced mathematics and other complex problem-solving tasks. Analyzing and discussing solved problems helps students develop a deeper understanding of the logical processes used to solve algebra problems.</i></p>	<p>4-5 6-8 6-8 9-12</p>	<p>Tier 3, Promising</p> <p>Source: Improving Mathematical Problem Solving in Grades 4 Through 8 (NCEE 2012-4055).</p> <p>Tier 1, Strong</p> <p>Source: Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students (NCEE 2015-4010)</p>

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Monitor and reflect on the problem-solving process.</p> <p><i>Monitoring and reflecting during problem solving helps students think about what they are doing and why they are doing it, evaluate the steps they are taking to solve the problem and connect new concepts to what they already know, which will help students master multistep or complex problems.</i></p>	<p>4-5 6-8</p>	<p>Tier 1, Strong</p> <p>Source: Improving Mathematical Problem Solving in Grades 4 Through 8 (NCEE 2012-4055).</p>
<p>Demonstrate multiple problem-solving strategies.</p> <p><i>Exposing students to problems that are solved using multiple strategies enables students to become more efficient in selecting appropriate ways to solve math problems with greater ease and flexibility.</i></p>	<p>4-5 6-8</p>	<p>Tier 2, Moderate</p> <p>Source: Improving Mathematical Problem Solving in Grades 4 Through 8 (NCEE 2012-4055).</p>
<p>Recognize and articulate mathematical concepts and notation.</p> <p><i>Explaining relevant concepts and notation in the context of a problem-solving activity, prompting students to describe how worked examples are solved using mathematically valid explanations, and introducing algebraic notation systematically helps students develop new ways of reasoning, which will help them solve mathematical problems.</i></p>	<p>4-5 6-8</p>	<p>Tier 2, Moderate</p> <p>Source: Improving Mathematical Problem Solving in Grades 4 Through 8 (NCEE 2012-4055).</p>
<p>Utilize the structure of algebraic representations.</p> <p><i>Understanding structure helps students make connections among problems presented in different forms.</i></p>	<p>6-8 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students (NCEE 2015-4010).</p>
<p>Solve problems by intentionally choosing alternative algebraic strategies.</p> <p><i>Learning and accessing multiple algebraic strategies enables students to approach algebra problems with flexibility. Comparing solution strategies can help deepen students' conceptual understanding allowing them to extend knowledge and think abstractly.</i></p>	<p>6-8 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students (NCEE 2015-4010).</p>

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Implement curriculum that is focused and coherent and based on the learning progressions that are foundational to algebra.</p> <p><i>Requisite skills and understandings are necessary for students to be prepared for success in Algebra I.</i></p>	6-8	Tier 3, Promising Source: Curricular Alignment to Support Student Success in Algebra I: Research Brief (September 2014) .

Professional Learning

The Connecticut State Department of Education the following evidence-based models of teacher professional learning that is collaborative, ongoing and deepens teachers' content and pedagogical knowledge.

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Provide professional learning that is intensive, ongoing and connected to practice.</p> <p><i>Intensive professional learning that includes applications of knowledge to teachers' planning and instruction influences teaching practices and leads to gains in student learning.</i></p>	<p>4-5 6-8 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Wei, R. C., Darling-Hammond, L., Andree, A., Richardson, N., Orphanos, S. (2009). Professional learning in the learning profession: A status report on teacher development in the United States and abroad. Dallas, TX. National Staff Development Council.</p>
<p>Focus on student learning and the teaching of specific curriculum content.</p> <p><i>Professional learning is most valuable when it provides opportunities to do hands-on work that builds the knowledge of academic content and how to teach it to students.</i></p>	<p>PreK-3 4-5 6-8 9-12</p> <p>PreK-3 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Wei, R. C., Darling-Hammond, L., Andree, A., Richardson, N., Orphanos, S. (2009). Professional learning in the learning profession: A status report on teacher development in the United States and abroad. Dallas, TX. National Staff Development Council.</p> <p>Tier 1, Strong</p> <p>Source: Strengthening Student Educational Outcomes: Mathematics Menu Best Practices and Strategies (2017).</p>
<p>Align professional learning with school priorities and goals.</p> <p><i>Professional learning that is an integral part of a larger school reform effort is more effective than isolated professional learning activities.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Wei, R. C., Darling-Hammond, L., Andree, A., Richardson, N., Orphanos, S. (2009). Professional learning in the learning profession: A status report on teacher development in the United States and abroad. Dallas, TX. National Staff Development Council.</p>

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Build relationships among teachers.</p> <p><i>The benefits of productive relationships include better instruction and more success in solving the problems of practice.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 1, Strong</p> <p>Source: Wej, R. C., Darling-Hammond, L., Andree, A., Richardson, N., Orphanos, S. (2009). Professional learning in the learning profession: A status report on teacher development in the United States and abroad. Dallas, TX. National Staff Development Council.</p>
<p>Implement Professional Learning Communities (PLC).</p> <p><i>PLCs affect both teaching practice and student achievement when there is collaboration, focus on student learning, and continuous teacher learning.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 2, Moderate</p> <p>Source: Vescio, V., Ross, D., Adames, A. (2007). A review of research on the impact of professional learning communities on teaching practice and student learning.</p>
<p>Provide instructional coaching.</p> <p><i>Effective instructional coaching has the structural conditions that support coaching, a guided, content-based focus, and instructional leadership by the coaches.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 2, Moderate</p> <p>Source: Instructional Coaching: Professional Development Strategies That Improve Instruction</p>

Extended Learning

The Connecticut State Department of Education supports evidenced-based models of extended learning that focuses on mathematics content and skills to reduce learning loss and the achievement gap.

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Maximize student attendance and participation.</p> <p><i>Student participation is affected by issues of access and convenience, as well as by the adequacy and attractiveness of the services and features provided in the program. Minimize the barriers to participation, especially for the students most in need of program services and most likely to benefit from them.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 4, Demonstrates a Rationale</p> <p>Source: Structuring Out-of-School Time to Improve Academic Achievement (NCEE 2009-012).</p>
<p>Adapt instruction to individual and small group needs.</p> <p><i>Supplementing learning from the school day and providing targeted assistance to students whose needs extend beyond what they can receive in the classroom instruction must be focused and targeted. Closely aligning the content and pacing of instruction with student needs will result in better student performance. Determining the right level of difficulty and pace and the most appropriate skills to teach is critical to effectively individualizing instruction.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 2, Moderate</p> <p>Source: Structuring Out-of-School Time to Improve Academic Achievement (NCEE 2009-012).</p>
<p>Use program assessment to improve quality.</p> <p><i>Both formative and summative evaluations are instrumental in any program improvement effort. Programs should have internal mechanisms to monitor staff performance, collect data related to program implementation, and conduct independent evaluations of program implementation and student impact.</i></p>	<p>PreK-3 4-5 6-8 9-12</p>	<p>Tier 4, Demonstrates a Rationale</p> <p>Source: Structuring Out-of-School Time to Improve Academic Achievement (NCEE 2009-012).</p>

Evidence-based practice and rationale	Grade band	Evidence level and source
<p>Provide summer programs.</p> <p><i>An academic summer program has the potential to minimize learning loss and result in achievement gains by providing enriching opportunities to develop mathematical skill that are aligned to the regular school year curriculum.</i></p>	<p>PreK-3 4-5 6-8</p>	<p>Tier 1, Strong</p> <p>Source: Strengthening Student Educational Outcomes: Mathematics Menu Best Practices and Strategies (2017).</p>
<p>Provide algebra readiness programs targeting skills to prepare for enrollment in Algebra 1.</p> <p><i>Achievement improves when there is a combination of academic and social focus. Implementation practices for success include selecting qualified staff, using curricula for focused program activities, providing individualized attention and supports to students, setting clear expectations and structures for participants, using age- and culturally appropriate materials, and monitoring program performance.</i></p>	<p>6-8 9-12</p>	<p>Tier 2, Moderate</p> <p>Source: Supplementary Learning Strategies to Support Student Success in Algebra I Research Brief (September 2014).</p>