Introduction to Document
The *Kansas Multi-Tier System of Supports (MTSS) and Alignment K-12 Math Structuring Guide* has been created to assist teams in documenting and utilizing the structures necessary to implement the Kansas MTSS and Alignment framework. This guide also provides steps to support districts in successfully completing the tasks and decision making necessary for a sustainable system. Content-area-specific guides for reading, behavior and social-emotional learning, and preschool are companion documents to this one, providing information specific to each respective content. All Kansas MTSS and Alignment documents are aligned with the *Kansas MTSS: Innovation Configuration Matrix (ICM)*, which describes the critical components of a Kansas MTSS and Alignment framework and what each component looks like when fully implemented, and the *Kansas Multi-Tier System of Supports: Research Base*, which provides a basic overview of the research support for the Kansas MTSS and Alignment.

[www.ksdetasn.org/mtss](http://www.ksdetasn.org/mtss)

Acknowledgements
A significant commitment of time and energy from numerous Kansas educators and their districts, organizations, and partners made this document possible. Their efforts to learn and help others understand what it takes to implement an MTSS within schools is reflected in this document. This grassroots effort on the part of Kansas educators indicates a commitment to meeting the needs of every student and sharing wisdom from the field and foundational research. As the list of individuals and districts that have contributed to this effort over the past many years has become too long to detail, a collective expression of gratitude is offered here to everyone who has contributed to the concepts, ideas, and knowledge that are reflected in all Kansas MTSS and Alignment documents.

This document was produced under the Kansas State Department of Education Technical Assistance System Network (TASN) Grant Title VI, Part B IDEA CFDA#84.027 Project #21006. Authorization to reproduce in whole or in part is granted. Permission to reprint this publication is not necessary.

**Recommended citation:**

The contents of this resource were developed under an agreement from the Federal Department of Education to the Kansas State Department of Education. However, the contents do not necessarily represent the policy of the Department of Education, and endorsement by the Kansas State Department of Education or the Federal Government should not be assumed. Kansas MTSS and Alignment is funded through Part B funds administered by the Kansas State Department of Education’s Special Education and Title Services. Keystone Learning Services does not discriminate on the basis of race, color, national origin, sex, disability, or age in this program and activities. The following person has been designated to handle inquiries regarding the non-discrimination policies: Keystone Learning Services Executive Director, 500 E. Sunflower Blvd, Ozawkie, KS 66070, 785-876-2214.
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Introduction

In Kansas, there is a belief that all children can learn. Fundamentally, every student should be challenged to achieve high standards, both academically and behaviorally. A systemic framework for ensuring that all students have this experience is referred to as the Kansas Multi-Tier System of Supports and Alignment (MTSS). Simply put, the Kansas MTSS and Alignment framework is a set of evidence-based practices implemented across a system to meet the needs of all learners. Horner et al. (2005) stressed the importance of supporting children both academically and behaviorally in order to enable them to reach their fullest learning potential. The Kansas MTSS and Alignment framework builds a system of prevention, early intervention, and support to ensure that all children learn. Additionally, Kansas MTSS and Alignment establishes a system that intentionally focuses on leadership, professional development, and an empowering culture in addition to a focus on student learning.

The Kansas MTSS and Alignment framework incorporates a continuum of assessment, curriculum, and instruction. This systemic approach supports both struggling and advanced learners through the selection and implementation of increasingly intense evidence-based interventions in response to both academic and behavioral needs. Whether a district’s program is implementing a single content or planning to integrate both academic and behavior content, it is essential to begin with the Phase 1 Guide and then the content guides. The Kansas MTSS and Alignment framework establishes a Self-Correcting Feedback Loop that includes ongoing monitoring of the effectiveness of instruction to ensure that each Kansas student achieves high standards.

Across the nation, schools use a variety of curricula, interventions, and methods to monitor student learning, both academically and socially. The goal of Kansas MTSS and Alignment is to provide an integrated systemic approach to meet the needs of all students. To achieve this, resources must be used effectively and efficiently. While the Kansas MTSS and Alignment framework does not necessarily require additional resources or making additions to existing practices, it does involve evaluating current practices to identify those that yield evidence of effectiveness, addressing areas that are missing, and replacing ineffective or inefficient approaches with those that are supported by research and/or evidence. The Kansas MTSS and Alignment is a guiding framework for school improvement and accreditation activities to address the academic and behavioral achievement of all students.

Demand for Mathematics

Simply put, math matters. For some reason, our society has deemed it acceptable to be “bad at math,” while on the other hand, one would be hesitant to confess their inability to read. The National Research Council (NRC) declares, “For people to participate fully in society, they must know basic mathematics. Citizens who cannot reason mathematically are cut off from whole realms of human endeavor. Innumeracy deprives them not only of opportunity but also
of competence in everyday tasks“ (NRC, 2001, p.1). Math principles are not only ingrained in everyday tasks, such as shopping for groceries, creating a monthly budget, and comparing interest rates, but the demand for math proficiency also correlates to current workforce opportunities. According to *U.S. News & World Report* (2016), the employment rate for jobs in the STEM field since 2000 has increased at a 22% higher rate than all other jobs. A similar report from 2015 estimated that jobs in which qualifications extend beyond a high school diploma, but not a four-year degree, require solid math skills and a strong level of digital proficiency. It is apparent that a call for proficiency in mathematics is required.

How are students in the United States measuring up according to the National Center for Educational Statistics (2021)? The Trends in International Mathematics and Science Study (TIMSS) assesses 4th and 8th grade students in number, measurement and geometry, data, and algebra (8th grade only) and is conducted every four years. In 2019, fewer than 50% of 4th graders and fewer than 40% of 8th graders met the level of “high standards” on this assessment, demonstrating no real change from the 2015 study. The Programme for International Student Assessment (PISA) measures 15-year-olds’ ability to use their reading, mathematics, and science knowledge and skills to meet real-life challenges. In math, the U.S. ranks 36th out of the 79 countries and regions that participated. U.S. math performance has not changed much since the first PISA tests in 2000, despite many well-intentioned efforts and initiatives by educators.

According to *Trajectories of Mathematics Performance: From Preschool to Postsecondary* (Powell & Nelson, 2016), student math performance in the elementary grades, such as skills with counting, numbers, calculation, and quantity comparison, reliably predict math achievement in later grades. In addition, skills in number line estimation and computation predict proficiency with fractions; fraction proficiency predicts math performance in middle and high school. Finally, the authors maintain that math ability in high school is directly correlated to hourly earnings upon entering the workforce (Powell & Nelson, 2016). Mathematical concepts build upon each other year after year, and unless students are given the proper instructional support early on, they are set on a path that leads to decreased postsecondary opportunities. It is critical that educators address this sense of urgency and take the necessary steps to improve mathematics instruction for all students.

For further guidance on early numeracy within the preschool classroom, refer to the Pre-K Math Guide and Preschool Resource Repository: Early Numeracy.

**Curriculum**

**Critical Concepts in Mathematics**

A discussion of critical concepts in math is important to ensure that personal experiences and feelings about math do not interfere with the ability to hold high expectations for student achievement in math. Teacher expectations for student achievement and other beliefs about math are often communicated to students in very subtle ways.

John Hattie’s *Visible Learning* effect sizes are documented on the MetaX website. The
research reflects that teachers’ estimates of student achievement yield an incredibly high effect size (1.46) on student learning. Therefore, a discussion of the critical concepts in math can help ensure that teachers understand some of the basic issues in the field and provide mutual support for developing productive practices for student learning and math instruction.

The following five critical concepts for math for school-age students were adapted from Riccomini and Witzel (2010), and the source for each critical concept is also referenced below:

- All students can be mathematically proficient (Kilpatrick, Swafford, & Findell, 2009).
- All students need a high-quality mathematics program (National Mathematics Advisory Panel, 2008).
- Effective mathematics programs must teach conceptual understanding, computational fluency, factual knowledge, and problem-solving skills (National Mathematics Advisory Panel, 2008).
- Effective mathematics instruction matters and significantly impacts student learning (National Mathematics Advisory Panel, 2008; Newman-Gonchar, Clarke, & Gersten et al., 2009).
- Teachers should use a balance of student-centered and teacher-centered instruction in the core mathematics program (National Mathematics Advisory Panel, 2008).

Tier 1 Mathematics
Math Proficiency

What does it mean for students to be mathematically proficient? In the book *Adding It Up: Helping Children Learn Mathematics* (NRC, 2001, p. 5), mathematical proficiency is the terminology used to convey the development of success in mathematics. The report states that mathematical proficiency has five strands, and “the most important feature of mathematical proficiency is that these five strands are interwoven and interdependent.” The five intertwined strands of mathematical proficiency are as follows:

- **Conceptual Understanding**: Comprehending mathematical concepts, operations, and relations – in other words, knowing what mathematical symbols, diagrams, and procedures mean
- **Procedural Fluency**: Carrying out mathematical procedures, such as adding, subtracting, multiplying, and dividing numbers flexibly, accurately, efficiently, and appropriately
- **Strategic Competence**: Being able to formulate problems mathematically and devise strategies for solving them using concepts and procedures appropriately
- **Adaptive Reasoning**: Using logic to explain and justify a solution to a problem or to extend from something known to something not yet known
- **Productive Disposition**: Seeing mathematics as sensible, useful, and doable—if you work at it—and being willing to do the work

It is necessary that students be given frequent and equitable opportunities to strengthen each proficiency strand within their mathematics classroom.
Standards for Mathematical Practice
Mathematical proficiency has been proven repeatedly in the research to be one of the greatest predictors of future success in students. Early mathematics competence is evidenced to be one of the best predictors of school success across the curriculum (Duncan et al., 2007; NAEYC/NCTM, 2010). The Standards for Mathematical Practice (SMP) describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on key processes and proficiencies with longstanding importance in mathematics education. The eight SMP are listed as follows (Common Core, n.d.):

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

The KSDE Mathematics Flip Books define each of these practices as well as provide examples of how these might be applied at each grade level. See 1st grade examples here.

Essentials for Core Mathematics
Essential core mathematics instruction, K-12, should occur for a minimum of 50 to 60 minutes per day (National Council of Teachers of Mathematics, 2006; Riccomini & Witzel, 2010). The math core should be effective with the majority of students and include differentiated instruction for students who experience math difficulty despite meeting the benchmark standard. The following are essential components of core mathematics instruction:

- The ingrained belief that all children can achieve proficiency in mathematics.
- A high-quality program for each individual child.
- Instruction that addresses the five strands of mathematical proficiency.
- Effective instruction embedded within all instructional practices at every tier.

Mathematics instruction in pre-kindergarten through eighth grade should be sequential and emphasize a well-defined set of critical topics. The math curriculum should not “revisit topics year after year without bringing them to closure” (National Mathematics Advisory Panel, 2008). In other words, students must learn critical skills at a level of conceptual understanding, proficiency, and fluency that enables automaticity in math computation and problem solving. Rather than racing to cover topics in a mile-wide, inch-deep fashion, the Kansas Standards require us to significantly narrow and deepen the way time and energy are spent in the math classroom. Achieve the Core illustrates the progression of these critical concepts from kindergarten through 8th grade in this chart.

The Kansas MTSS and Alignment Math team has adapted the Achieve the Core chart to portray the 2017 Kansas Math Standards so that educators can see the progression of skills and critical focus areas across grade levels in the PreK-8 Math Instructional Foci document.
In addition to the critical mathematical concepts at each grade level, consider the three shifts in mathematics identified by the Common Core mathematics standards when ensuring the vertical alignment of your PreK-12 mathematics program:

- **Focus** strongly on areas on which the standards focus.
- **Coherence**: Think across grades and link to major topics within grades.
- **Rigor**: In major topics, pursue conceptual understanding, procedural skill and fluency, and application with equal intensity.

For further information on the shifts, see [College- and Career-Ready Shifts in Mathematics](#).

**Math Core Curriculum Considerations**

Because the core curriculum is the comprehensive curricula that *all* students receive, materials that comprise the core curriculum must support good quality classroom instruction to ensure that all students meet or exceed the Kansas Standards.

In order to evaluate the core curriculum materials, staff members must:

- Analyze which materials are currently in use,
- Examine their alignment with the Kansas Standards,
- Look at the evidence regarding their effectiveness, and
- Determine if there is a need to strengthen the core curriculum

Research shows that the curriculum chosen for core instruction can make a difference in the achievement level attained by students. For this reason, it is important to review the available evidence regarding the effects of math curricula that might be under consideration. When selecting a core curriculum, look for alignment with the standards, critical areas that are taught both conceptually and procedurally, and a balance between student-centered and teacher-directed lessons. It is also recommended that educational leaders consider alignment of instructional practices and mathematics vocabulary between core and intervention resources (Nelson, Pfannenstiel & Edmonds, 2019). Below are online resources that can be used to locate evidence regarding a specific math curriculum:

- EdReports
- What Works Clearinghouse
- Best Evidence Encyclopedia
- Evidence for ESSA

When considering a curriculum adoption for mathematics, read the [Kansas Instructional Curriculum/Resource Adoption Process Guide](#) for more resources and guidance.

**Tier 2 and 3 Mathematics**

**MTSS Hybrid Model**

When fully implementing MTSS, supplemental and intensive support is provided through a hybrid intervention model that combines a protocol and problem-solving approach to ensure a rapid response to meet student needs as they arise. The protocol aspect of the hybrid model requires that each building preselect a set of interventions that will be used, as student data indicate a need for support beyond the core. The problem-solving aspect of the MTSS hybrid model is used to further identify and customize supports for students, especially at the Tier 3
Considerations for Math Intervention Materials

Students experiencing difficulties with whole-number knowledge most likely struggle with one or more of three central areas: early numeracy, computation, or word-problem solving (Codding et al., 2017). Gersten et al. (2009a) outlined in the Institute of Education Sciences (IES) Practice Guide that, when considering these mathematical concepts for intervention, educators can apply the following recommendations for intervention materials:

- Instructional materials for students receiving interventions should focus intensely on in-depth treatment of whole numbers in kindergarten through grade 5 and on rational numbers in grades 4 through 8. These materials should be selected by a committee.
- Intervention materials should include opportunities for students to work with visual representations of mathematical ideas, and interventionists should be proficient in the use of visual representations of mathematical ideas.

Evaluating Intervention Materials

Codding et al. (2017) shared eight features for evaluating current and/or potential math intervention materials. These eight features have been adapted into the following questions for math teams to use for guidance:

1) Is content provided using explicit instruction?
2) Is strategy instruction incorporated?
3) Is instruction sequenced logically?
4) Are progress monitoring and feedback embedded?
5) Are drill, practice, and cumulative review activities included?
6) Is student verbalization of the problem-solving process modeled and encouraged?
7) Are visual representations used?
8) Is reinforcement provided?

Just as the core curriculum was reviewed and evaluated by staff members, it is imperative that instructors review the current Tier 2 and Tier 3 materials to determine what will work best to meet the academic needs of all students. By conducting this review, staff members will be positioned to make the necessary decisions regarding whether there are gaps in materials that should be filled. Staff members will also make decisions about discontinuing or replacing curricula due to the lack of effectiveness or an evidence base.

For students in upper elementary and middle school, interventions should be more targeted to key algebra-readiness progressions. Interventions should, at a minimum, place heavy emphasis on the computation of whole numbers, working with fractions, and solving equations.

There will be a wide range of needs during intervention at any grade level; therefore, it is vital that schools have interventions that comprehensively address all critical areas of mathematics and cover both conceptual and procedural aspects of mathematics. Often content-specific targeted interventions lack depth, focusing primarily on rogue procedures.
Websites for Evidence-Based Math Interventions and Strategies:

- National Center on Intensive Intervention
- Evidence-Based Intervention Network
- What Works Clearinghouse
- TeachingLD
- Evidence for ESSA

**Instruction**

**Tier 1 Mathematics**

It is recommended that core instruction creates a balance between teacher-centered and student-centered instruction (National Mathematics Advisory Panel, 2008). During teacher-centered instruction, the teacher directly teaches concepts using explicit instruction. In student-centered instruction, the teacher guides students in constructing meaning through discovery learning. However, this approach is only appropriate once students have shown accuracy and fluency with the specific skills needed to successfully complete the task (VanDerHeyden & Codding, 2020; Buongiovanni, 2021). For students who are struggling, low achievers, and students with disabilities, teacher-centered instruction has been demonstrated to be especially important (Gersten et al., 2009b).

**The Science of Math**

**Common Misconceptions**

The Science of Math is a movement that utilizes objective evidence regarding how students learn math most effectively in order to make educational decisions in addition to informing policy and practice. The following table outlines several common misconceptions and the truths according to research. A wealth of resources can be downloaded and printed from the site linked above.

*The information in Table 1 below was retrieved from The Science of Math, http://www.thescienceofmath.com/.*

<table>
<thead>
<tr>
<th>Misconception</th>
<th>Truth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procedural and Conceptual Understanding</strong> Some educators believe students should not be exposed to procedural instruction until they have demonstrated adequate conceptual understanding of a topic.</td>
<td>Conceptual knowledge supports procedural knowledge AND procedural knowledge supports conceptual knowledge. They should be taught together!</td>
</tr>
<tr>
<td><strong>Growth Mindset</strong> Many educators believe interventions targeting a growth mindset will improve academic achievement.</td>
<td>Intervention research on stand-alone growth mindset interventions yield minimal gains on GPA in mathematics courses, and replication attempts have failed. The most effective way to</td>
</tr>
</tbody>
</table>
Improve academic achievement is to deliver skill-building intervention.

**Explicit Instruction**
Inquiry-based instruction should be the primary tactic used to teach students. Explicit instruction only is beneficial for struggling learners. Explicit instruction is an instructional tactic through which students are provided with correct answers and only promotes rote learning to passive learners.

Explicit instruction offers value through sequencing of tasks in increments of difficulty, fluency building that promotes effective practice, and scaffolded opportunities for students to combine learned skills with new knowledge. Explicit instruction facilitates creativity.

**Productive Struggle**
Many educators believe that struggling or grappling with challenging math tasks causes students to gain a deeper understanding than would be achieved if they learned the same skill without a struggle.

Productive struggle does not deepen understanding, grit, or creative problem solving. Productive struggle can lead to frustration and cause students to develop misconceptions. In addition, the false starts that are involved in struggling with challenging tasks without adequate support or guidance lead to lost instructional time and inefficiency.

**Algorithms**
Many educators believe algorithms promote memorization, and this would contribute to a superficial understanding of steps, conventions, and rules. This belief leads to the idea that students should not be taught algorithms.

An algorithm is a step-by-step procedure for solving a problem. Using an algorithm requires conceptual understanding of what is happening in the problem and procedural knowledge to accurately solve. Algorithms can serve as a link between conceptual understanding and procedural knowledge.

**Math Anxiety**
Many educators believe math anxiety is caused by instructional activities and timed tests. In schools, educators may interpret students’ disengagement in math activities or statements that they dislike math as math anxiety. Educators may reduce the difficulty of a math lesson or remove timed tests as a way to reduce math anxiety.

No studies have determined that timed tests cause math anxiety, defined as feelings of apprehension, tension, or fear that may interfere with performance on math-related tasks. In fact, timed tactics improve math performance.

### Instructional Practices

**Explicit Instruction**
Explicit instruction is a non-negotiable instructional practice for ALL tiers of mathematics instruction. Archer and Hughes (2011) expressed, “One of the greatest tools available to us... is explicit instruction – instruction that is systematic, direct, engaging, and success oriented.” Visible Learning research shows that explicit teaching strategies have an effect size of 0.57,
which equates to more than one year’s growth for one year of input. We define explicit instruction as:

[The inclusion of] clear statements about the purpose and rationale for learning the new skill, clear explanations and demonstrations of the instructional target, and supported practice with feedback until independent mastery is achieved. Explicit teaching strategies involve teacher-led instruction with a series of supports or scaffolds throughout the learning process from modeling to guided practice to mastery. (Adapted from Visible Learning MetaX)

Read our Explicit Instruction handout for more details about the true implementation of the many components of explicit instruction.

Systematic Instruction
Often, systematic is heard alongside explicit instruction. It is important to specifically define systematic instruction as a means for understanding how it complements explicit teaching strategies. The 2021 IES Practice Guide: Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades states that “The term systematic indicates that instructional elements intentionally build students’ knowledge over time toward an identified learning outcome” (Fuchs et al., 2021, p.12). Recommendations for implementing this practice include integrating previously learned content, sequencing instruction logically so that learning builds incrementally, including visual supports, and providing immediate corrective feedback.

Differentiated Instruction
Differentiated instruction offers an organized way of proactively adjusting teaching, learning to meet kids where they are, and helping them to achieve maximum growth as learners. Differentiation of teacher-directed instruction is a teacher’s response to learners’ needs. It is guided by general principles of differentiation, such as the use of data, sequence of instruction, flexible grouping, materials and resources, and teachers’ and coaches’ collaboration in planning. It involves using multiple approaches to the content, process, product, and learning environment. Teachers can differentiate what students are learning, how students are learning, how students demonstrate their learning, and the climate of the classroom (Tomlinson, 1999; Tomlinson, 2014). For more clarity regarding differentiation examples and non-examples, see What Differentiated Instruction Is and Isn’t.

Scaffolded Instruction
Scaffolded instruction is “the systematic sequencing of prompted content, materials, tasks, and teacher and peer support to optimize learning” (Dickson, Chard, & Simmons, 1993). When students are learning new or difficult tasks, they are given more assistance. As they begin to demonstrate task mastery, the assistance or support is decreased gradually in order to shift the responsibility for learning from the teacher to the students. Thus, as the students assume more responsibility for their learning, the teacher provides less support. For students
to become proficient in performing mathematical processes, explicit instruction should include scaffolded practice, in which the teacher plays an active role and gradually transfers the work to the students. This phase of explicit instruction begins with the teacher and students solving problems together. As this phase of instruction continues, students should gradually complete more steps of the problem with decreasing guidance from the teacher. Students should proceed to independent practice when they can solve the problem with little or no support from the teacher (Gersten et al., 2009a).

Hamilton and Amador (2019) recommend a three-step sequence for scaffolding: prompt-cue- reteach. Prompting type questions serve to activate students’ prior knowledge. Cues direct students to the necessary information; however, one must be mindful not to jump straight to cueing prior to giving the necessary prompts. Finally, reteaching is a last resort when prompts and cues have proven ineffective.

**Computational Fluency**
According to the National Mathematics Advisory Panel (2008), the ability to recall basic mathematics facts is critical for general success in mathematics. The National Mathematics Advisory Panel (2008), Common Core State Standards (n.d.), and National Council of Teachers of Mathematics (NCTM, 2006) all state that the quick and accurate recall of math facts is a core skill and prerequisite for higher-level learning. Automatic recall must be developed over time through sufficient instruction, practice, and feedback (Baroody, 1999; Willingham, 2009). VanDerHeyden and Burns (2008) describe this process as moving from acquisition (accuracy) to proficiency (speed). The IES guide (2009) recommends that interventions at all grade levels devote ten minutes in each session to building fluent retrieval of basic arithmetic facts (Gersten et al., 2009a). The Kansas MTSS and Alignment recommends that all students, whether they are receiving intervention or not, undergo this ten-minute differentiated period devoted to arithmetic automaticity. For more information on improving students’ computational fluency, refer to the 10 Minutes of Computational Fluency brief.

**Mathematics Vocabulary**
The number of mathematics vocabulary terms that students encounter throughout grades K-12 merits the intentional focus on this particular topic. The 2021 IES Practice Guide recommends that educators dedicate adequate time to teaching mathematical language in order to support students in effectively communicating their conceptual understanding (Fuchs et al., 2021). The Standards for Mathematical Practice call for educators to create an instructional environment that expects students to routinely construct viable arguments, critique the reasoning of others, and attend to precision. The intentional alignment of systematic and explicit vocabulary instruction across grade levels and content areas plays a critical role in carrying out those practice standards to address gaps and improve coherence between core and intervention (Nelson et al., 2019a).

**Supplemental Instructional Practices**
**Computer-Assisted Instruction**
While computer-assisted instruction (CAI) programs can offer instruction, drill and practice, and motivation, which can all be beneficial for students, CAI is not a replacement for direct, explicit instruction from a qualified classroom teacher (Codding et al., 2017). We recommend
that teachers provide explicit instruction for conceptualization and accuracy prior to students using CAI. Most CAI programs address word-problem solving and computational fluency, with fluency being the prominent component. Rich et al. (2017) compared 2nd grade students’ abilities to generalize their math facts for different assessment formats, dependent upon the type of practice utilized. Students’ practice opportunities consisted of computer-based only, paper/pencil only, or a combination of the two. Students who received paper/pencil practice or a combination made significant gains from pre- to posttest on both assessment formats (computer vs. paper/pencil). The students who only received computer-based practice struggled to apply those skills to the paper/pencil assessment. One can conclude that only offering computer-based practice can hinder students’ ability to generalize those skills to different formats, which is an important stage in the instructional hierarchy; acquisition, fluency building, and generalization (Haring et al., 1978).

Other considerations for CAI include evaluating the capacity for technology use (e.g., number of computers available, broadband) within the building or district and training of staff to ensure fidelity of implementation, funding, and scheduling (minutes per day, days per week). Teams should look for the aspects below when choosing a CAI program (Codding et al., 2017):

- Evidence-based teaching practices including explicit teaching and scaffolding
- Alignment to core curriculum (strategies, vocabulary, etc.)
- Data-based individualization, tracking mastery
- Immediate, corrective feedback to students
- Engagement and motivation for students

Websites that review and/or list CAI programs:
- LearningWorks for Kids
- TechMatrix
- Common Sense Education
- What Works Clearinghouse
- Educational Technology Clearinghouse, University of South Florida
- The Math Forum, Drexel University

Cooperative Learning Strategies
Visible Learning research assigns an effect size of 0.40 to cooperative learning and recommends this practice for both gifted and remedial learners. Perseverance with mathematics tasks and developing students’ productive disposition proficiency strand can both be nurtured through cooperative learning. Zakaria et al. (2013) found that secondary students working in a “cooperative group were able to increase their understanding and to develop their self-confidence” (p. 1). Other benefits to cooperative learning include increasing social skills, self-efficacy, effort, and participation (Codding et al., 2017).

Peer-Assisted Learning
Peer tutoring has the potential to accelerate learning with an effect size of 0.51 according to Visible Learning research. Students work in pairs and can switch roles back and forth from tutor to tutee. The larger concept of peer-assisted learning includes students working
in small groups or teams. According to Coddington et al. (2017), important considerations for peer-assisted learning include:

- Close monitoring by the teacher in order to provide immediate feedback
- Training of students in the necessary skills and roles by modeling, role-playing, and guided practice with the teacher
- Setting group goals and providing rewards for collaboration, effort, and academic performance
- Establishing student expectations during peer tutoring sessions

**Math PALS** is an example of an evidence-based, whole-group, peer-tutoring program for grades K-6.

**Maintenance Practice**
A common theme or concern heard amongst mathematics educators is that students are not maintaining previously taught skills. Since mathematics concepts build upon each other, it is important for students to retain critical skills from lesson to lesson, unit to unit, and grade to grade. Watch the video *Maintenance Practice in Mathematics Classrooms* with Dr. Paul Riccomini for training on this subject. The following practices are effective ways to increase retention:

**Retrieval Practice**
Retrieval practice involves giving students opportunities to recall, from memory, previously learned information. This recall opportunity is then followed by feedback so that students can rate themselves on how well they recalled the information. Lastly, it is important for this practice to be low stakes; “Think of retrieval as a learning strategy, not an assessment tool” (Agarwal et al., 2020, p.3). [See Retrieval Practice Guide](#).

**Interleaved Practice**
Mathematics textbooks typically use what is called *blocked practice*, which occurs when students use the same strategy or procedure for multiple consecutive problems (Rohrer et al., 2017). Dr. Riccomini shares that this practice is appropriate when students are acquiring a new skill or concept; however, for maintenance of previously learned skills, it is more effective to incorporate *interleaved practice* opportunities in addition to blocked practice (Ragsdale, 2020). Interleaved practice is simply mixing problem types so that consecutive problems require students to choose a different strategy or procedure. [See Interleaved Mathematics Practice Guide](#).

**Spaced Practice**
If you have ever crammed at the last minute for an exam, then you understand the idea of massed practice. You might have noticed that, shortly after the test, you were unable to recall the majority of the information. This is because “when information is quickly acquired, it’s often quickly forgotten” (Carpenter & Agarwal, 2020, p.5). *Spaced practice* involves chunking a lesson or practice session over time into multiple, shorter sessions. Carpenter and Agarwal state that this method allows students to transfer the information to long-term memory and therefore increase their ability to retrieve that information in the future. [See Spaced Retrieval Practice Guide](#).
Metacognitive Strategies

Visible Learning defines meta-cognition as thinking about thinking and includes methods used to help students understand the way they learn. Meta-cognition has been assigned an effect size of 0.60, meaning that it has the potential to accelerate learning at 1.5 times the typical rate. When students reflect on what they know and monitor their own learning, while also using those reflections to inform their next steps, they are practicing the key components of meta-cognition (Son, Brittingham-Furlonge & Agarwal., 2020). Retrieval practice and spaced practice are two ways to improve students’ meta-cognition and therefore improve their learning. See Metacognition Guide.

Classwide Intervention

Generally speaking, when more than 40% of students in a particular class do not meet benchmark on a universal screening measure, then it is recommended that educators implement a classwide intervention. Reminder: a strong tier 1 is the first and best intervention. Skills targeted during a classwide intervention should reflect skills that students have acquired but in which they need to build fluency. The National Association of School Psychologists recommend the following active ingredients to building a successful classwide intervention (2020, p.2):

- Guided practice with corrective feedback as needed.
- Think aloud during problem solving.
- High dosage of opportunities to respond at the correct level of task difficulty.
- Task difficulty is selected to reflect a skill that the student has acquired (i.e., the child can accurately complete the task, but the performance is labored).
- Independent practice with a goal to try to “beat one’s last best score.”
- Delayed error correction and explanation to the math partner how the error was corrected.
- Group contingency delivering a small privilege, reward, or celebration based on the growth of the class as a whole.

Spring Math is an example of a classwide math intervention program. MIND: Facts on Fire is a free, schoolwide (Tier 1) application for addressing acquisition and fluency building of basic math facts.

Other evidence-based strategies for implementing a classwide math intervention for computation and/or word-problem-solving deficits include the following:

- Cover-Copy-Compare
- Taped Problems
- Schema-Based Instruction

Tier 2 and 3 Mathematics

Scheduling Considerations, K-12

- Avoid conflicting with core, other content, and recreational periods. Intervention time should stand alone and be represented as a separate slot of time within the master schedule.
- Ensure 50-60 minutes of core instruction, of which 10 minutes is
devoted to differentiated computational fluency practice.

- Ensure that intervention time is sufficient to accommodate the recommendations of the chosen curriculum. If you have not chosen a curriculum, plan for approximately **30 minutes at least four days per week**.
- If math time must be split, consider splitting the core time into more than one section of time prior to chunking intervention time.

**Resources and Recommendations for Math Intervention**

One of the challenges facing the leadership team is to identify resources that might already be available in the system to provide effective interventions for students. IES also provides multiple practice guides with evidence-based recommendations from panels of national experts. These recommendations not only support students that are struggling in mathematics but are also strong practices for supporting the mathematics proficiency of all students. The Kansas MTSS and Alignment Math team encourages educators to consider embedding the instructional practices from the following IES practice guides:

- **Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades**
- **Developing Effective Fractions Instruction for Kindergarten Through 8th Grade**
- **Improving Mathematical Problem Solving in Grades 4 through 8**
- **Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students**
- **Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools**

**Assessment**

Assessment plays a key role in determining the effectiveness of instruction. "Instruction is successful, or effective, to the degree that it accomplishes what it sets out to accomplish" (Kirschner, 2022). Assessment measures the success of instruction and therefore the overall purpose of mathematics assessment must be to improve student learning. Assessment should support the learning of important mathematics and furnish useful information to both teachers and students. NCTM (2007) maintains that assessment should be an integral part of instruction, providing not only the teacher but also the student with information about the student’s learning.

**Universal Screening**

Universal screening assessments must be reliable, valid, and efficient. Specific recommendations for criteria for these features can be found in the **IES Practice Guide: Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools** (Gersten et al., 2009a). It is recommended that a universal screening assessment take less than 20 minutes to administer. Universal screening in MTSS addresses basic critical skills/concepts, and not every concept taught in the classroom. Remember that universal screeners are formative, and their purpose is to identify students at risk of not meeting current and future benchmarks.
**Universal Screening for Grades K-1**

Universal screening for kindergarten and first grade assesses the skills and concepts related to number sense. Measures typically include constructs of numeral recognition (number identification), magnitude comparison (quantity discrimination), and strategic counting (missing numbers). In some assessments, strategic counting and magnitude comparison have been identified as key predictive variables (Gersten, Clarke, & Jordan, 2007). All students in kindergarten and first grade should also be screened for early numeracy skills three times a year.

The early numeracy assessments are often administered individually and typically take one minute per subtest. Students who fail to reach the benchmark on one or more of the early numeracy subtests are grouped for instruction during the MTSS implementation process and sorted into groups for intervention for early numeracy skills.

**Universal Screening for Grades 2-12**

All students in grades 2-12 should be screened three times per year. Universal screening measures for math can be given to an entire classroom and do not require individual administration. The screening data will identify students who are at, above, or below benchmark. Students who are below benchmark will be further grouped for intervention.

**Diagnostics**

**Informal Diagnostics**

The purpose of an informal diagnostic is to identify the instructional focus for each student requiring intervention support. Tools that can be used to identify the instructional focus for students include placement tests within the intervention curriculum, reports within the screening assessment system, pre/post measures within the core curriculum, student interviews, and/or student work samples.

**Formal Diagnostics**

Formal diagnostics are designed to be used for students who are not progressing as intended and need to be assessed for specific misconceptions that might not have been evident in previous measures. Formal diagnostic assessments for mathematics provide a more in-depth analysis of a student’s strengths and weaknesses and are used to further guide instruction. Most diagnostic assessments will provide either age-based or grade-based norms or rubric scoring, which are used to determine whether a student has significant problems in specific skill domains. This information can then be used to design instruction specific to the student’s individual learning needs. It is important that formal diagnostic assessments be given to students when additional information is needed for more customized instructional planning, but it is also important not to overuse these assessments. Formal diagnostic assessments require numerous building resources and should not be given as a matter of course to all students. Instead, they should only be given when their progress monitoring data indicates that further information is necessary to adequately plan instruction.

**Single-Skill CBM Probes and Error Analysis**

Whenever students fail to make adequate growth in intervention, it might be an indication that
further analysis is needed. The school might decide to gather additional diagnostic information by conducting error analysis and examining error patterns (Ashlock, 2006; Riccomini, 2005), especially at the student’s instructional level. When error analysis indicates possible skill deficits, verification of these deficits can be conducted by using single-skill CBM probes (Hosp, Hosp, and Howell, 2007). Each single-skill probe assesses only one type of skill at a time, enabling a more reliable and valid assessment of specific deficits for a given computational skill. Single-skill CBM probes for mathematics are available from Intervention Central. Marilyn Burns’ Listening to Learn math interviews provide a source for error analysis.

Comprehensive Formal Diagnostic Assessments
The school might also choose to administer a formal diagnostic assessment to determine underlying mathematics issues. This assessment is not necessarily for special education referral, but rather for the purposes of planning instruction. Understand that these types of assessments are dense in nature and will take training and larger amounts of instructional time to complete. It is important that these assessments only be used with students who truly need them. Less invasive diagnostic information includes but is not limited to suggestions listed previously, as well as an integrated look across reading, behavior, and social needs. This information should be considered prior to administering a formal diagnostic. The team should also ensure that initial grouping was appropriate. Formal diagnostic assessments for mathematics include but are not limited to:

- TEMA-3 – Test of Early Mathematics Ability–Third Edition (Between Ages 3.0 and 8.11)
- Key Math III (grades K-12)
- Tools for Early Assessment in Math (TEAM) (grades preK-2)
- Number Knowledge Test (age levels 4, 6, 8 and 10 years)

Decision Rules for Formal Diagnostic Assessments K-12
All buildings should establish decision rules to address when additional diagnostic assessments will be given, which students will receive tiered support, and how students will be assigned to skill groups. There could be different decision rules established for the use of brief, criterion-referenced diagnostic assessments as compared to more formal, norm-referenced diagnostic assessments that are more resource-intensive to administer. The leadership team should then review each selected diagnostic assessment to determine the skills/concepts assessed and time to administer.

Progress Monitoring
Formal progress monitoring refers to a broad assessment or General Outcomes Measure (GOM), ideally the same broad construct as the universal screener, which will identify how the student’s general math ability is progressing in a normed comparison across other students at the same instructional level. Informal progress monitoring refers to mastery assessments within the intervention curriculum in the form of pre-/post-testing. Both are critical and vary in interpretation and application. We recommend administering a formal progress monitoring measure every two to four weeks and skill-specific informal progress monitoring measures as often as needed in order to inform instruction and gauge students’ mastery.
Math Grouping Process
According to universal screening results, students who score at or above benchmark are considered Tier 1 and perform at their current grade level. Students who score below benchmark are considered Tier 2 or 3. ALL students, including those in Special Education, receive 50-60 minutes of differentiated core instruction every day. Students needing Tier 2 or 3 support will also receive a minimum of 20-30 minutes of intervention at least four days per week. If utilizing a walk-to intervention model, students at Tier 1 should receive enrichment opportunities during this time.

Identifying Instructional Level for Tier 2
Students receiving Tier 2 support are to be considered below benchmark, but are most likely still on level with their current grade (i.e., a student who tests at a Tier 2 level in 3rd grade will have an instructional level of grade 3). However, it is important to note that secondary students receiving Tier 2 supports could have deficits below their current grade level.

Identifying Instructional Level for Tier 3
Backwards Testing
Students at Tier 3, however, must undergo a series of backwards tests to determine their instructional levels. In some assessment systems, this will require the student to take the previous grade’s universal screener to compare achievement with that level’s end-of-year benchmark score. If the student does not achieve the end-of-year benchmark score, he/she will then take the previous grade universal screener. This process will continue until the student achieves at or above the end-of-year benchmark score. Once this occurs, a student will be considered to have an instructional level at one grade above that achievement. For example, if a 5th grade student tests backwards and they achieve above the end-of-year benchmark on the 2nd grade screener, their instructional level is 3rd grade.

Scaled Scoring
Other systems use an adaptive screening assessment that will provide a student a scaled score that will be consistent through all levels (K-8). Finding the student’s scaled score at the assessment’s recommended percentile at subsequent grades will enable educators to find their instructional level. For example, an 8th grade student scores a 212 on the FastBridge aMath screener, and the 50th percentile scores for fall of 4th and 5th grades are 210 and 216, respectively. Therefore, this student’s instructional level is 4th grade.

Identifying Instructional Focus for Intervention (Tiers 2 and 3)
Once instructional levels are determined, a comprehensive protocol placement test within the selected intervention curriculum should be utilized to identify the specific point of beginning intervention (instructional focus). If the intervention curriculum does not contain a placement exam, it might have an instructional planning report that can be used to determine a starting point. Leaders might also consider using other diagnostic measures (See Informal Diagnostics above). Students are then placed into homogenous intervention groups based on their identified instructional focus. These groups are not static, but should be fluid in nature to allow students to progress and move through the continuum of critical math skills. This process is highly complex and involves student-level decision making due to the overlapping skill deficits along the progression of the mathematics standards. It might be necessary to utilize more than one diagnostic tool to narrow the instructional
focus for each student.

**Professional Development and Fidelity**

**Professional Development Considerations**

The Building Leadership Team will identify the professional development needs of staff related to all mathematics curriculum, instruction, and assessment. ALL staff members with instructional responsibility must have a solid understanding of the *core curriculum* and receive professional development that enables them to implement it with fidelity. In this instance, staff refers to the staff members responsible for instruction at all three MTSS levels. This is necessary to ensure that the intervention curriculum is aligned with the core curriculum and all students have equal opportunities and access to high quality instruction independent of their classroom placement.

It is not necessary that all staff members in a building know how to implement intervention curricula; however, everyone involved in collaborative teams should understand the skills targeted in each curriculum so they can be involved in instructional planning.

The most effective intervention teachers are those who are trained in the use of a well-developed, explicit, and systematic math intervention program and are provided ongoing support for fidelity of implementation. Students with individualized education plans are not excluded from access to small-group instruction. Teachers of these groups can include general education teachers, paraprofessionals, specials teachers, non-math content teachers, Title teachers, and special education teachers. Instruction can occur both inside and outside the special education classroom and should be based on a common identified instructional focus. Remember: special education is a service, not a room. The KSDE Special Education and Title Services asserts, “those children who do not respond to the core instructional procedures will receive targeted group interventions in addition to core instruction (KSDE, 2019, p. 26).

Often when determining the capacity of school staff utilized during math intervention, we often rule out non-math content teachers, thinking that the lack of mathematics knowledge will impede student achievement. Recent research, however, deems otherwise. Nelson, Van Norman, Parker, and Cormier (2019b) found no effects on students grades four through six; math achievement scores were observed for interventionists’ content knowledge. A stronger factor in student achievement, rather, was the fidelity of implementation of the mathematics intervention. “Higher student post-test scores were observed for interventionists with an average fidelity of 95% or greater” (Nelson, Van Norman, Parker, & Cormier, 2019). For this reason, it is recommended that districts have a system of training and ongoing evaluation in place for measuring implementation fidelity of math interventions. In practicality, these findings broaden the capacity for staffing intervention, rather than districts being limited to only math content teachers.

When determining interventionists, it is critical to have a good match between the instructors and the interventions they will be teaching. Leadership teams should consider how all staff members can be utilized. For example, if a particular teacher is highly skilled in understanding the skill progression underlying operations with fractions, allow them to utilize that strength for...
the benefit of the students in that particular skill-based group.

If your district has questions or needs guidance regarding implementation fidelity, refer to the Kansas MTSS & Alignment Phase 1 Guide, or reach out to your regional Systems Alignment Specialist.

**Ensuring Fidelity of Assessment**

Professional development for the selected assessments should be integrated into the district and/or building’s professional development plan and go beyond the assessment training to include ongoing support, coaching, and onboarding to ensure sustained fidelity. Decisions need to be made about who will administer, score, and interpret each assessment. All staff members involved in the administration of an assessment need to be trained on the purpose, rationale, and uses of the assessment and how to interpret the data and its instructional implications. Not only does this help build school capacity, but it also encourages buy-in of the assessment, which is critical for ensuring that teachers use the data to inform their instruction.

Staff members should share a common understanding of monitoring fidelity, viewing it as a means of leveraging their collective impact rather than a punitive evaluation process. The monitoring of fidelity ensures that all data are appropriately collected and used. The three main factors that need to be monitored are as follows: all staff members are trained to administer and score assessments, decision rules and assessment calendars are followed, and results are correctly interpreted and used to guide instructional planning.

Training for staff members is best scheduled just before the assessments are given so the scoring rules can be practiced and reinforced, depending on the assessment system. Effective ways to minimize scoring errors and ensure fidelity include making sure that examiners have excellent training and practice opportunities, periodic ongoing training, experienced examiners to check first-time examiners’ scores, and opportunities to shadow score.

**Ensuring Fidelity of Curriculum and Instruction**

The professional development plan for curriculum implementation proactively identifies training based on staff learning needs. This ensures that staff members are accessing and utilizing curricular materials in the expected manner. To accomplish this, leadership teams should establish methods for monitoring the use of the curriculum by individual teachers. This monitoring allows leadership to customize and plan ongoing professional learning opportunities to support each staff member.

Activities for monitoring the individuals’ fidelity of curriculum implementation are not intended to be punitive, but rather should be understood as a piece of the overall professional development plan, resulting in further staff support as needed. To accomplish this, a method to check for the correct use of the curriculum materials must be established. Many purchased curricula and programs come with fidelity-monitoring tools such as observation or walk-through forms. If districts desire, they can create a form or checklist of their own.

Depending upon district preference, district or building leadership teams might be responsible for establishing a plan to monitor and support the correct and effective use of curriculum.
materials and instructional practices. The following steps can be used to decide how to support staff in the use of evidence-based materials and instructional practices:

- Develop a plan to provide professional development to appropriate instructional staff (e.g., ESOL, Migrant, Title, SPED, and paraprofessionals)
- Determine the key elements of instruction that need to be monitored for fidelity and who will be monitored
- Determine a method (e.g., walk-through, peer coaching) to monitor key elements for fidelity as well as the frequency
- Develop and implement a plan to provide training and coaching to instructional staff members who need additional assistance in providing instruction, as identified through monitoring
- Monitor the plan for fidelity of implementation

These critical components are designed to help leadership teams as they begin the development of an overall professional development plan. Once specific decisions are made, the building leadership team should record the results on the building’s professional development plan. The leadership team should also consider whether the discussion of professional development and fidelity of instruction has led to a need to develop an action plan.

For more information regarding how to plan for professional development and monitor fidelity, refer to the Phase 1 Guide

**Leadership**

**Building Leadership Team**

The Building Leadership Team (BLT) is an essential component of the district’s self-correcting feedback loop, because this team ensures communication between the collaborative teams and the district leadership team. Then the Building Leadership Team also ensures fidelity of implementation, effectiveness of the system, and monitoring of student progress. The team should include teachers, administrators, and staff members who are empowered to make decisions and have areas of expertise that contribute to the academic and social emotional growth of the students.

**Collaborative Teams**

The purpose of collaborative teams is to review data related to student improvement, share data and ideas, and collaborate with other teams to refine instructional methods. Depending on the district, each collaborative team can include but not be limited to every teacher of the same grade level or band, every teacher of the same content area, special education teachers, classified staff, specialists, and coaches. It is also recommended that each collaborative team include a representative from the BLT in order to ensure effective communication within the self-correcting feedback loop.

**Empowering Culture**

**Belief in Students**

The first essential component in mathematics is that teachers hold an ingrained belief that ALL children can achieve proficiency with mathematics. Wilkerson (2020) underscores the
importance of this belief in an NCTM President’s Message, titled *Believing Our Students Can Do Mathematics*, by posing the following questions:

- Do I really believe that each and every student can do mathematics?
- Do I believe each and every student can engage in rigorous mathematics and problem solving?
- Do I believe that each and every student can contribute to classroom discourse about rich mathematical concepts?

Collaborative teams are highly encouraged to truly reflect on their beliefs and how they impact their students. Teachers need to support each other and hold each other accountable in upholding these beliefs. However, this approach goes beyond beliefs because they should translate into actions. Do teachers’ beliefs and actions align? With the support of building leadership, collaborative teams must have these crucial conversations.

**Collective Teacher Efficacy**

Visible learning research defines Collective Teacher Efficacy (CTE) as “the shared belief by a group of teachers in a particular educational environment that they have the skills to positively impact student outcomes.” CTE has the potential to more than triple the rate of learning for students; however, it is neither a quick fix nor easily achievable. Nurturing CTE in a school building and district takes time, but it is well worth the investment. Donohoo (2017) describes four sources that shape this shared belief by teachers as mastery experiences, vicarious experiences, social persuasion, and affective states. The webinar *Fostering Collective Teacher Efficacy* expounds on this topic. Mastery experiences prove to hold the most value, and this is why the Kansas MTSS and Alignment framework advocates for the incorporation of short impact cycles when implementing evidence-based practices as one way to build CTE. See the [Phase 1 Guide](#) for more details about impact cycles.

**Family Engagement**

Bryk et al. (2010) found that schools that are chronically weak in family engagement did not improve math scores. In contrast, schools strong in family engagement were ten times more likely to improve math scores. We recommend partnering with parents to build a deeper understanding of the mathematical concepts and procedures their students will be learning each year. By intentionally sharing student data with parents, educating them on student assessments, and collaborating to set students’ goals, educators take the lead in improving communication between school and home. To learn more about ways to involve families, please visit the [Kansas Parent Information Resource Center](#).

**Conclusion**

Structuring and implementing the components of the Kansas MTSS and Alignment framework within a district is a complex and long-term process. While many details have been discussed throughout this guide, educators can also visit the [Kansas MTSS and Alignment Mathematics Repository](#) for a wealth of resources and guidance. The contact information for all regional Kansas MTSS Math Trainers is listed on this repository.
References


National Association for the Education of Young Children (NAEYC) and the National Council of Teachers of Mathematics (NCTM) (2010). *Promoting good beginnings. A joint position of NAEYC and NCTM*.


