Kansas Multi-Tier System of Supports & Alignment

Early Childhood Math: Structuring

Early Childhood Structuring Guide for Math

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KANSAS TECHNICAL ASSISTANCE SYSTEM NETWORK
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Introduction to Document

The *Kansas Multi-Tier System of Supports Structuring Guides* have been created to assist teams in documenting the structures necessary to begin the implementation of a Kansas Multi-Tier System of Supports (MTSS). This document may contain tools that are to be used in conjunction with content area-specific documents for reading, mathematics, behavior, and social-emotional content areas. All Kansas MTSS documents are aligned with the *Kansas Multi-Tier System of Supports: Innovation Configuration Matrix (ICM)*, which describes the critical components of a MTSS, the features of a fully implemented MTSS, and the *Kansas Multi-Tier System of Supports: Research Base*, which provides a basic overview of the research support for the MTSS.

https://ksdetasn.org/

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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. An aligned, systemic framework for ensuring all students have this experience is referred to as Kansas Multi-Tier System of Supports and Alignment (MTSS). Simply put, Kansas MTSS 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. Kansas MTSS builds a system of prevention, early intervention, and support to ensure that all children learn. Additionally, Kansas MTSS establishes a system that intentionally focuses on leadership, professional development, and an empowering culture, in addition to a focus on student learning.

Kansas MTSS 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. A brief to help start this conversation is located at https://ksdetasn.org/resources/1266. Whether your program is implementing a single content or planning to combine both academic and social/behavior contents, it is essential that you begin with the System Guide and then the specific content guides. The Kansas MTSS system of alignment 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 is to provide a systemic approach to meet the needs of all students. To achieve this, resources must be used in a manner that is both effective and efficient. While Kansas MTSS does not necessarily require additional resources or 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 evidence. Kansas MTSS is an approach to school improvement and accreditation activities that address the academic and behavioral achievement of all students.

Math and Preschool MTSS

Young children have both the capacity and interest to learn mathematics very early (Clements & Sarama, 2007). Long before young children enter school, they naturally and spontaneously explore and use mathematics. Starting in infancy, babies are curious about their world and begin to think about it in mathematical ways. As early as 10 months of age, infants can distinguish a set of two items from a set of three. Unfortunately, mathematics has often taken a back seat to literacy, both in homes and in classrooms. When parents are asked which is more

important, they more frequently say language and literacy over mathematics. They value early language and literacy skills because they are reflective of how children communicate and express themselves. Teachers of young children also tend to neglect teaching mathematics due to their own negative experiences with math (NRC 2009; Clements & Sarama, 2007; Copley 2010).

Nevertheless, learning mathematics is vital for young children's school success. Not only does early mathematical competence influence children's future success in mathematics, it can also impact success in literacy, science, and technology. Early mathematic competence is actually one of the best predictors of school success across the curriculum (Duncan, et al., 2007; NAEYC/ NCTM, 2010).

Children's learning of mathematics is improved when children are provided research-based teaching and learning strategies, well-planned and sequenced curriculum, and integrated mathematical experiences (i.e. teaching mathematics through meaningful contexts). Young children need opportunities to practice and extend mathematical thinking through play, exploration, and creative thinking (NRC, 2009), which makes the application of Kansas MTSS for mathematics in preschool especially important.

The National Research Council (NRC) Committee on Early Childhood Mathematics along with the National Council of Teachers of Mathematics (NCTM) recommends preschool mathematics instruction concentrate on three areas, also known as focal points: numbers and operations (i.e. numbers, comparison, counting, and cardinality), geometry (i.e. shapes and spatial relationships), and measurement (i.e. identifying measurable attributes and comparisons based on those attributes). NRC and NCTM also recommend prioritizing instructional time for each of these areas. The primary focus of mathematics instructional time in preschool should be spent on numbers and operations. The second priority should be geometry, but with less time devoted to it than numbers and operation. Thirdly, they recommend only a small amount of instructional time be set aside for measurement. In addition, they recommend work on patterning and data be woven into the main three focal areas and not taught with the same time investment as the prioritized topics. It should be noted, when lessons combine more than one of the topics (e.g. including numbers in a geometry lesson) it facilitates learning and deepens the understanding of both topics (NRC,2009; Fusion et al., 2010). Kansas MTSS was designed to utilize these key areas and early mathematical research to support all learners.

There is a need for more intentional and explicit mathematics instruction in preschool classrooms. Teaching all students to be mathematically competent requires a system for the early identification of students who are "at risk," as well as a system for providing those students with the interventions they need to become proficient in mathematics. Good classroom curriculum and instruction can meet the needs of most students, however an efficient system for providing high-quality interventions is required to ensure the needs of all students are met.

At times, the application of Kansas MTSS in preschool will be slightly different than what may

be put in place for school-aged children; however, the basic process and practices are similar. For appropriate application to occur, leadership teams must understand the similarities and differences between programming for very young children and those approaches used in more formal schooling. It is important that programs use evidence-based instructional practices that have been shown to be effective with young children, including developmentally appropriate teaching strategies.

Creating the Structure for a Preschool MTSS

The guidance for creating the necessary structure for a preschool MTSS currently focuses on the following:

1. Implementation of an evidence-based core curriculum that supports the acquisition of early math skills and serves as the foundation for meeting the needs of ALL children.
2. Instructional strategies and interventions that support the acquisition of early math skills through differentiated instruction (e.g., small flexible groups, embedded learning opportunities).
3. Determination of preschool end-of-the-year learning targets based on information gathered from curriculum-based assessments, early math general screening tools, and/or other means (e.g., Kansas Early Learning Document: Early Learning Standards [KSELD]) as identified by your leadership team.
4. Universal screening and progress-monitoring activities that assess the areas of early math that are predictive for later math success, specifically those activities included in numbers and operations.
5. Identification of preschool children for whom the core curriculum and instruction does not appear to be sufficient and who may need more intensive instruction.
6. Provision of tiered support (Tier 2/3) through more targeted instruction on specific skills.

Tier 1/Curriculum and Instruction for Early Mathematics

From birth, young children develop knowledge and skills that build a foundation for later mathematical ability. These skills do not develop in isolation, but are intertwined with other developmental domains (Copple & Bredekamp, 2009). As young children explore their world, specific interests spark in-depth investigations, and playtime provides meaningful opportunities to practice and become proficient. Preschool teachers must intentionally create environments and utilize instructional strategies to build children's math competence and conceptual knowledge, while also promoting the capacity for reflection, explanation, and justification of thinking.

How preschool educators teach math is as important as what they teach young children. Early mathematic experts advocate for a balanced approach to preschool instruction (NRC, 2009; Fuson et al., 2010). Traditionally, math in preschool has focused on narrow skill-based instruction embedded within calendar and/or center time, which often results in haphazard or random instruction. When teachers do give mathematics adequate curricular time, they often try to cover so many topics that the results can be superficial and uninteresting to children.

It is important to understand that mathematics and mathematical thinking are distinct in nature. Mathematics are a means of mathematical thinking and reasoning. Mathematical proficiency is one of the greatest predictors of the future academic success of students (Duncan et al., 2007). The Standards for Mathematical Practice describe the variety of expertise that educators should seek to develop in young children. These practices are grounded in the important processes and proficiencies shown to have longstanding importance for mathematics education. The list below presents the Standards of Mathematical Practice and ideas for their application in early childhood classrooms.

Standards for Mathematical Practice (Common Core, 2012).

1. Make sense of problems and persevere in solving them.

Students should be able to understand the problem, determine appropriate ways to attack it, and stick with it until the problem is solved. Preschool students begin to build the understanding that math involves solving problems and asking questions using concrete objects. They check their thinking by asking, "*Does this make sense*" and by trying a variety of strategies to solve a problem. Teachers can support this problem-solving process by asking questions such as, "*How did you figure that out*?" "*What are you trying to figure out*?" and/or "*Can you think of another way to do that*?"

2. Reason abstractly and quantitatively

This standard brings to light the concepts of contextualizing and decontextualizing content. Teachers should model for students the process of breaking down problems to the point of pictorial representations to guide them through concepts that cause students to struggle. This standard represents the point at which students begin to recognize a number represents a specific quantity, and they connect that quantity to a written symbol. Teachers can support this learning by asking questions such as, "*What do you know about the number 4*?" "*How can you show me 4*?" "*Is there another way you can make 4*?" and/or "*How do you know which one has less/more*?"

3. Construct viable arguments and critique the reasoning of others

Talking about the mathematical process while working through problems is essential. Add to this the expectation that students question one another and their processes, and an environment is created in which students will gain a stronger understanding of mathematical language and processes. When engaged in this standard, preschool students will create justifications for their answers and listen to the arguments of others related to how they solved the problem. Teachers can reinforce this standard by asking questions such as, "*How can you be sure that_____*?" "*Will that strategy still work if _____* ?" and/or "*How/why did you decide to try that*?"

4. Model with mathematics

Take mathematics outside the confines of a math lesson. Through this standard, teachers show students the application of mathematics to real-world problems, data collection, and analysis, as well as an understanding of applying logic to the world around us. Teachers in the preschool

classroom can support this standard by looking for opportunities throughout the day that require real-life problem solving and helping children discover solutions through the use of manipulatives, acting problems out, and/or creating drawings.

5. Use appropriate tools strategically

Students select an appropriate tool for use within the classroom, as well as in real- world experiences. This requires a teacher to allow students to seek out appropriate tools and not always provide step-by-step directions. In a preschool classroom, teachers can provide a variety of manipulatives with multiple uses for problem solving, such as using non- standard measurement tools and providing puzzles on a computer in addition to puzzles in the classroom.

6. Attend the precision

Exactness and meticulousness are used when students speak of and practice mathematics. Encourage students to move past the expression, "*I don't know*" to using exact language to mathematically talk through where their understanding is halted within a process. In a preschool classroom, teachers can support this by using rich mathematical language throughout the day so students can refine their language to more mathematically specific vocabulary. In addition, teachers can provide opportunities for mathematical discussions among students, which further helps to grow their mathematic specific vocabulary.

7. Look for and make use of structure

Encourage students to find patterns and repeated reasoning, which helps students as problems become more complex. In a preschool classroom, this goes beyond seeing linear patterns of "red, blue, red, blue" to the more complex patterns seen in numbers. Teacher can support this by pointing out patterns of repetition in numbers, visual patterns found when subitizing, and/or how when one is added to any number, it is always the next number on the number line.

8. Look for and express regularity in repeated reasoning

Students must be able to generalize their thinking and not focus on just the one problem in front of them. Students should work to keep the big picture of a problem in mind while they work on finite pieces during the problem-solving process. Students can also look for short cuts by understanding that certain consistencies exist in math, such as number order, and when 0 is added to any number, the number always stays the same.

Strong early mathematical programs provide a combination of teacher-directed and child-initiated activities, differentiation, grouping strategies (large, small, and individual), and flexible schedules that allow for sustained and in-depth learning through play and responsive/nurturing teaching techniques (Clements & Sarama, 2009; NAECY/NCTM, 2010). Teachers should teach specific math lessons in a logical sequence to expand children's learning to a deeper level of understanding and to ensure that no skills are left to chance. That same logical sequence must also be incorporated through the indirect teaching that happens across the daily schedule.

Effective math instruction happens all day long and across the curriculum. When teachers offer math-related language or "math talk" while children are actively engaged in their own pursuits, children's ability to understand and apply those concepts increase over instruction that involves math talk provided only during whole group lessons (McCray, 2007).

Not only should teachers model "math talk", they should also ask questions that help children expand their thinking and use their own math vocabulary. This can be done by having children explain why they believe their answer is correct or how they arrived at a solution. It is important to encourage students to have math conversations with each other. Young children can share their mathematical thinking, work together to solve problems, explain how they solved a problem, and discuss alternate ways of solving problems. The conversations children have about math should be less focused on the correct answer and more focused on the process used to arrive at an answer. Mathematical conversations support and extend children's thinking and solidifies their understanding.

Once early educators have explicitly taught a math lesson, time must also be provided for children to play and experience math. Play combined with math talk is as important as an explicitly taught lesson. Children at play can learn essential math skills, such as counting, equality, addition, subtraction, estimation, planning, patterns, classification, and measurement. According to the Joint Position Statement on Math published by the National Association for the Education of Young Children (NAEYC) and NCTM, play does not guarantee mathematical development, but it does offer rich possibilities and instills the understanding that math skills are accessible to all (NAEYC/NCTM, 2010; Clements & Sarama, 2004).

The NRC and NCTM identified these three areas as essential preschool math focal points:

1. Numbers and Operations
2. Geometry
3. Measurement

To achieve depth of instruction, the majority of a preschool math curriculum's instructional time should be focused on teaching numbers and operations, followed by geometry, and finally measurement, rather than covering every topic or every skill with the same weight. While data analysis and algebra are also important, they should not be given the same amount of instructional time as the first three; instead, they should be woven into the first three (NRC, 2009; Fuson et al., 2010).

<u>Numbers and Operations</u>

Numbers and operations are the primary curricular focal point and should be the primary goal for preschool. This is where the most math instructional time should be spent. Quantity or number sense may be as important to math development as phonemic awareness is to emergent literacy. Just as children need to hear language, rhymes, and sounds for early literacy, they need experiences with numbers and operations to fully develop their number sense (NRC, 2009; Fuson et al., 2010; McCray, 2007).

Numbers and operations are not simply recognizing numbers and counting; they also involve a conceptual understanding of numbers and what they represent.

Numbers and operations are made up of three major components:

1. Number Core
2. Relations Core
3. Operations Core

Number Core

This component is the largest element of numbers and operations and contains the most crucial skills for numerically proficient children. Those skills include cardinality, knowing the number word list, one-to-one correspondence, and written number symbols.

Cardinality is recognizing that the last number said is the number that represents the set of objects. Or stated simply, knowing how many you counted. Often times, children will count a set of items such as 6 buttons, then if you picked up the last button they counted in the set, they may tell you that button is six. Children must learn to remove the labels of the number words from each individual item and gain an understanding that the last number they stated represents the entire collection, not just the last item. When first teaching cardinality, it is important to start with a small group of items arranged in a row, count from left to right, and make sure the items being counted are of similar size and shape.

Once children seem confident with cardinality, teachers can deepen their level of understanding by asking a child to start in the middle or at any point along the set of objects and count and tell you how many they have. This incorporates order irrelevance, or an understanding that it doesn't matter which order you counted the set, there are still the same number of items. Finally, children need to learn object irrelevance, or the understanding that items do not have to be the same size or shape to be part of a set that can be counted (Clements & Sarama, 2009).

The next skill included in the number core is knowing the number word list, often referred to as rote counting. Children need to learn that there is a stable order in which to say the number word list and it is the same every time. By age 3, most children understand that numbers go in a certain order, but they will often skip numbers and don't have a good sense of the entire number word list. This happens because children learn the number word list as a string of words without meaning. Once they begin to attribute meaning to the words, you may notice children who once could count to 10 or 20 without skipping begin skipping numbers or getting them out of sequence It appears as if they have stepped backwards in their learning, but they haven't. They are making sense of the number words and how they fit together, and they will soon swing back to a stable count order and continue their growth (Brownell et al., 2014).

Once a child can consistently count starting at zero or one, it is important to begin working with them to begin counting from any number and count on. The ability to start at any given number and count on is a precursor to addition and subtraction. This is a skill that cannot be taught or practiced too much. It is important to create fluidity and automaticity in counting, so as to allow children's brains to focus on higher-level math skills. There are several steps involved in problem solving; if children have to think about the number word list, they are unable to perform more difficult counting tasks, including making comparisons between two groups and basic addition or subtraction. Multiple opportunities to practice can become more effective when paired with a movement for every word in the list, such as clapping, stomping, or jumping (Clements & Sarama, 2009). However, over emphasis on rote counting to high numbers before establishing counting principals such as cardinality and one-to-one correspondence with small numbers is counterproductive. The goal in early childhood mathematics is a deeper understanding of numbers and what they represent (Brownell et al., 2014).

One-to-one correspondence is another skill housed within numbers and operations. This is the understanding that each item you are counting gets one and only one count. This skill should be paired with cardinality to help children develop the understanding that the purpose of counting is to determine "how many." Fluency in counting objects in combination with knowing the number word list is a crucial skill for children to move forward in higher-level mathematical concepts.

The final piece of numbers and operations is the written number symbol. Children should be able to recognize the written numeral and understand that it is a symbol that represents a conceptual understanding of a set of four. The quantity of "four" is so much more than a "4" written on a page. As children develop meanings for the written numerals or number symbols, they should also compare these numerals with the quantities they represent. Using multiple representations for the quantity of each numeral helps to build conceptual understanding. This might look like matching the numeral to the time on the clock, to a pattern on a die, and to objects in a set (Fuson et al., 2010).

Relations Core

This component is about relationships, which can be determined by looking at attributes of a set. To support this skill in the classroom, it is important to provide not only visual comparisons but also multiple opportunities to build connections between those visual sets to number words and quantity terms (e.g. a group with 5 bears is more than the set with 3). The greater the use of a variety of words to describe comparisons, the stronger vocabulary children will acquire and be able to use in their own math talk. Preschool teachers tend to concentrate on the "bigger" attribute, such as which has more, which has the most, and which is longer. It is important to broaden the vocabulary and the understanding for children by giving the concepts of less, smaller, fewer and shorter equal time (Clements & Sarama, 2007). To give children a real sense of number size and support their ability to make reasonable comparisons, include benchmark collections of sets of objects posted in your room such as sets of 3, 10, 20, 50, and 100. When doing estimations, support students' learning by teaching them to use those benchmark collections so they are not just guessing how much, but have an anchor to help them make educated predictions (Brownell, 2014).

Included within the relations core are the skills of conservation of number and subitizing. Conservation of numbers is another concept preschool age children acquire. Children grow in their understanding that the number remains the same regardless of how items in sets are distributed or their likeness in size or shape. Prior to a child developing conservation of number, they tend to focus on their perceptions of things rather than the factual information. For example, when objects in 2 groups are a different size or shape, even after counting them, a child will perceive the group with the larger items to have more. The same is true if the items in one group are spread out, making a longer line. Once they gain conservation of number, children understand that there are the same number of items in a group, and they begin to consider the factual information of how many they counted over the perceptual information of how it looks. Providing multiple opportunities to count and recount the same number of items in different configurations and talking about their results helps to solidify young children's conservation of number (Fuson et al., 2007).

Subitizing involves seeing sets and knowing how many are there without physically counting every item. Subitizing introduces basic ideas of cardinality, or "*how many*," as well as more and less, parts and whole, and quantity. It also has a direct link to addition and subtraction. Subitizing is one of the main abilities young children should have opportunities to develop, and can be an area that is lacking especially for children from low-resource communities and those with special needs (Clements & Sarama, 2007). When helping children acquire the skill of subitizing, it is important to change the configurations of sets so children are not just memorizing a visual pattern, but truly gain a sense of how many. Always start with linear patterns, followed by a domino or dice configuration, leaving random scatters for more advanced practice as they are the most difficult for children to subitize. It is also important to use similar shapes on a contrasting background. Teachers should stay away from cute pictures and busy backgrounds that might take away from being able to see the set. Practice with subitizing can be done with dots on a page or with simple manipulatives such as lacer links or inch cubes on a table. Quickly show children different arrangements of items from 1-5 and ask them how many they saw. In addition to supporting an understanding of how many and quantity comparisons, subitizing also helps to develop an understanding that there are numbers within numbers. For instance, 5 can be made up of 3 and 2, or 4 and 1. If we only present numbers through manipulatives in a straight line, children tend to live in a "ones world" and do not see how numbers can be composed. As you begin to work with numbers larger than 4, it is important to emphasize the numbers within the numbers. If 7 is presented in a straight line of dots or manipulatives, the tendency is to count each dot or manipulative. However, if we present 7 as a 3 and a 4, we begin to encourage students to see numbers as compositions of other numbers. This is a critical element of quantity and a precursor to addition and subtraction (Clements & Sarama, 2007; Fuson et al., 2007).

Operations Core

The Operations Core deals with the addition and subtraction of objects. In preschool, when working on basic operations, students should always start with some type of concrete object. It also helps to put the problem in a story form and use physical objects related to the story. The movement involved when children use manipulatives or act out a story problem helps to anchor their learning and solidify their understanding of what it means to add and subtract. Fingers are a

great manipulative, as well. Allow and even teach children to use their fingers when solving problems. There is no need to worry about fingers becoming a crutch for students. Once children gain a better understanding of mathematical processes later in life, this strategy is replaced by more efficient ones (Clements & Sarama ,2007). When children become proficient at using manipulatives through story problems, they can then move into drawings to solve their equations. Only at this point should they be introduced to written expressions and equations using appropriate terminology and symbols (+, –, and =). Having multiple words in their vocabulary for similar actions helps support their conceptual learning of the skill. When teaching addition, use a variety of terminology such as: add, join, put together, plus, combine, total and for subtraction include vocabulary such as: minus, take away, separate, difference, and compare.

Geometry

Geometry is the second mathematic focal point determined by NRC and NCTM. While focused instructional time in geometry is needed at the preschool level, it is recommended that the time spent on these concepts be less than the time devoted to numbers and operations (Fuson, et al., 2010). From the earliest years, children learn about shape and spatial relationships. At first, they are not able to distinguish circle, triangles, and squares from each other, but gradually they develop a richer sense of the parts and attributes of these shapes, along with the ability to orient them in a space (Fuson et al., 2010).

There are three components to geometry that are important for young children to learn:

1. Shape and Structure
2. Composition and Decomposition of Shapes
3. Spatial Reasoning

Shape and Structure

The shape and structure component focuses on teaching children to recognize two- and three-dimensional shapes. Children learn their understanding of shapes based on example, therefore children will develop a more accurate sense of shape when they are exposed to a wide variety of shapes within each category. Children also need to be exposed to examples of shapes beyond circles, squares, rectangles, and triangles; otherwise, children will develop a limited understanding of shapes. For instance, children may not think of a trapezoid as a shape, because it's not a shape that has a name they know. Forming accurate mental models of shapes is important, but not sufficient. When teaching children about shapes, it is also important to include vocabulary that helps them analyze shapes and understand that shapes are characterized and defined by certain parts or attributes. For example, a triangle has three sides and three corners or vertices, and a square has four sides of equal length. When teaching shapes and their attributes, make sure to include a wide variety of vocabulary including both common names and appropriate mathematical terms such as oval and ellipse, corners and vertices, and ball and sphere (Fuson et al., 2010; Brownell et al., 2014).

Composition and Decomposition of Shapes

Composition and decomposition of shapes helps children understand that shapes can be taken apart or put together to create other shapes. For instance, two triangles can be put together to create (compose) a square, or a square can be taken apart (decomposed) to create two triangles. Show children that shapes can also be transformed when they are used to fill other shapes or put together to create pictures, much like children do when using pattern blocks and picture cards. Symmetry is also an integral part of the composition and decomposition of shape. Symmetry includes flipping the same shape over, sliding it, or rotating it into new positions to duplicate designs and three-dimensional structures (Clements & Sarama, 2009).

Spatial Reasoning

Spatial reasoning includes two main abilities: spatial orientation (i.e., knowing where you are and how to get around) and spatial visualization (i.e., building and manipulating objects mentally). Children's skills are initially based on their position within an environment, but quickly expand to include external references. To teach spatial reasoning, it is important to include spatial vocabulary such as "on, in, under, and over" in your daily language with children, and also to provide interesting environments for them to explore and navigate. When going to typical places (e.g., recess or the restroom) with young children, talk about the landmarks you see on the way (i.e., drinking fountains, pictures on the wall), or the routes you take to get to your destination. To deepen children's understanding, encourage them to draw maps beginning with very familiar areas (e.g., their bedroom, their home, the playground, or the classroom) and then extend it to have them create maps of a city they built in the block area or a zoo they have created in dramatic play (Fuson et al., 2010).

Puzzles are another tool to teach spatial reasoning, especially spatial visualization. Children build these skills as they visualize the pieces and work to determine where a puzzle piece may fit or how they might turn it to get it to fit. A great means to increase the speed at which children acquire spatial reasoning and visualization skills are computer puzzles. This is one area in which computers can be more effective in early childhood than hands-on manipulatives. A child may turn and manipulate a physical puzzle piece and not really pay attention to what they have done or how they moved it. On a computer, they have to be aware of the decisions they are making to put the piece in the appropriate spot. This process helps them articulate what they have done more effectively, and solidifies their learning of spatial reasoning (Clements & Sarama, 2009).

<u>Measurement</u>

Children who are surrounded with interesting objects, such as blocks and sensory tables with a variety of containers, are naturally led to discover relationships among them and how they are the same or different. The more frequently children make comparisons, the more complex their comparisons become. Measurement develops from a need to compare two or more objects in a variety of ways. It has a way of bringing both geometry and numbers together, as children explore and experiment with their comparison. When making comparisons with numbers, it is important to teach both sides of specific measurement terms (e.g., more and less, same and

different, heavy and light, longer and shorter, full and empty) and to incorporate specific measurement terms into your daily vocabulary whenever possible.

While measurement is important, the NRC and NCTM recommend only a small amount of instructional time be spent on this third focal area (Fuson et al., 2010). The measurement focal area involves skills for identifying measurable attributes and making comparisons based on those attributes, including length, area, and volume.

As children begin to measure using non-standard units, teachers support their learning by helping them recognize the need to measure by using the same unit. Children often see no problem mixing non-standard units as they measure, for example using both blocks and paperclips at the same time to cover what they are trying to measure. Children need to learn that when units are not equal, they are not a unit that can be used for measuring. Once children have measured something and are counting the units, they always need to clarify their units by labeling them, using the measurement terms, not just the number count. For example, teach them to say, "the flag is seven blocks long" instead of "the flag is seven." Another common error children make is leaving gaps between the units, instead on aligning them end to end. You can help children develop an understanding of the necessity to align the objects without gaps by comparing that child's results with the results of another child who measured the same item with the same units without gaps. Initiate conversations about the varying results, helping them discover the reason for the different measurements (Brownell, 2014).

Once children become proficient at measurement using non-standard units, teachers can further their understanding by teaching them the relationship between the size and number of non-standard units used. This is done by comparing the results of measuring the same object multiple times using a variety of manipulatives. For example, when measuring the length of a table, have one child measure using inch cubes while another measures the same table using a block from the block area. Discuss the results and the children's conclusions about why they came up with different number amounts in their measurement.

Finally, preschool is the perfect time to begin to support children in making indirect comparisons using a third object. For example, when children dig 2 holes on the playground and they use a stick to see which one is deeper (Clements & Sarama, 2004).

Algebra and Data Analysis

The foundations for data analysis in early childhood lie in other areas such as counting and classifications. Calendar serve as a connection to the focal points of numbers and operations and geometry. As children learn to sort objects and quantify their groups, they also gather data to answer questions, classify those answers into categories, and quantify their responses (Clements & Sarama, 2009). Data Analysis has deep connections to the other focal point areas, NCTM does not recommend giving data analysis its own block of instructional time, but rather, recommends combining it into the other areas.

Algebra at the preschool level is about finding patterns in the world. However, the concept of pattern goes beyond the typical practice of "doing patterns" in preschool classrooms, which involves creating simple sequential patterns such as "red, blue, red, blue" with manipulatives or on a paper chain. It includes seeing more complex patterns, such as the perceptual patterns found on dominoes, the patterns found in the number world, the repetition of numerals 0-9, and the pattern of one more when counting and adding (Clements & Sarama, 2009). It's important for teachers to understand patterning in all its forms, so they can take children beyond simple linear patterns to a way of thinking about patterns that support them in making mathematical connections. By talking about patterns not only in terms of the ABAB pattern and its variations (e.g., AABAAAB and ABCABC), but also assigning numerical value to patterns, by identifying when there are two of something and then one of something else, or every third one is yellow. These deeper conversations help children make mathematical generalizations (e.g. when adding a zero, the sum is always that number, or when you add one more, the sum is always the next number in the number sequence). It is important to tie this type of algebraic thinking to both numbers and shapes.

Calendar

When thinking about preschool mathematics, many teachers immediately think about "calendar time" and believe it infuses math into the student's day. The calendar seemingly provides the time to teach patterning, number, and the number word sequence on a regular basis. However, scholars (Ethridge & King, 2005; Beneke, Ostrosky & Katz, 2008) have questioned the calendar as a context for preschool mathematics and the breadth/depth of mathematical learning children actually receive during a typical calendar routine. When reflecting on the value of incorporating calendar time into preschool, teachers must consider their instructional goals for this routine and whether the skills being taught and the strategies used to teach those skills are developmentally appropriate.

To participate meaningfully in calendar activities, young children must understand that time is sequential (i.e. yesterday, today, and tomorrow; morning, afternoon, and evening; Sunday, Monday, Tuesday, and so on). Children also must be able to conceptualize before and after and think about future and past events. While preschoolers can recall past events and talk about what will happen, most do not understand the concepts of yesterday, today, or tomorrow, nor are they able to talk about these events in terms of units of time such as days or weeks. The ability to judge the relative time from a past event or until a future event typically is not in place until sometime between the ages of seven and ten (Beneke et al., 2008; Ethridge & King, 2005). While children can learn to recite the days of the week and months of the year, they assign little meaning to them. Psychological time, which focuses on the important events in a child's life or the life of their family (i.e. birthdays, trips, and events), is much more relevant to young children than time on a clock or days on a calendar, and does not correspond to regular units of minutes, hours, days, and months.

Early educators sometimes use the calendar to teach concepts other than time, such as sequencing, patterning, and number recognition. However, this too has its own set of complications. The seven-column, five-row grid of a calendar interferes with children's understanding of our base-ten system. The calendar grid gets filled in a different way each month, the day a month begins is different every month, and the number of days is variable; which prohibits children from seeing true patterns in the numbers. Seven is an unnatural break in our 0-9 sequence of digits and doesn't support children in using their natural counting tools – their fingers (Brownell et al., 2014).

The 10-20 minutes spent on calendar during a preschool day would be more productively spent on intentional math instruction, which gives preschool children opportunities to explore and experiment with math concepts, use concrete materials, and interact with a responsive adult to question and guide learning (Brownell, 2014; Beneke et al., 2008).

Standards and Curriculum

The Kansas Early Learning Standards (KELS) document (http://www.ksde.org/Portals/0/Early%20Childhood/Early%20Learning%20Standards/KsEarlyLearningStandards.pdf) provides a starting point for teachers and curriculum committees. The KELS document provides information and guidance to early childhood providers on the developmental sequence of learning for children from birth through kindergarten. Aligned with the Kansas K-12 Standards, the KELS are structured around domains for learning that include a whole-child perspective.

The KELS were not designed to serve as an assessment or a curriculum. Rather, they were designed to guide educators in selecting curricula and assessments focused on the skills and knowledge young children should have as a result of participating in high-quality early childhood programs. An understanding of early math development, the curriculum focal points of early math, and evidence-based instructional strategies are fundamental considerations when selecting preschool mathematics curricular materials.

The Kansas MTSS Framework advocates for the selection of a comprehensive, evidence-based preschool curriculum that addresses all domains of learning outlined in the KELS. While your MTSS efforts are focused on academics and/or social behavior when it comes to intervention, it is important that programs use curricula that address the needs of the whole child. Programs are encouraged to use resources such as the Head Start Preschool Consumer Reports (https://eclkc.ohs.acf.hhs.gov/sites/default/files/pdf/math-preschool-curriculum-report_0.pdf and/or the What Works Clearing House (https://ies.ed.gov/ncee/wwc/) to examine the evidence-base of different preschool curricula.

In addition, programs should examine their selected curriculum to determine whether the three focal points for mathematics instruction are adequately addressed. Some comprehensive curricula provide strong support for early mathematics, while other may not include all three

essential areas with the appropriate weight. If this is the case, supplemental mathematic materials may be needed to strengthen your overall program and ensure students' outcomes are maximized.

Professional Development, Curriculum Fidelity, and Communication

Once a program has determined what their comprehensive and/or early mathematic curriculum will be during the implementation of their beginning MTSS efforts, their leadership team will want to record this information on their Tier 1 protocol with enough specificity to ensure all teachers can implement the curriculum with fidelity. Typically, curricula contain more components/content/days than can be implemented within a classroom day or year. Leadership teams will want to decide what parts of their curriculum are essential elements and what are up to teacher discretion. It will be important when comparing data across classrooms that there be some consistency regarding what and how the preschool curriculum is taught. It is also important to keep in mind what the curriculum itself considered critical elements. For research-based curricula that have demonstrated positive outcomes, decisions to eliminate or reduce the time spent on an essential element can impact the results your program may experience.

Leadership teams should also make decisions about expectations regarding the daily schedule. A preschool program's daily schedule is a critical component of curriculum and instruction. Depending on your program's philosophy and/or requirements, you may want to determine how much time should be expected for self-directed learning, how much time should be teacher directed, the maximum duration of a teacher-direct activity, etc. This step will ensure that leadership teams have outlined an achievable and developmentally appropriate expected use of their preschool curricula and help provide consistency in implementation across classrooms. Teams should create a sample schedule with expected time allotments for the day. Decisions about what parts of the curriculum must be implemented, in what types of settings (whole group, small group, play), and for how long (how long should a typical whole group last, how much time should be spent outside or in play) should then be documented and communicated to teachers.

Whether implementing a new curriculum or refining the use of a current curriculum, professional development is another task leadership teams should take time to consider and plan. Creating a plan for professional development is a critical step in ensuring fidelity and sustainability. Teams should consider:

- What training will staff members need to implement curriculum expectations?
- Who needs to know the expectations?
- When and how will the curriculum expectations be communicated to staff?
- What type of follow-up will be needed?
- Who will communicate the expectations to new staff?
- How and when will new staff members receive training on your curriculum?

Leadership teams will want to plan for both their communication and professional development needs each time they meet. Communication is an important aspect of achieving staff buy-in and

sustained change. Therefore, while developing a communication and professional development plan, teams should ensure there is bidirectional communication. A one-way communication plan may get the message out, but it does not easily allow for feedback. Reciprocal communication is critical for a leadership team to create a plan the staff will support.

Once these decisions have been made and documented, leadership teams will also want to consider how they will monitor the fidelity of the implementation of their plan. Monitoring fidelity of curriculum implementation is not meant to be punitive; rather, it is intended to provide information for leadership teams to use when making data-based decisions regarding their MTSS. Curriculum fidelity data can provide insight into needed professional development, assist teams in making determinations about curriculum, and/or help leadership teams decide whether the expectations they outlined are appropriate and possible. Using the expectations that were outlined for teachers regarding the Tier 1 protocol, a checklist can be created charting your curriculum expectations. This checklist could be used by an administrator during walkthroughs, as a reflective self-assessment, or as a peer mentoring tool. How the fidelity checklist will be used and how fidelity will be monitored is up to a leadership team based on the needs of their system.

Assessment

Comprehensive Assessment Plan and Data-Based Decision Making

Preschool programs already use a variety of assessment tools for a variety of purposes. Developmental screening tools (e.g. DIAL, ASQ) are used to determine which students may have developmental delays and may need further assessment. Diagnostic assessments (e.g., Braken, Brigance, PLS, Peabody Motor Scales) often compare children to a standardized sample and are most generally used to determine whether a child may qualify for special education or other services. Curriculum-based assessments (e.g., AEPS, Carolina, Teaching Strategies Gold) are used multiple times per year to measure a child's progress over time and help teachers in planning core curriculum. Program assessments (e.g., ECO, Kindergarten Readiness Snapshot) are often measures required by funders and used to evaluate the overall effectiveness of programs. In the Kansas MTSS process, the first step in creating a comprehensive assessment plan is to consider the assessment tools you are already using, the purposes for which you are using those tools and whether there are tools or practices that are duplicative in purpose or are no longer necessary. This information should be documented on your Comprehensive Assessment Plan along with other decisions your leadership team makes about the assessments that will be used in your program.

Universal Screening

The next step in the MTSS process is to determine what your program will use as a universal screening tool. Unlike developmental screening tools, a universal screening tool is used to compare students to a normative sample or standard for the purposes of identify which students may be at risk for later learning difficulties based on indicators that are predictive of later achievement. A developmental screening tool identifies children who may have a developmental delay, while a universal screening tool identifies students who may be at risk and ranks them

based on that risk into levels/tiers. This distinct difference makes the data from universal screening tools particularly helpful for examining the effectiveness of your curriculum and supports a process for tiered intervention.

Universal screening tools appropriate for early mathematics assess the skills related to number sense. Typically, these skills include counting, cardinality, number recognition, and quantity comparisons. They are valid and reliable for this purpose, can be used with confidence to make instructional decisions, and can be given at least three times per school year. To assist teams in selecting universal screening tools appropriate for early childhood programs the document *Preschool Universal Screening Tools* can be found in the appendix. Leadership teams will need to ensure that they have a tool that examines the predicative elements of early mathematics.

Creating a comprehensive assessment system is one of the major structuring tasks that must be completed by your leadership team. Kansas MTSS recommends screening preschool students at least three times per year using a universal screening tool. This information should be reviewed alongside elementary universal screening data to support discussions related to the adequacy of your preschool curriculum, the match between your preschool and kindergarten scope and sequence, as well as the information necessary to meet the need of individual students. When comparing preschool and elementary data, leadership teams should keep in mind the make-up of their preschool population and how it differs from the kindergarten population. In most school systems, all kindergarten students do not attend a public preschool program. Additionally, the students who do attend preschool in a public school often had to qualify for that program because they met at-risk criteria or were receiving preschool special education services.

Your leadership team will use universal screening data to examine the adequacy of your curriculum and your system's need for professional development. Classroom staff members will use universal screening data to plan for differentiated instruction within the core curriculum, to identify students in need of additional support for mathematics, and to determine the focus of that intervention. Each universal screening tool sets the criteria for determining which students are at or above benchmark and which students are in need of Tier 2/3 support. Programs should follow the decision rules for the tool they select when using this information to group students into levels of tiered support.

<u>Progress Monitoring</u>

Progress monitoring is conducted within Kansas MTSS to inform staff members of students' growth related to content knowledge and skills. Regular progress monitoring and use of the data when making instructional decisions results in students making more academic progress than when teachers do not use progress monitoring. Teachers' accuracy in judging student progress increases when progress monitoring strategies are used consistently (Stecker & Fuchs, 2000).

For preschool students in the core (Tier 1), progress monitoring is often conducted using curriculum-based assessments (e.g., AEPS, Teaching Strategies Gold), administered three to four

times per year. These assessments are tied to content-area instruction and help teachers determine whether students have learned the concepts and skills taught so that the subsequent instruction can be adjusted to re-teach concepts or provide additional practice of skills not yet mastered.

For students receiving supplemental (Tier 2) and intensive (Tier 3) instruction, progress-monitoring data are used to chart the growth of individual students regarding the skills being targeted in intervention. Progress monitoring for students receiving supplemental or intensive instruction addresses two questions:

1. Is the intervention working?
2. Does the effectiveness of the intervention warrant continued, increased, or decreased support?

Unlike the K-12 MTSS system, preschool universal screening tools generally cannot also be used as progress monitoring tools because they cannot be given with enough frequency to monitor intervention effectiveness and make changes to the level of intervention a student receives. Instead, preschool programs are encouraged to use mastery monitoring strategies to assess and monitor the progress of students receiving tiered intervention. Mastery monitoring strategies are teacher designed and involve directly collecting data on a student's mastery of the specific skills being taught in intervention. Typically, changes to the level of tiered instruction a preschool student receives will only happen after each universal screening benchmark period; however, teachers can use the data they collect through mastery monitoring and their knowledge of the child to make changes when the intervention efforts do not seem to be effective or indicate a change is needed.

Collecting and graphing progress-monitoring data over a series of weeks will provide a visual pattern of skill acquisition for students receiving additional support. Kansas MTSS recommends mastery monitoring data collection in preschool should occur at least one time every two weeks for students receiving Tier 2 support and one time every week for students receiving Tier 3 support.

Diagnostic Assessments

It is not generally necessary for leadership teams to identify a formal diagnostic process to determine instructional focus in preschool. The skills being assessed at the preschool level are often basic enough to not warrant deeper evaluation. In the K-12 MTSS assessment system, diagnostic assessments are used to help narrow down the focus for intervention. Preschool early math intervention will focus on the number core. Some published protocol interventions, if selected, do have informal assessments that can be used to place a student into the appropriate level of the program and could be used at the preschool level.

Professional Development, Assessment Fidelity, and Communication

Once assessments and assessment processes have been selected, your leadership team should plan for appropriate professional development and ongoing support to all staff expected to use

these tools and processes. Decisions need to be made about who will administer the universal screening tools, score the assessment, and enter data into your database. If all teachers are involved in the administration of an assessment, they will need to be trained and supported to ensure fidelity of assessment administration. Sometimes programs choose to create an assessment team to collect universal screening data, in which case those team members need training. Regardless of whether every staff member administers the assessment or a team does, all staff members must understand the purpose, rationale, uses of the assessment, and how to interpret the instructional implications of data. Initial and ongoing training should be differentiated according to the expected use, alignment of practices, and each staff member's prior knowledge.

It is important to monitor the fidelity of assessment administration, especially when it is new for staff. Fidelity monitoring helps ensure all data are valid and reliable. There are three main areas to be considered:

1. Are assessments administered and scored by staff members who have been trained to do so?
2. Are assessments administered according to the assessment calendar?
3. Are assessment results correctly interpreted and used to guide intervention?

Effective techniques to minimize scoring errors while ensuring fidelity include making sure examiners have the following:

- Excellent training
- Opportunities to practice
- Periodic training review
- Experienced examiners, mentor/check first-time examiners' scorning
- Opportunities for shadow scoring (two examiners score the same student, thereby allowing them to compare scores)

Within the framework of professional development, the best opportunities for ongoing professional development among staff members come through commissioning new examiners to work with the experienced examiners and providing opportunities for shadow scoring. Such opportunities should be included within the professional development plan as implemented and monitored by your leadership team.

In planning for professional development, it is helpful for leadership teams to consider these questions specific to each assessment method:

- Which staff members are expected to administer the assessment?
- Which staff members will not be administering the assessment, but will be involved in interpreting instructional implications of the results?
- Which staff members, if any, have experience with or have previously received professional development on the assessment?

- Which staff members need to attend initial professional development on the administration of the assessment?
- Which staff members need to attend initial professional development on the interpretation of the assessment?
- When (date) will staff members first be expected to administer the assessment?
- When (date) will initial professional development be provided?
- Who will provide the professional development?
- Who will monitor the correct administration (fidelity) of the assessment?
- What method will be used to monitor the correct administration (fidelity) of the assessment?
- How frequently will the administration (fidelity) of the assessment be monitored?
- When and how will ongoing professional development for staff members be provided?
- When and how will professional development for staff members needing additional support in effective assessment administration be provided?
- Who will provide professional development for new staff, and how will it be provided?

These questions are designed to help leadership teams as they begin the development of an overall professional development plan. Once specific decisions are made, the leadership team should record the results on the professional development plan and organize how these decisions will be communicated with staff. Once again, it is important to remember that communication is a key aspect of achieving buy-in and sustainability. Therefore, procedures are designed and executed to ensure regular and consistent communication about what is happening regarding your MTSS efforts—not only among the leadership team, but also with all stakeholders. It does not have to be a large formal plan; it only needs to be as large and formal as necessary for the leadership team to ensure that bi-directional communication occurs as planned.

Leadership teams also need to consider communication with various stakeholders regarding how, when, and what assessments are given. Staff members will need to know about decisions regarding changes in assessment practices. Parents are also interested in assessments in which their children will be participating, and leadership teams will need to discuss how the results of assessments will be shared with parents. The leadership team should make decisions regarding what information is appropriate to share with which stakeholders and when that information should be shared.

- Who needs the information about assessments?
- What information do they need?
- When will communication occur?
- Who will provide the information?
- How will the communication be provided?
- What feedback or input will be requested?
- How will the feedback/input be used?

Once the leadership team develops a communication plan regarding assessment, the plan should be implemented and then regularly reviewed at leadership team meetings. Any communications

that have occurred or feedback that has been received can be shared with team members, and any needed revisions can be planned and implemented. In this way, consistent communication between the leadership team and stakeholders is ensured.

Tier 2/3

Grouping for Preschool Math Intervention

Preschool populations by their very nature include children with a wide variety of skill levels. Therefore, preschool daily schedules are designed to provide multiple opportunities for differentiated instruction along the developmental continuum. ALL children, including those needing support through Tiers 1, 2, and 3, should participate in the core mathematics curriculum with differentiation provided. Differentiation of core curriculum is considered an element of Tier 1 for all students.

When considering how to provide interventions for students needing Tier 2/3 support, Kansas MTSS recommends preschool programs not follow the intervention models typically used in K-12 programs. Instead of grouping students across classrooms or bringing in someone the child does not know, Tier 2/3 intervention should ideally be provided in a child's classroom by familiar adults. It is especially important for young children to develop positive and secure relationships with adults. Research suggests that preschool teacher-child relationships play a significant role in influencing young children's social and emotional development (Fox & Hemmeter, 2009). Therefore, children identified through universal screening as requiring more support should receive that support through additional small groups and/or embedded learning opportunities within the daily routine and their play.

Using the decision rules determined by your universal screening tool, children needing additional instruction in key early math skills will be identified to participate in intervention focused on a comprehensive intervention that encompasses the multiple skills included in number sense.

Tier 2

Kansas MTSS recommends that classroom teams consider at least one of two approaches when designing early math intervention for individual students. Classrooms may use a combination of both approaches to meet the individual needs of their students.

The first option involves the design of an additional small group (e.g. 3 to 4 students, 2 to 3 times per week for 10 to 15 minutes). Students needing Tier 2 support would be assigned to an intervention group based on the universal screening tool. Small groups could be provided in a variety of ways in a preschool classroom. Interventionists might pull students for a short time during self-directed learning activities or during other flexible times of the day (arrival/opening activities, transitions, snack time, etc.). Times for intervention can also be built into the daily

schedule. Adults might work with all of the students in small groups of varying sizes and purposes. Interventions should be selected from the district's Tier 2 Protocol.

For some students/classrooms, it may make more sense to use the evidence-based strategy of Embedded Learning Opportunities to provide a student with distributed practice across the daily schedule on intervention targets. Therefore, another option is to design an intentional schedule that provides a student with frequent (i.e. 8 times per day) documented Embedded Learning Opportunities on targeted skills. The key to this option is the documentation of who, what skills, how, and when the Embedded Learning Opportunities will occur and a method to ensure that each student receives the specified opportunities to practice each day. For this approach, teams will narrow down the learning target to a small set of skills that can be embedded based on developmental progressions. The use of a matrix, with the daily schedule listed vertically and the activities listed horizontally, can allow teams to create a process for when/who/how embedding will occur. The specific learning targets should be listed on each student's matrix and a process to keep track of when the opportunities are provided should be documented.

To increase opportunities for practice, it is also recommended that, whichever approach is used, a learning center be intentionally designed based on early math targets. Classroom staff should encourage students needing Tier 2 support to participate in this targeted center multiple times per week. These learning opportunities should be designed to complement and extend what was learned in intervention, as well as other early math topics addressed in the core curriculum.

Tier 3

Students who are identified as needing Tier 3 early mathematics intervention require more intensive opportunities to learn early math skills. Recommendations for Tier 3 look similar to those in Tier 2, but the intensity of the intervention should be increased through more frequent and smaller groups.

One option for intervention at Tier 3 is small group instruction. In contrast to Tier 2, the group size for student's needing Tier 3 should be decreased and the frequency should be extended (e.g. 1 to 2 students, 4 to 5 times per week for 10 to 15 minutes) to provide students more intensive support. Students needing Tier 3 support are assigned to an intervention group based on the need identified by the universal screening tool, and interventions should be selected from the district's Tier 3 Protocol.

The use of Embedded Learning Opportunities may be an especially useful strategy for some students needing Tier 3 early math intervention. Therefore, another option within Tier 3 is to design a schedule that provides a student with more frequent (i.e. 12 time per day) documented Embedded Learning Opportunities with targeted skills. This option also requires documentation of how, with whom, and when the Embedded Learning Opportunities will occur each day and a method to ensure students receive the planned Embedded Learning Opportunities each day.

To increase opportunities for practice, it is also recommended that instructors encourage students in Tier 3 to participate in learning centers proactively designed based on early math targets multiple times per week.

Tier 2/3 Protocols

Leadership teams must develop a Tier 2 and Tier 3 Protocol for mathematics intervention. A protocol outlines a procedure or system of rules that govern the selection of intervention methods and materials based on the intervention area identified by the universal screening tool. Just as leadership teams determined the core curriculum, it is imperative they consider what staff members will use to provide early math intervention. A protocol makes it easier for staff to implement interventions, because they do not need to design individualized interventions for each student. It also helps leadership teams as they examine data. If teachers are selecting from the same few interventions and students are not making the expected progress, leadership teams have documentation that different intervention materials and approaches are needed.

Leadership teams should identify current materials and critically evaluate them to ensure that the essential skills are represented and materials will support targeted areas. Leadership teams must also consider the evidence-base of different interventions and instructional approaches. Prior to selecting, purchasing, or using any instructional materials, it is critical to carefully review the research base and match it to your student population. To assist teams in selecting math interventions appropriate for early childhood programs, the document *Preschool Early Math Intervention Ideas* can be found in the appendix.

In Kansas MTSS, the intervention curriculum protocol incorporates a portion of the protocol methodology and the problem-solving model. This is referred to as a hybrid model. In a hybrid model, a set group of interventions is defined to be used throughout the system. The interventions are chosen from a list of evidence-based approaches designed for specific areas of concern. Collaborative teams determine which intervention is to be used first, based on their universal screening data. Once the intervention begins, progress monitoring data are used to determine if an intervention needs to be adjusted, intensified, or customized, based on pre-established decision rules (McCook, 2006). Once the curriculum protocols are developed, leadership teams should determine a management system for organizing and using the materials selected to ensure all staff members providing supplemental and intensive intervention know where materials are located and how they are organized, thereby allowing for efficient planning for instruction.

The goal of interventions should always be to accelerate learning. If student performance indicates that this is not happening, the intervention needs to be adjusted. Intensity of instruction may be needed in order for interventions to be effective. “If instructional groups are too large, instruction is not properly paced or focused, or too many intervention sessions are cancelled, then impacts on student performance will be reduced” (Torgesen, 2006, p. 4). According to Torgesen (2006, p.4), one of the biggest risks of intervention groups is that we begin to expect a lower

standard of performance for students who require them. For intervention groups to work properly, intervention systems require school-level monitoring and regular adjustments. This is accomplished in Kansas MTSS through collaborative teams who meet on a regular basis to analyze students' progress, make adjustments to instruction, and use of the Self-Correcting Feedback Loop for communication. At least eight key aspects are involved in developing and maintaining an effective intervention system (Torgesen, 2006):

1. Strong motivation on the part of teachers and school leaders to be relentless in their efforts to leave no child behind.
2. A psychometrically reliable system for identifying students who need interventions in order to make normal progress in learning math.
3. A reliable system for monitoring the effectiveness of interventions.
4. Regular team meetings and leadership to enforce and enable the use of data to adjust interventions as needed.
5. Regular adjustments to interventions based on student progress. The most frequent adjustments should involve group size and time (intensity).
6. Enough personnel to provide the interventions with sufficient intensity.
7. Programs and materials to guide the interventions that are consistent with evidence-based research.
8. Training, support, and monitoring to ensure that intervention programs are implemented with high fidelity and quality.

Professional Development, Assessment Fidelity, and Communication

Once the intervention materials have been selected, it will be necessary to provide professional development that is comprehensive, sustained, and intensive enough to support all staff members who are expected to use the curricula to provide instruction. Simply having curriculum materials available does not ensure appropriate use. Staff members must have a working knowledge of the curriculum content and materials, as well as an understanding of the planning and pacing process for lesson development. Leadership teams must set clear expectations that curricular materials be implemented and used with fidelity and provide professional development to support such outcomes.

Ensuring Fidelity of Intervention

A professional development plan for intervention curriculum should be dynamic in nature and result in intervention curriculum being implemented with fidelity. It is a plan that proactively identifies professional development needs based on individual staff members' learning needs to utilize specific intervention curriculum/strategies. It ensures that staff members are accessing and utilizing curricular materials in the expected manner, by planning for and conducting intermediate and follow-up activities. Activities for monitoring the fidelity of intervention curriculum implementation are not intended to be punitive, but rather, should be understood as a part of the overall professional development plan. Many purchased curriculum and programs come with fidelity-monitoring tools, such as observation or walk-through forms. Leadership teams are responsible for establishing a plan to monitor and support the correct and effective use of curriculum materials.

In planning professional development, it is helpful for a leadership team to consider the following questions specific to each curriculum selected:

1. Which staff members are expected to implement the curriculum/strategy?
2. Which staff members, if any, have experience with or have previously received professional development regarding the curriculum/strategy?
3. Which staff members will not be implementing the curriculum/strategy but will be expected to align instruction?
4. Which staff members need to attend initial professional development on the curriculum/strategy?
5. When (date) will staff be first expected to use the curriculum/strategy?
6. When (date) will initial professional development be provided?
7. Who will provide the professional development?
8. Who and how will it be ensured that staff members have all materials necessary to implement the curriculum/strategy?
9. Who will monitor the use/implementation (fidelity) of the curriculum/strategy?
10. What method will be used to monitor the use/implementation (fidelity) of the curriculum/strategy?
11. How frequently will the use/implementation (fidelity) of the curriculum/strategy be monitored?
12. When and how will ongoing professional development for staff members using the curriculum/strategy be provided?
13. When and how will professional development for staff needing additional support to use the curriculum/strategy effectively be provided?
14. Who and how will professional development for new staff be provided?

As at each of the previous steps, once decisions have been made and documented for Tier 2/3 interventions, leadership teams should create a plan for communication/dissemination.

Collaborative and district-level teams will need to know the plan so it can be carried out with fidelity. Leadership teams should consider the following:

- Does the communication plan need to be modified?
- Are there steps that need to be modified?
- Did the discussion of a communication plan for intervention lead to a need to develop an action plan or to add any items to the stop-doing list?

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Appendix

Preschool Universal Screening Tools			
Reference	**Description**	**Target Group**	**Cost/ Retrieval Information**
myIGDIs (McConnell, Wackerle- Hollman, Bradfield-Roloff, Rodriguez, Hojnoski, Floyd, Duran, & Missall, 2006, 2013)	The myIGIDs early literacy+ includes measures for vocabulary, comprehension, phonological awareness and alphabet knowledge. An alternate Spanish version is available for literacy. The myIGDIs early numeracy includes measures for numbers and operations.	4 and 5 year olds	Early Literacy+ Kit is $315 per classroom set. Includes 1 year access to online data system and training modules. Annual renewal fee for online data system Early Numeracy Kit is $285 per classroom set. Includes 1-year access to online data system and training modules. Annual renewal fee for online data system. When purchased together the early literacy + and early numeracy kits are $495 per classroom set. http://www.myigdis.com
Preschool Early Literacy Indicators (PELI) (Dynamic Measurement Group, 2016)	The PELI measures early literacy through a storybook format and includes measures for alphabet knowledge, vocabulary, oral language/comprehension and phonological awareness	3 to 5 year olds	Available to anyone willing to participate as a research partner. Research partners must purchase classroom kits. The 3-4 year old bundle is $99 and the 4-5 year old bundle is $99. https://dibels.org/peli.html
FastBridge (FastBridge Learning, 2017)	earlyReading composite measures alphabet knowledge and phonological awareness Developmental Milestones measures oral language earlyMath composite includes measures for numbers and operations.	4 and 5 year olds	Available from FastBridge Learning. Those interested should contact FastBridge for pricing and availability http://www.fastbridge.org/assessments/
mCLASS:CIRCLE (Landry and the University of Texas Health Science Center)	mCLASS:CIRCLE is a computer based assessment that can be administered in English and Spanish. It measures vocabulary, alphabet knowledge, phonological awareness and numeracy. It also includes measures for 11 Head Start Domains	Preschoolers	Available from Amplify. Those interested should contact Amplify for pricing and availability https://www.amplify.com/
PALS-PreK (Invernizzi, Sullivan, Meier and Swank, 2005)	PALS-PreK measures phonological awareness and alphabet knowledge.	4 to 5 year olds	Pricing is on a per student basis with online scoring available at an additional const. Pricing information

	It does not include an oral language measure.		can be obtained by contacting the PALS Marketplace https://www.palsmarketplace.com/
Early Screening Project: (ESP; Walker, Severson, & Feil,1994)	The ESP is a screening tool that assesses the frequency and intensity of behavior problems in young children. There are three stages of assessment, ranging from teacher rankings and ratings to direct observations of behavior.	Preschool	There is a free version online at http://esp.ori.org/index.html Walker, H.M., Severson, H.H., & Feil, E.G. (1995). ***Early Screening Project.*** Eugene, OR: Oregon Research Institute. ***(A KIT is available for purchase from Applied Behavior Science Press, 261 East 12th Avenue, Suite 210, Eugene, OR 97401, Phone: 888.345.8744, Fax: 541.345.3854)***
Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997)	Used to assess students on five behavioral domains: conduct problems, hyperactivity, peer problems, emotional symptoms, and prosocial behavior.	Preschool – High School	Free – Download on-line or Access web-based administering and scoring http://www.sdqinfo.org
BASC – 2 Behavioral and Emotional Screening System (BASC-2 BESS; Kamphaus & Reynolds, 2007)	Used to identify children who may be experiencing behavioral or emotional issues that negatively impact their academic achievement or social relationships.	Preschool (starting at age 3), School-age through 12th grade	Approximately $100 for the preschool kit (Manual and 25 each of the parent and teacher forms. Approximately $1 per form for packages of 25 or 100 forms. Approx $70 for the manual. www.pearsonassessments.com

Prices may change. Please confirm pricing before making final decisions.

Kansas MTSS
Preschool Math Intervention Ideas

Tier 1 Instructional Practices /Curricula

- Choosing a Comprehensive or Math Curriculum –
  - Head Start Preschool Curriculum Consumer Reports https://eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/practice/curricula
  - Mathematics Curriculum Consumer Report - https://eclkc.ohs.acf.hhs.gov/hslc/tta-system/teaching/docs/math-preschool-curriculum-report.pdf
- SRA Building Blocks – https://www.mheonline.com/onlinesamples/program.php?subject=5&program=135&p=1
- My Math - https://www.mheonline.com/mhmymath/product
- DLM Early Childhood Express - https://www.mheonline.com/programMHID/view/DLM2011
- Engage New York - 1 https://www.engageny.org/resource/prekindergarten-mathematics-module-1
- Big Ideas of Early Mathematics - https://www.pearsonhighered.com/product/The-Early-Math-Collaborative-Erikson-Institute-Big-Ideas-of-Early-Mathematics-What-Teachers-of-Young-Children-Need-to-Know/9780132946971.html
- Let's Talk About Math - http://products.brookespublishing.com/Lets-Talk-About-Math-P763.aspx
- Teaching Mathematics in Early Childhood https://www.amazon.com/Teaching-Mathematics-Early-Childhood-Moomaw/dp/1598571192

Tier 2/3 Intervention - Number Core (# word sequence, 1 to 1 correspondence, cardinality, and object and order irrelevance)

- Small Group Instruction on Counting and Cardinality (e.g Big Ideas strategies for Sets, Number Sense, Counting).
- Number Worlds - http://www.mheducation.com/prek-12/explore/number-worlds.html
- Get Set For School – Numbers and Operations Strand pgs 25 – 66
  Engage New York – Module 1 https://www.engageny.org/resource/prekindergarten-mathematics-module-1