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WHITE PAPER:

Enhancing Mathematics Achievement Through a District-Implemented Multi-Tiered System of Supports (MTSS) for Kindergarten Through Fifth Grade

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Executive Summary

This white paper advocates for the effective implementation of a Multi-Tiered System of Supports (MTSS) in K–5 mathematics education, addressing the significant challenges students face in acquiring basic mathematical skills. It emphasizes the critical role of a robust MTSS framework in enhancing mathematics proficiency through structured, tiered interventions and strong district-level support. The framework focuses on strengthening Tier 1 universal instruction to address the needs of approximately 80 percent of students, thereby reducing the dependency on more intensive interventions. For students who continue to struggle, Tier 2 provides targeted support, and Tier 3 offers intensive, personalized interventions. Effective MTSS implementation demands active district leadership in resource allocation, professional development, and the removal of educational barriers, guided by ongoing data analysis to ensure responsive and effective teaching practices. This strategic approach is designed to significantly improve foundational math skills across all students, setting a solid groundwork for future academic success.

Introduction

Mathematics proficiency is a foundational element of a student's academic journey, yet a significant portion of students exhibit difficulties in acquiring basic math skills. Research highlights that 25 percent to 35 percent of students struggle with mathematical knowledge and application skills in general education classrooms, necessitating targeted interventions (Mazzocco, 2007).

The Need for MTSS in Mathematics

Section 8002 of the Elementary and Secondary Education Act (ESEA) includes a definition of Multi-Tiered System of Supports (MTSS) as: "... a comprehensive continuum of evidence-based, systematic practices to support a rapid response to students' needs with regular observation to facilitate data-based instructional decision making."

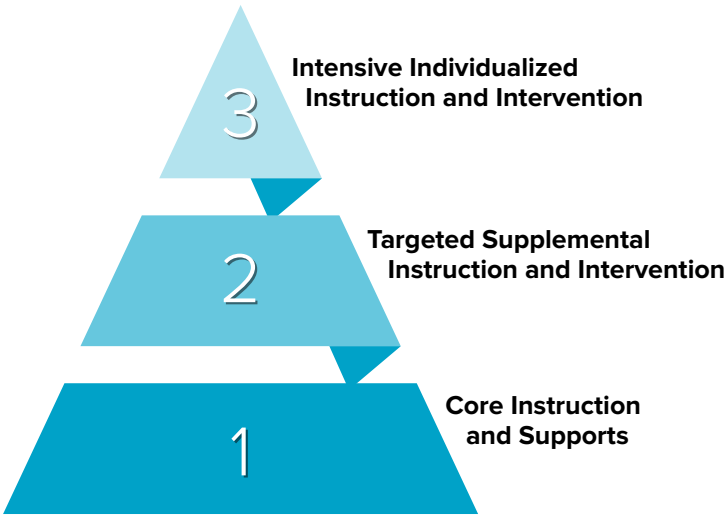
The MTSS framework offers a structured approach to educational intervention, tailored to meet the diverse needs of students through multiple tiers of support. While the broader structure of MTSS encompasses both Response to Intervention (RtI) on the academic side and Positive Behavioral Intervention Supports (PBIS), for our purposes here we are primarily focused on the academic component applied to mathematics. The MTSS system is crucial in mathematics, where early deficits can severely impact later learning and overall academic progression. It allows for early identification and support for students before they fall significantly behind their peers. In the absence of intensive instruction and intervention, students with mathematics difficulties and disabilities lag significantly behind their peers (Jitendra et al., 2013; Sayeski & Paulsen, 2010).

An effective MTSS framework not only supports individual student needs through targeted interventions but also reduces the overall need for these interventions by strengthening Tier 1 instruction.

Implementation of MTSS in Mathematics

TIER 1: Universal Instruction

Tier 1 provides high-quality, research-based general education instruction to all students based on grade-level standards. It includes regular screening, benchmarks, and formative assessments to monitor all students' progress and adjust teaching strategies accordingly. Reteaching grade-level standards in smaller groups is one component of high-quality Tier 1 instruction. Group size in and of itself does not determine the tier of instruction. Effective practices within Tier 1 are essential, as they form the foundation upon which additional supports are built. For MTSS to be effective, Tier 1 must address the needs of approximately 80 percent of students.



To enhance Tier 1, district leaders are pivotal in ensuring the implementation of robust, evidence-based curricular materials and providing necessary resources such as instructional coaching and professional learning. This is crucial for meeting the diverse needs of a large majority of students.

In Principles to Actions, (National Council of Teachers of Mathematics, 2014), the following Effective Mathematics Teaching Practices were identified:

- Establish mathematics goals to focus learning.
- Implement tasks that promote reasoning and problem solving.
- Use and connect mathematical representations.
- Facilitate meaningful mathematical discourse.
- Pose purposeful questions.
- Build procedural fluency from conceptual understanding.
- Support productive struggle in learning mathematics.
- Elicit and use evidence of student thinking.

The Standards of Mathematical Practice (SMP) included in most state math standards sets should be considered and applied in high-quality Tier 1 instruction. The focus of these standards is not only on procedural skills but also on understanding and applying mathematical concepts through real-world problem solving, reasoning, and communication. The Standards for Mathematical Practice are designed to be integrated with the content standards in each grade, ensuring that students grow their mathematical competency comprehensively. These standards include:

1. **Make sense of problems and persevere in solving them:** Encourages students to understand the problem at a deep level and to persist in finding solutions even when challenges arise.
2. **Reason abstractly and quantitatively:** Students should make sense of quantities and their relationships in problem situations, abstracting a given situation and representing it symbolically.
3. **Construct viable arguments and critique the reasoning of others:** Focuses on understanding and constructing arguments concerning mathematical concepts, and engaging in discourse to analyze and evaluate the arguments of others.
4. **Model with mathematics:** Students apply mathematical knowledge to solve real-world problems, representing these situations mathematically to analyze them and draw conclusions.
5. **Use appropriate tools strategically:** Involves selecting and using tools such as diagrams, rulers, and software effectively and efficiently in the context of mathematical problems.
6. **Attend to precision:** Students are expected to communicate precisely with others in their mathematical reasoning, carefully specifying units of measure, and systematically checking representations.
7. **Look for and make use of structure:** Students look for patterns and structures in mathematics, recognizing properties that can simplify computations and deepen their understanding of mathematical concepts.
8. **Look for and express regularity in repeated reasoning:** Students notice repeated calculations or reasoning, and look for general methods and shortcuts, reflecting on whether their results are consistent and the extent to which they make sense.

TIER 2: Targeted Instruction

For students identified through Tier 1 assessments as needing additional support, Tier 2 interventions are more targeted. These interventions are designed to address specific skill gaps and are provided in addition to all Tier 1 supports. Tiers 2 and 3 supplement Tier 1 instruction; they do NOT supplant it. Specific skills to be targeted in Tier 2 can be determined with an annual diagnostic assessment. Once remediation is in progress, frequent progress monitoring assessments ensure the interventions are effective and adjustments are made as necessary. Tier 2 instruction is consistent in addressing a skill deficit until a student has shown proficiency and/or mastery over the specific skill(s). The level of support students need to be successful can change from year to year and even semester to semester. It is possible to close a skill gap with effective remediation that would enable a student to be successful in the future with only Tier 1 level supports. Research and/or evidence-based strategies and programs can be used to support Tier 2 instruction.

TIER 3: Intensive Instruction

Tier 3 is reserved for students who demonstrate minimal progress in Tiers 1 and 2 and thus require more intensive and individualized support. This may involve significantly more time spent on mathematics, with highly tailored interventions aimed at specific skill gaps. Like Tier 2, Tier 3 supports remediate skill deficits identified

through diagnostic assessments and/or progress monitoring at Tier 2. Tier 3 supports must be more intensive than those provided at Tier 2. Supports including strategy and program implementation can be intensified with one or more the following:

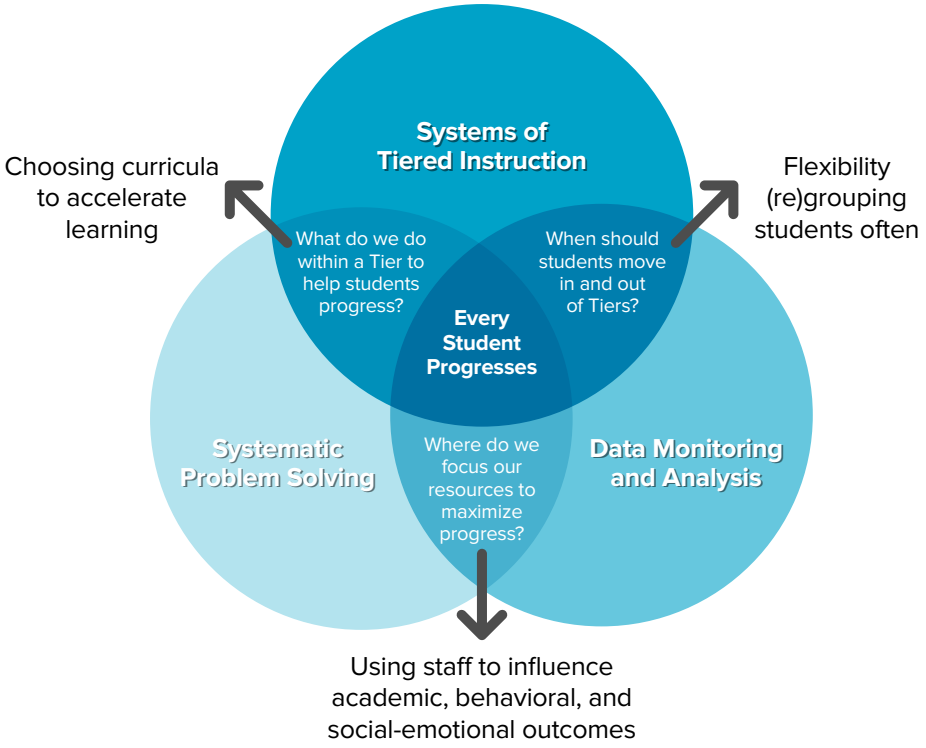
- Decreased group size
- Increased frequency
- Increased duration

ALL TIERS

It is important to note that many highly effective teaching practices are applicable at all tiers within a multi-tiered system of supports. These practices and frameworks include, but are not limited to:

- Universal Design for Learning (UDL)
- Differentiated Instruction (DI)
- Specially Designed Instruction (SDI) for students with disabilities
- Scaffolding
- Data-informed instruction
- Small group instruction
- Strengths-based teaching and learning in mathematics
- Use of evidence-based core and supplemental instructional materials

Supports for students with disabilities, multilingual learners, and/or students with a 504 plan such as accommodations begin at Tier 1. Students' labels do not belong at any single tier of instruction. Students with various eligibilities will require support at different tiers in different academic and behavioral domains.



Conceptual Venn diagram

Revised from Ellen Edmonds' Webinar "Implementing a Multi-Tiered System of Math Support, Grades 1–8."

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Systematic Problem-Solving Approach

An integral part of MTSS is the systematic problem-solving approach used to identify, analyze, develop, and evaluate educational strategies and interventions. This approach ensures that the support provided is data-driven, focused on the student's specific needs, and adjusted based on ongoing assessment results.

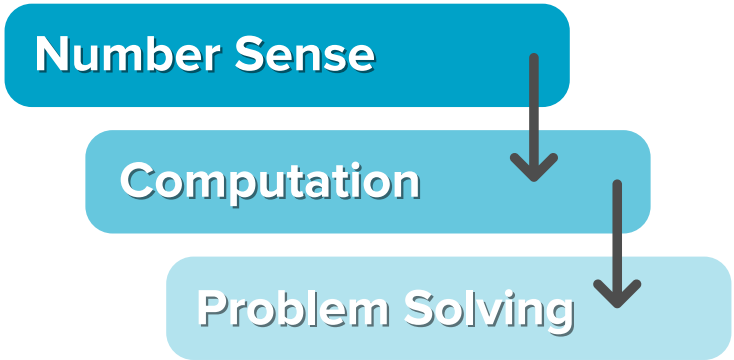
Within a multi-tiered system of supports, there are four guidelines for effective interventions that should be adhered to. Interventions should be:

1. **Aligned to a priority educational need:** Oftentimes, students who are struggling have many skill gaps. In order for remediation to be successful, priority skills must be identified and addressed instead of trying to address all gaps simultaneously.
2. **Teacher directed:** A certified teacher should pull students in need of more targeted or intensive instruction into small groups to utilize high-quality instructional strategies and materials as a crucial component of intervention.
3. **Progress monitored regularly (weekly or biweekly):** Assessments for progress monitoring should address only the skill(s) specifically addressed in the intervention. Program-specific assessments and curriculum-based measures (CBMs) that are skill based are reliable options. Beware of assessments such as chapter tests that address many skills and standards at one time.
4. **Implemented with fidelity per recommended implementation guidelines:** Intervention programs are only proven to be effective when implemented per the guidelines from the program developer. If the researched frequency and duration guidelines are not reached, results are not guaranteed. For strategy implementation, best practice according to the *IES Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools Practice Guide* is that interventions are typically provided for 20 to 40 minutes, four to five times each week.

Challenges and Recommendations

- **Resource Allocation:** Effective implementation of MTSS requires sufficient resources, including trained personnel, appropriate materials, and time for planning and assessment.
- **Professional Development:** Continuous professional development for educators is crucial to equip them with the skills to implement MTSS effectively.
- **Parental Involvement:** Engaging parents in the process can enhance the support students receive and improve outcomes.
- **Data Utilization:** Schools must develop robust methods for collecting and analyzing student data to inform instructional decisions and interventions effectively.

Establishing a Priority Educational Need in Mathematics



According to Kroesbergen and Van Luit (2003), there are three levels of math skill development. As students move from lower to higher grades, they move through levels of acquisition of math skills to include number sense, basic math operations (addition, subtraction, multiplication, division), and problem-solving skills. Instruction at all of these levels occurs simultaneously in high-quality Tier 1 instruction. However, when it comes to determining a priority educational need for intervention in mathematics, these levels are addressed individually, beginning with number sense.

Number Sense

While there are different definitions of number sense, there are consistencies among them. According to Clarke and Shinn (2004), number sense is "... the ability to understand the meaning of numbers and define different relationships among numbers. Children with number sense can recognize the relative size of numbers, use referents for relative size of numbers, use referents for measuring objects and events, and think and work with numbers in a flexible manner that treats numbers as a sensible system."

Ben-Hur (2004) points out that children must learn to determine quantity by rote counting, counting objects individually and within a set, counting items not readily perceived, and ultimately rapid counting that leads to addition and subtraction.

The characteristics of good number sense include:

- Fluency in estimating and judging magnitude
- Ability to recognize unreasonable results
- Flexibility when mentally computing
- Ability to move among different representations and to use the most appropriate representation (Kalchman, Moss, & Case, 2001).

Computation (Basic Math Operations/Arithmetic)

NCTM Principle and Standards of School Mathematics (2000) define computational fluency as having efficient, flexible, and accurate methods for computing.

- **Efficient:** The ability to choose an appropriate, expedient strategy (and/or algorithm) for a computation
- **Flexible:** The ability to use number relationships with ease in computation
- **Accuracy:** The ability to produce a correct answer

Fact fluency is essential for estimation, complex computation, mental calculation, word problem solving, rational number learning, algebra, and overall success in mathematics (National Mathematics Advisory Panel [NMAP], 2008). Students who lack fact fluency can experience higher cognitive load and frustration when learning more complex mathematical concepts (Jitendra et al., 2007). On the contrary, when a student is fluent with their basic math facts, they have increased capacity for more complex learning, like developing understanding of the concept of equivalence (LeFevre et al., 2005).

Direct-strategy instruction is an essential component of an intervention in computational fluency. Strategy instruction teaches efficient methods for deriving facts and highlights patterns to help students organize and generalize their fact knowledge (Baroody et al., 2009; Isaacs & Carroll, 1999).

Problem Solving

"Problem solving forms the base for application and comprehension of mathematics and is the process by which meaningful learning takes place" (NCTM, 2005). In Kroesbergen and Van Luit (2003)'s three levels of math skill development, they refer to problem-solving skills as "The solution of both verbal and nonverbal problems through the application of previously acquired information." Students need to be competent problem solvers to meet the regimen of educational standards and most importantly to demonstrate proficiency in using mathematics to solve real-life problems (Wilson & Sindelar, 1991). Limitations in word problem-solving ability reduce confidence for mathematics and affect learner performance on informal classroom evaluations as well as on standardized state assessments (Jordan, Hanich, & Kaplan, 2002). Students are less likely to persevere on problems that are irrelevant or uninteresting (Murphy & Ross, 1990).

Conclusion

In conclusion, the strategic implementation of a Multi-Tiered System of Supports (MTSS) in kindergarten through fifth grade mathematics represents a pivotal shift toward addressing the widespread challenges in math education at a foundational level. An integrated approach not only targets individual student deficiencies but also strengthens the overall instructional framework. By enhancing Tier 1 instruction, districts can significantly reduce the need for intensive interventions, allowing resources to be more effectively allocated toward students who require targeted and intensive support. Furthermore, the role of district leadership is crucial in ensuring the success of MTSS, necessitating a commitment to professional development, resource allocation, and the removal of systemic barriers to learning.

As districts move forward with the implementation of MTSS, it is imperative that they maintain a dynamic approach to data analysis and instructional adjustment. Continuous monitoring and evaluation will enable educators to respond adeptly to the evolving educational needs of students, thereby maximizing the effectiveness of interventions. Ultimately, a well-implemented MTSS framework promises not only to elevate mathematics achievement across all student groups but also to cultivate a generation of learners who are proficient in mathematical thinking and problem solving. This foundational success in mathematics is essential, as it supports not only academic achievement but also critical-thinking skills necessary for the challenges of the twenty-first century.

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