Math Recovery® Alignment with WWC's *Practice Guide 26*

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Math Recovery intervention aligns with What Works Clearinghouse's *Practice Guide 26: Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades*. *Practice Guide 26* makes six practice recommendations for small-group and one-on-one intervention instructional settings in grades K-6. Below are listed each recommendation followed by how Math Recovery aligns to that recommendation.

1. Systematic Instruction: Provide systematic instruction during intervention to develop student understanding of mathematical ideas [via:] 1. Review and integrate previously learned content throughout intervention to ensure that students maintain understanding of concepts and procedures… 2. When introducing new concepts and procedures, use accessible numbers to support learning… 3. Sequence instruction so that the mathematics students are learning builds incrementally… 4. Provide visual and verbal supports… 5. Provide immediate, supportive feedback to students to address any misunderstandings. (*Practice Guide 26*, pp. 5-10)

The Learning Framework in Number (LFIN) provides a series of progressions of incremental advancements in the domains of numeracy. Math Recovery Specialists learn the Dimensions of Mathematization which focus on advancing student knowledge along those progressions via extending the range, varying the orientation, increasing the complexity, distancing the setting, notating and formalizing student thinking, allowing students the opportunity to refine their strategies into more efficient, more sophisticated strategies, developing notions of unitizing and decimalizing, developing a network of relationships between numbers and understanding how mathematical ideas generalize (Wright & Ellemor-Collins, 2018). Math Recovery Specialists employ instructional techniques that include both inquiry mode and rehearsal mode. Inquiry mode tasks focus on the development of new conceptual understanding through problem-based instruction. This mode involves presenting the student with carefully selected problems that attend to the student's current facility with number word sequences, numeral identification, and structuring number to ensure that the problems are accessible and within the student's range of potential construction. Rehearsal mode tasks are designed to develop facility and automaticity with previously learned concepts such as automaticity with basic facts (Wright et al, 2012). The intervention is a careful balance between advancing student conceptual understanding in inquiry mode and providing students the opportunity to fold back to practice previously developed concepts in rehearsal mode activities. In both inquiry and rehearsal mode instruction, Math Recovery promotes the use of visual and verbal scaffolds to support student thinking as well as the intentional fade of those scaffolds over time. Several of the Key Elements of intensive one-to-one instruction involve elements of feedback including focused prompting, giving encouragement to a partly correct response, directing the student to check their response, querying an incorrect response, correcting a response, querying a correct response, affirming, and confirming, highlighting, and privileging a correct response (Wright & Ellemor-Collins, 2018).

2. Mathematical Language: Teach clear and concise mathematical language and support students' use of the language to help students effectively communicate their understanding of mathematical concepts. (*Practice Guide 26*, pp. 11-20).

Math Recovery professional development helps teachers develop a specialized professional vocabulary for discussing student thinking as well as vocabulary for use with students in mathematics instruction to precisely communicate mathematical ideas.

3. Representations: Use a well-chosen set of concrete and semi-concrete representations to support students' learning of mathematical concepts and procedures. (*Practice Guide 26*, pp. 21-28).

Math Recovery practice involves the use of well-chosen, research validated settings of what have been called concrete representations or manipulatives. The use of chips and screens is an example of a concrete setting that is used extensively in Math Recovery. Two examples of semi-concrete representations settings are the use of several types of printed ten frames to develop structuring number and dot tiles to engender multiplicative thinking. Math Recovery also intentionally connects these concrete and semi-concrete settings with figural images, pictorial representations, and systems of notation. The Math Recovery series of books and professional development materials clearly set forth progressions that move from the perceptual, visual concrete representations, to promoting figural images of the concrete representations by covering or screening the settings, to informal jottings and pictural representations, to abstract, formal mathematical notations. This systematic progression is codified in Math Recovery practice as 'distancing the setting' and 'notating and formalizing' (see Wright & Ellemor-Collins, 2018).

4. Number Lines: Use the number line to facilitate the learning of mathematical concepts and procedures, build understanding of grade-level material, and prepare students for advanced mathematics. (*Practice Guide 26*, pp. 29-39).

Math Recovery uses several settings that develop the mental number line. At the earliest level, the numeral track (number path) and the numeral roll present students with a simple number line focusing on discrete units (Wright et al., 2015). As students progress, the bead string is introduced as a concrete manipulative with leads to the emergence of the empty or open number line which was first popularized by the Realistic Mathematics Education project in the Netherlands. Math Recovery uses the empty number line as a model of and for student thinking. The empty number line is a useful model of student thinking across a range of mathematical tasks involving such things as multi-digit addition and subtraction, early multiplication and division, elapsed time, and money (Wright et al., 2012). As students progress into the study of fractions, number lines are used in several ways by students to solve problems and communicate thinking (Hackenberg et al., 2016).

5. Word Problems: Provide deliberate instruction on word problems to deepen students' mathematical understanding and support their capacity to apply mathematical ideas. (*Practice Guide 26*, pp. 40-50).

Math Recovery has been greatly influenced by the Realistic Mathematics Education (RME) project in the Netherlands. Central to RME is the notion of the context from which mathematical ideas grow. These contexts should be familiar to students and supportive of their mathematical concept development. For example, the context of the double decker bus is used to explore addition with the number of people who could sit on each level of the bus. A 20-bead two-color bead rack is the concrete setting that supports students thinking about the context. The Math Recovery series of books contain several problems from a real-life context. Snack Time (see Wright et al, 2012, Activity IA7.2, pp. 163-164) involves the distribution of grapes into bowls for snack time. In the Fraction work, word problems are routinely used to tie fraction concepts to contexts that are easy for students to grasp such as fairly sharing two identical granola bars among three friends (see Hackenberg et al., 2016, pp. 111-118).

6. Timed Activities: Regularly include timed activities as one way to build fluency in mathematics. (*Practice Guide 26*, pp. 51-55).

It is first important to recognize what this recommendation is not promoting. The recommendation is clearly not recommending high-stress, timed tests of mixed random facts divorced from any instruction of strategy. "The panel does not recommend merely giving students timed worksheets or putting students on a computer-based program without supporting their learning" (Practice Guide 26, p. 51). The

recommendation very clearly sets forth the principle of strategy development prior to introduction of a timed element.

Math Recovery is carefully designed to allow students to develop concepts prior to introducing any timed element. When timed elements are introduced, they are often in the context of an engaging activity or game. For example, finger patterns are a part of the early structuring number progression. Once students have explored accurately building finger patterns through counting, students are then encouraged to build them or "throw" the finger patterns as quickly as possible. Initially this is done in the student's field of view. Later the activity subtly changes to "bunny ears" (see Wright et al, 2015, pp. 81-21) in which the students create the patterns as quickly as possible while their hands are held beside their heads out of their field of view. Another related teaching procedure involves the teacher briefly displaying a finger pattern to the students. Students must then identify the number of fingers in the "flashed" pattern. Student responses can take a number of forms depending on their needs including building the pattern on their fingers, selecting or writing a matching numeral, or saying the number. The use of subitizing or quick image flashes is another example of a highly engaging, low stress teaching procedure that introduces the timed element. The teacher or another student briefly displays a dot pattern (such as ten frames or domino patterns), students must identify the number of dots on the pattern. Some students might use chips to recreate the pattern, other students might show their answer as bunny ears or a numeral written on a white board.

The observant teacher can quickly assess which students have developed facility with the different types of patterns and which students are still not facile. Similarly, teachers can observe student behavior during rehearsal mode games to determine which students have automaticity with particular basic facts and which students are still employing a strategy to determine the answer. Math Recovery teaching materials include several rehearsal-mode games that target facts related to particular strategies. Teachers can use checklists to assess students without drawing unnecessary attention to the element of time.

The most recent book in the Math Recovery Series (Tabor et al, 2021) includes a chapter on "Brain Research: Implications for Teaching and Learning Mathematics." This chapter helps teachers understand how to help students make a frontal-to-parietal shift that enables students to off-load demands on working memory so they have greater capacity for problem-solving. The development of automaticity of basic facts, units coordination, and reversible reasoning are all covered in the chapter. Thus, Math Recovery agrees that developing facility with basic facts is critical to strong mathematical development. Furthermore, teachers must avoid creating high-pressure timed activities that promote the development of early onset mathematical anxiety (Boaler, 2014; Mammarella, Caviola, and Dowker, 2019).

Conclusion:

Math Recovery intervention is consistent with the recommendations outlined in What Works Clearinghouse's Practice Guide 26: *Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades*.

References:

Boaler, J. (2014). Research suggests timed tests cause math anxiety. *Teaching Children Mathematics, 20*(8), 469-474.

Hackenberg, A. J., Norton, A., & Wright, R. J. (2016). *Developing fractions knowledge*. London: Sage Publications, Ltd.

Mammarella, I. C., Caviola, S., & Dowker, A. D. (Eds.). (2019). *Mathematics anxiety: What is known and what is still to be understood*. London: Routledge.

Tabor, P. D., Dibley, D., Hackenberg, A. J., & Norton, A. (2021). *Numeracy for All Learners: Teaching Mathematics to Students with Special Needs* (J. Clark Ed.). Thousand Oaks, CA: Corwin.

What Works Clearinghouse. (2021). *Practice Guide 26: Assisting Students Struggling with Mathematics: Intervention in the Elementary Grades: Educators' Practice Guide*. (WWC 2021006). Institute of Education Sciences, U. S. Department of Education, Retrieved from https://ies.ed.gov/ncee/wwc/PracticeGuide/26.

Wright, R. J., & Ellemor-Collins, D. (2018). *The Learning Framework in Number: Pedagogical tools for assessment and instruction*. London: Sage Publications, Ltd.

Wright, R. J., Ellemor-Collins, D., & Tabor, P. D. (2012). *Developing number knowledge: Assessment, teaching & intervention*. London: Sage Publications, Ltd.

Wright, R. J., Stanger, G., Stafford, A. K., & Martland, J. (2015). *Teaching number in the classroom with 4-8 year olds* (2nd ed.). London: Sage Publications, Ltd.