Mathematics Intervention at the Secondary Prevention Level of a Multi-Tier Prevention System: Six Key Principles

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Mathematics interventions at the Tier 2 (secondary prevention) level of a multi-tier prevention system must incorporate six instructional principles:

1. Instructional explicitness
2. Instructional design that eases the learning challenge
3. A strong conceptual basis for procedures that are taught
4. An emphasis on drill and practice
5. Cumulative review as part of drill and practice
6. Motivators to help students regulate their attention and behavior and to work hard

This article describes each of these principles and some of their research underpinnings, with consideration given to how the principles can be implemented in real-world teaching contexts.

The first principle of effective intervention in mathematics at the secondary prevention level is *instructional explicitness*. Typically developing students profit from the general education mathematics program even though it relies, at least in part, on a constructivist, inductive instructional style. Students who are at risk for serious mathematics deficits, however, fail to profit from those programs in a way that produces understanding of the structure, meaning, and operational requirements of mathematics. A meta-analysis of 58 math studies (Kroesbergen & Van Luit, 2003) revealed that students with math disability benefit more from explicit instruction than from discovery-oriented methods. Therefore, effective intervention in Tier 2 requires an explicit, didactic form of instruction in which the teacher directly shares the information the child needs to learn.

Explicitness is not, however, sufficient. A second and often overlooked principle of effective secondary mathematics intervention is *instructional design that eases the learning challenge*. The goal is to anticipate and eliminate misunderstandings by means of precise explanations and with the use of carefully sequenced and integrated instruction. The purpose is to close the achievement gap as quickly as possible. This may be especially important for mathematics, which involves many branches and strands that may be distinct, each with its own conceptual and procedural demands. So, given the ever-changing and multiple demands of the mathematics curriculum, instructional efficiency is critical, creating the need for the tutor or the program on which the tutor relies to minimize the learning challenges for the student.

Careful instructional design begins by teaching a set of foundational skills the student can apply across the entire program: counting up for number combinations, two-digit calculations, solving algebraic equations, and checking work. These foundational skills can be taught as intact instructional targets and then applied efficiently across subsequent units once word problem instruction begins. Then instruction purposefully conceptualizes, organizes, and teaches students to recognize problem types that pertain broadly to the kinds of problems found in the general education curriculum and in high-stakes tests. That way, novel word problems are not random events for students, each of which requires the creation of a solution strategy. Rather, the student recognizes novel problems as familiar, using schemas for problem types that the program teaches, and thereby deciphers when to apply which set of solution rules he or she has learned. Finally, instruction conceptualizes transfer within the same problem-type structure, so that irrelevant information, finding missing information in any of the three slots of an equation, and finding relevant information within charts or graphs recurs predictably and efficiently across problem-type instructional units.

The third principle of effective secondary mathematics intervention is the requirement that instruction provide a *strong conceptual basis for procedures that are taught*. Special education is already strong in emphasizing *drill and practice*, a critical and fourth principle of effective practice. Special education has, however, sometimes neglected the conceptual foundation of mathematics, and such neglect can result in confusion, learning gaps, and a failure to maintain and integrate previously mastered content. Drill and practice, the fourth principle of effective secondary mathematics intervention, includes practice in sorting problems into problem types, the mixing of problem types within the daily lesson (once at least two problem types have been introduced), and daily review. We note that this practice should be rich in *cumulative review*, a fifth principle of effective secondary mathematics intervention. This is reflected in continual reliance on the foundational skills taught in the introductory unit and the use of mixed problem types within conceptual instruction, sorting practice, and paper-and-pencil review.

Finally, secondary mathematics interventions need to incorporate *motivators to help students regulate their attention and behavior and to work hard*. Students at risk for poor academic outcomes often display attention, motivation, and self-regulation difficulties that may adversely affect their behavior and learning (Fuchs et al., 2006; Montague, 2007). By the time students enter secondary intervention, they often have experienced at least some failure, which may cause some to avoid the emotional stress associated with mathematics: They no longer try to learn for fear of failing. For this reason, secondary intervention must incorporate systematic self-regulation and motivators, and for many students, tangible reinforcers are required.

Although mathematics preventative tutoring at the Tier 2 level has received less attention than in reading, several validated protocols do exist in the primary grades. Further information is available from the RTI Action Network or can be obtained by contacting Flora Murray at Vanderbilt University.