Intensifying Intervention for Students With Persistent and Severe Mathematics Difficulties

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Success in algebra is considered to be the "gatekeeper" to postsecondary education and essential for many careers (National Mathematics Advisory Panel, 2008). Mastering algebraic concepts and skills—such as understanding number properties and operations, ratios and proportional reasoning, and mathematical equivalence—are important for developing algebraic thinking and being successful in more advanced mathematics instruction (Blanton, Levi, Crites, & Dougherty, 2011). These mathematics topics are listed in the Common Core State Standards for Mathematics (CCSSM; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010), which were developed to provide coherence and focus for key mathematical domains that should be emphasized at each grade level. Notably, instruction in "operations and algebraic thinking" begins as early as kindergarten. An emphasis on "number and operations in base ten" spans the elementary grades, and a focus on "number and operations—fractions," which occurs in third grade, begins to prepare students for topics such as "ratios and proportional relationships." In the middle grades, an extension of previous mathematics topics emerges. For example, a focus on ratios and proportional relationships expands work in measurement and multiplication and division from the earlier grades in preparation for using ratios in geometry and algebra, and knowledge of arithmetic and properties of operations is extended to instruction on algebraic expressions in preparation for future instruction on algebra (Common Core Standards Writing Team, 2013). Moreover, key mathematical practices—such as

understanding the structure of mathematics, being able to justify and explain mathematical solutions, and using tools such as graphs, calculators, and concrete representations (e.g., counters, two-sided color chips)—are integral to mathematics instruction and promoting algebraic thinking. Given that most states have adopted the CCSSM fully or partially, many students with disabilities (e.g., students with learning disabilities [LD]) who receive their mathematics instruction in the general education setting will receive instruction in a standards-based curriculum and be expected to master grade-level expectations.

Unfortunately, recent national data show that a group of students with disabilities is not faring well in mathematics. For example, on the National Assessment of Educational Progress (NAEP; National Center for Education Statistics, 2015), scores showed that a high percentage of students with disabilities do not have basic mathematics skills. Grade 4 results indicated that 45% of students with disabilities scored below the basic level, as compared with 14% of students without disabilities. The eighth-grade results are even more alarming: 68% of students performed below the basic level, as compared with 23% of students without disabilities. These data indicate that many students with disabilities do not have even basic mathematics skills despite intervention through a multitiered system of support or specialized instruction.

What Difficulties Do Students With Disabilities Experience?

Students demonstrate difficulties with mathematics across the grade levels. For example, primary-age students with severe mathematics difficulties typically have problems with the concepts and skills of whole numbers (Bryant et al., 2011; Clarke et al., 2016). Many students with mathematics difficulties lack the ability to remember basic facts and effective strategies for solving problems based on them. These students may have problems understanding mathematics symbols (e.g., the equal sign) and the idea of mathematical equivalence, which can affect solving calculations and word problems (Powell & Fuchs, 2010). They also have difficulties solving word problems (Fuchs et al., 2008) because of issues related to reading problems and challenges with understanding word problem structures (e.g., join, separate problems).

Understanding rational numbers is another area that is crucial for advanced mathematics success (e.g., algebra) yet can be problematic for students with mathematics difficulties and disabilities. For instance, students with mathematics LD showed difficulties in identifying fraction and decimal equivalence (.50 = 5/10) and in comparing and ordering fractions and decimals (Mazzocco & Devlin, 2008).

It stands to reason that students with mathematics difficulties who are experiencing these types of problems learning and understanding mathematics may need more intensified intervention. Students whose response to mathematics intervention is persistently low are good candidates for more intensified intervention (National Center on Intensive Intervention, 2013). Therefore, it is important that teachers who teach students with mathematics difficulties and disabilities have access to techniques such as evidence-based strategies for intensifying intervention, to help them teach CCSSM algebraic concepts and skills. For example, instructional delivery can be intensified through explicit and systematic instruction by providing more modeling, increasing practice opportunities, providing more scaffolded instruction, and using multiple representations (e.g., number lines, ten frames) to visualize the mathematics (Bryant et al., 2014; Doabler et al., 2015). Also, increasing instructional time and reducing instructional grouping sizes are other ways that intervention can be intensified (Vaughn, Wanzek, Murray, & Roberts, 2012).

In this special issue on intensifying intervention for teaching algebraic concepts and skills to students with mathematics difficulties, papers are presented on topics for different levels (i.e., elementary, secondary). The articles feature ways to promote mathematical understanding and algebraic thinking. Equally important to instruction is measuring student progress, and this special issue includes ideas for accomplishing this as well.

Overview of the Articles

This special issue features five articles. Dougherty, Pedrotty Bryant, Bryant, and Shin begin the issue with "Promoting Understanding of Ratios and Proportional Reasoning for Middle School Students With Persistent Mathematics Difficulties." The authors describe how important knowledge of ratios and proportions is to student learning, given that it crosses a variety of mathematical topics—including slope, constant rate of change, and similarity of figures—which are fundamental mathematical ideas that promote conceptual understanding of algebraic concepts and skills. Many students who struggle with ratios and proportional reasoning are confused by mathematical misconceptions—that is, faulty and incorrect ideas that may have been formed and fostered in the elementary grades. Misconceptions associated with ratios and proportional reasoning, which may impede successful algebraic thinking, are presented. The authors also provide a number of examples of how specific lesson components can address student misconceptions.

Foegen and colleagues contribute "Using an Online Tool For Learning About and Implementing Algebra Progress Monitoring," in which they describe procedures to monitor student progress for algebra interventions. Three types of measures and an online system are presented that promote teachers' professional development and data management support. Through the use of two authentic case studies, the authors work through the steps involved with monitoring algebra progress. In the first, a number of

visuals are presented that illustrate the content of the measure and demonstrate how graphed student data can inform interventions. With their second case study, Foegen and her colleagues demonstrate how a different teacher applies the progress-monitoring process in a different instructional context.

Strickland offers "Using the CRA-I Strategy to Develop Conceptual and Procedural Knowledge of Quadratic Expressions," which describes an instructional unit that has research-based instructional practices. The unit, which includes the "box method," helps students transition from manipulatives to abstract notation. Using real-life area problems, the instructional unit provides a framework for engaging students. Strickland notes that research-supported strategies such as those provided in the unit may help students with LD access higher-level mathematics skills and concepts, many of which are important for college and career readiness.

Harbour, Karp, and Lingo's "Inquiry to Action: Diagnosing and Addressing Students' Relational Thinking About the Equal Sign" focuses on the well-documented struggles that many students encounter in forming a relational understanding of the equal sign. Using the formative assessment model of "inquiry to action," Harbour et al. discuss the use of diagnostic interviews to help teachers first gather data to assess students' understanding of the equal sign. Based on the interview data, a plan of action can then be written to support the development of relational thinking. Important features of the two-phase process focus on how the student learns to recognize that the equal sign is linked to relational thinking.

In "Preparing for Algebra by Building Fraction Sense," Rodrigues, Dyson, Hansen, and Jordan describe how even after several years of fraction instruction, many middle school students with LD continue to have a weak foundation for truly understanding fractions. Unfortunately, problems with understanding and calculating fraction problems may place students at risk of later failure during algebra instruction. In their article, Rodrigues et al. report key features of research-based fraction lessons that may help struggling middle students overcome challenging stumbling blocks while learning fractions. It is possible that through participation in these fraction lessons, struggling students can advance their fraction understanding and be better prepared for algebra.

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