Core practices in understanding the progress of students with special education needs in order to respond to intervention success

(overview essay)

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Abstract: *Currently in the United States (USA), implementation of a widely used Evidence-Based Practice (EBP), Response to Intervention (RtI) model to increase reading instruction are being implemented by more school administrators and teachers, looking to learn effective RtI practices to support learning in mathematics. This article explores some of the key elements of RtI practices in mathematics, including screening for the early identification of students who may have Dyscalculia, or are struggling learners. We will also examine a process of progress monitoring for measuring instructional proficiency for all students. We describe some of the similarities and differences between RtI processes in reading and mathematics. The article addresses the use of diagnostic data and details the importance of the National Teachers of Mathematics (NTCM) standards and Common Core Mathematics standards, among others. The article concludes with a discussion of some evidence-based interventions in mathematics, and we provide an implementation checklist to assist educators as they begin to implement RtI in mathematics.*

Keywords: *Curriculum-Based Measurement, Assessment, Screening, Progress Monitoring, Interventions*

1 Introduction

The Individuals with Disabilities Act (IDEA) explicitly allowed the use of student response to instruction when identifying a learning disability. This government policy acknowledged that early identification with less dependence on discrepancy between intellectual potential and achievement. To address the flexibility that IDEA allows, many states and school districts have begun transitioning away from the previous identification model and moving toward a form of Response to Intervention (RtI;

Zirkel & Thomas, 2010). Although RtI models may be relatively new to most educators. School districts in several states (i.e., Iowa, Minnesota, Florida, Ohio, and Illinois) have been using RtI models for identifying and assisting struggling students in reading for more than a decade with positive results (Jimerson, Burns, & VanDerHeyden, 2007).

Two important inferences about the implementation of RtI are drawn from these state initiatives: (a) RtI models may be successfully implemented in schools to meet the needs of struggling learners, and b) RtI models assume different identities and formats across different schools and districts. These differences are due, in part, to the notion that each school district is unique and that RtI is described in many ways (Hoover & Love, 2011). Although most of the evidence supporting the use of RtI models has been conducted in reading, increasing attention is being paid to the area of mathematics, as the realization that students who struggle with reading often also struggle with mathematics as well.

There are three significant reasons students who have Dyscalculia need to learn mathematics. First, mathematics is integral to many important life skills (Minskoff & Allsopp, 2003). Each day, people are presented with the need to have basic mathematics proficiency, such as when purchasing goods and services, performing household budgeting, and meeting today's technical work demands. Second, high-stakes assessments, particularly at the secondary level, include mathematics skills (i.e., algebra) that have become a benchmark for obtaining a high school diploma (Minskoff & Allsopp, 2003). Therefore, students who have learning difficulties must have basic proficiency with these mathematical concepts if they are to pass these tests and successfully graduate from secondary school. Third, mathematics has become integral to student understanding in other subject areas, such as the sciences, economics, and computer literacy. Students who struggle with mathematical concepts will find it difficult to learn this important complex content. Without a basic knowledge of mathematics, students may struggle to pass courses and standardized tests, leading to potential academic failure (Minskoff & Allsopp, 2003).

Research investigating the effective implementation of RtI has its foundation in reading; however, there are many core components founded in reading research that can be utilized in creating an RtI model in mathematics. Riccomini and Witzel (2010) have identified six core components that form RtI models first established in reading research but are fully translatable to mathematics. The first component is a system centered on the idea that all students can learn when EBPs are implemented and continually monitored. The second component includes universal screening to measure all students' levels of proficiency at least three times each academic year, serving to identify students who may need more specialized instruction. The third component is that a system of progress monitoring implemented to confirm the effectiveness of teacher instruction and to inform academic decision making. The fourth component includes the exclusive use of EBP in our instruction being used in both core learning and intensified academic interventions. For the fifth component, tiers of instructional supports are created and appropriate EBP and trained educators are used to implement supports to students in each tier. Finally, the sixth component suggests that ongoing program evaluation is essential to ensure the effective implementation of RtI systems in schools.

As teachers and administrators begin to implement RtI in mathematics, many aspects used in reading are routinely applied. There are some differences between reading and mathematics. Unlike reading, mathematics difficulties may be blamed on the notion that not everyone can be proficient in mathematics. Even parents and some teachers will often excuse problems in math by rationalizing that they were not good in math at that age either (Riccomini & Witzel, 2010). The National Mathematics Advisory Panel (NMAP; 2008) stated that "all students can and should be mathematically proficient in grades pre-K through 8" (p. 10). Another important distinction between RtI implementation in reading and mathematics is the type of measure used for screening and progress monitoring. In reading, the primary measures that have been used have been measures of oral reading or word selection during a silent reading task. In mathematics, many measures are group administered and include assessments of computation skill and applied knowledge of concepts. Finally, core instruction and academic interventions will differ in content in mathematics, although many reading interventions can be applied to some extent to mathematics vocabulary and word problems, for instance. There is significantly less research in mathematics interventions than in reading, but recent documents published by the NMAP (2008) and Gersten et al. (2009) summarize current findings in mathematics.

2 Screening

A recent document published by the National Center on RtI, titled "Essential Components of RtI: A Closer Look at Response to Intervention" (National Center on RtI, 2010) suggests that screening in an RtI model relies on two processes. First, universal screening, which consists of a brief assessment administered to all students, is performed at the beginning, middle, and end of the school year. Second, students who fall below the benchmark levels associated with the set of measures, are then given additional assessment, or can be monitored for an extended period of time to gather more information regarding the student's risk for Dyscalculia.

One type of measurement that has been widely used in RtI frameworks for universal screening is Curriculum-Based Measurement (CBM; Deno, 1985). In the area of mathematics, CBM universal screening measures are available for pre-K to first grades in early numeracy, for elementary students in computation and concepts and applications, and for secondary students in estimation and algebra (Chard et al., 2005; Clarke & Shinn, 2004; Foegen, 2000; Foegen, Olson, & Impecoven-Lind, 2008; Fuchs, Hamlett, & Fuchs, 1998, 1999; Lembke & Foegen, 2009). The screening tools chart on the National Center for RtI Web site (rti4success.org), updated frequently, provides an expert evaluation of screening tools that are submitted for examination. Suggested screening tools that have been determined to be EBP can be found on the National Center's Web site by clicking on the screening tools chart.

2.1 Implementation of Screening in Mathematics

Screening measures are administered in 1 to 8 minutes, with early numeracy measures administered individually and measures for elementary and secondary students administered in a group, typically by each classroom. Measures range from early numeracy tasks, such as counting, number identification, and quantity discrimination for preschool and primary grades, to computation, completing algebra equations, and mathematical concepts such as data, time, and measurement for late elementary to secondary school students.

A summary of reliability and validity data and establishing suggested growth rates and sources for many common CBM measures are included in Table 1. This table can give educators a sense of how measures fare across studies. Included in this list are measures from common web-based programs, including AIMSweb (aimsweb.com) and Wireless-Generation (mClass:Mathematics; wirelessgeneration.com). Other screening tools for early numeracy can be found on the Research Institute for Progress Monitoring site (progressmonitoring.org), for K-8 mathematics on easyCBM.com, and for algebra on the Algebra Assessment and Instruction site (www.ci.hs.iastate.edu/aaims/).

Table 1: *Technical Adequacy of Elementary Mathematics CBM Measures*

Study	Grade Level	Alternate Form Reliability	Criterion Validity	Growth Rates (Weekly)	Source
Counting Knowledge					
Hampton et al. (2012) (using mClass math measures)	K-1st	.84–.90 (K) .83–.91 (1st)	Concurrent: WJ-BM: .45 (K), .40 (1st) Predictive: WJ-BM: . 56 (K), .44 (1st)	1.54 digits (K) 1.16 digits (1st)	www.wirelessgeneration.com
Baglici, Codding, & Tyron, 2010. (using TEN measures)	K-1st			.65 digits (K) .34 digits (1st)	www.aimsweb.com
Clarke, Baker, Smolkowski, & Chard (2008)	K		Concurrent: SESAT: .55–.59	Did not fit linear growth model	
Clarke & Shinn (2004) (using TEN measures)	1st	.93; Test-retest-.78–.80	Number Knowledge Test: .70 WJ-AP: .60–.64 M-CBM: .49–.50	.55 units	www.aimsweb.com
Number Identification					
Hampton et al. (2012) (using mClass math measures)	K-1st	.87–.94 (K) .84–.91 (1st)	Concurrent: WJ-BM: .44 (K), .49 (1st) Predictive: WJ-BM: .45 (K), .49 (1st)	.73 digits (K) .53 digits (1st)	www.wirelessgeneration.com
Baglici et al., 2010. (Using TEN measures)	K-1st	.71–.84		.11 digits (K) .15 digits (1st)	www.aimsweb.com
Lembke & Foegen, (2009)	K-1st	.91–.92 (K) .87–.90 (1st) Test–retest (median of 3 scores): .83–.87 (K)	MBA: .52 (K); .49 (1st) Teacher ratings: .47–61 (K); .46–60 (1st) TEMA: .33 (K); 1.52 (1st) SESAT: 1.52 (1st)	.79 (K) .25 (1st)	www.progressmonitoring.org
Clarke et al. (2008)	K		Concurrent: SESAT: .53–.61	Did not fit linear growth model	
Lembke et al. (2008)	K-1st	.79–.93 (K) 77–.89 (1st)	Teacher ratings: .44–.66 (K); .03–.70 (1st) SESAT:-.47 (1st)	.34 digits (K) .24 digits (1st)	www.progressmonitoring.org
Chard et al. (2005)	K-1st		Number Knowledge Test: .58–.65 (K); .56–.58 (1st)	1.3 digits (K) .88 digits (1st)	
Clarke & Shinn (2004) (using TEN measures)	1st	.89–.93 Test–retest: .76–.85	Number Knowledge Test: .70 WJ-AP: .63–.65 M-CBM: .60–.66	.47 units	www.aimsweb.com

Study	Grade Level	Alternate Form Reliability	Criterion Validity	Growth Rates (Weekly)	Source
Magnitude Comparison (QD)					
Hampton et al. (2012) using mClass math measures	K-1st	.66–.88 (K) .63–.84 (1st)	Concurrent: WJ-BM: .26 (K), .48 (1st) Predictive: WJ-BM: .40 (K), .46 (1st)	.60 digits (K) .48 digits (1st)	www.wirelessgeneration.com
Baglici et al. (2010) (using TEN measures)	K-1st	.89–.91		.21 digits (K and 1st)	www.aimsweb.com
Lembke & Foegen (2009)	K-1st	.83–.89 (K) .81–.89 (1st) Test–retest (median of 3 scores): .84–.86 (K); .84–.91 (1st)	MBA: .38–.50 (K); .31–.48 (1st) Teacher ratings: .46–.59 (K); .56–.66 (1st) TEMA: -.45 (K); .57 (1st) SESAT: 60 (1st)	.49 digits (K) .12 digits (1st)	www.progressmonitoring.org
Clarke et al. (2008)	K		Concurrent: SESAT: .62	Growth of 3.3 across 5 assessments	
Lembke et al. (2008)	K-1st	.83–.91 (K) .70–.85 (1st)	Teacher ratings: .55–.62 (K); .04–.75 (1st) SESAT: .50 (1st)	.27 (K) .12 (1st)	www.progressmonitoring.org
Chard et al. (2005)	K-1st		Number Knowledge Test: .50–.55 (K); .45–.53 (1st)	.28 digits (K) .42 digits (1st)	
Clarke & Shinn (2004) (using TEN measures)	1st	.92–.93 Test–retest-.85–.86	Number Knowledge Test: .80 WJ-AP: .71–.79 M- CBM: .71–.75	.36 units	www.aimsweb.com
Missing Number					
Hampton et al. (2012) (using mClass math measures)	K-1st	.72–.84 (K) .66–.80 (1st)	Concurrent: WJ-BM: .29 (K), .39 (1st) Predictive: WJ-BM: .47 (K), .53 (1st)	.31 digits (K) .10 digits (1st)	www.wirelessgeneration.com
Baglici et al. (2010) (using TEN measures)	K-1st	.81–.86		.33 digits (K) .02 digits (1st)	www.aimsweb.com
Lembke & Foegen (2009)	K-1st	.59–.75 (K) .73–.81 (1st) Test–retest (median of 3 scores): .79–.82 (K); .78-.88 (1st)	MBA: .49–.57 (K); .44–.45 (1st) Teacher ratings: .57–.64 (K); .56–.70 (1st) TEMA: .48 (K); .54 (1st) SESAT: .75 (1st)	.17 (K) .03 (1st)	www.progressmonitoring.org
Clarke et al. (2008)	K		Concurrent: SESAT: .60–.64	Did not fit linear growth model	

Study	Grade Level	Alternate Form Reliability	Criterion Validity	Growth Rates (Weekly)	Source
Lembke et al. (2008)	K-1st	.76–.82 (K) .61–.79 (1st)	Teacher ratings: .50–.64 (K); .21–.61 (1st) SESAT .21 (1st)	.15 digits (K) .11 digits (1st)	www.progressmonitoring.org
Chard et al. (2005)	K-1st		Number Knowledge Test: .64–.69 (K); .61 (1st)	.33 digits (K) .35 digits (1st)	
Clarke & Shinn (2004) (using TEN measures)	1st	.78–.83 Test–retest-.79–.81	Number Knowledge Test .74 WJ-AP: .68–.69 M-CBM: .74–.75	.23 units	www.aimsweb.com
Next Number					
Hampton et al. (2012) using mClass math measures	1st	.52–.80 (1st)	Concurrent: WJ-BM: .52 (1st) Predictive: WJ-BM: .56 (1st)	.27 digits (1st)	www.wirelessgeneration.com
Number Facts					
Hampton et al. (2012) using mClass math measures	1st	.63–.81 (1st)	Concurrent: WJ-BM: .52 (1st) Predictive: WJ-BM: .67 (1st)	.18 digits (1st)	www.wirelessgeneration.com
Computation					
Fuchs et al. (1998: MBSP	2–6	.45–.93	MCT: .77–.87; SAT-MC: .55–.93	.20–.77	www.proedinc.com
Concepts and Applications					
Fuchs et al. (1998: MBSP	2nd–6th	.45–.93	CTBS: Total math: .71–.81; CTBS: Computation: .64–.74; CTBS: Concepts/Applications: .64–.81	.12–.69	www.proedinc.com
AIMSweb Math-Concepts and Applications	2nd–6th	.83–.89		.4 points (2nd: 50th percentile); .2 points (3rd: 50th percen-tile); .1 points (4th/5th: 50th percentile)	www.aimsweb.com

Note: Adapted from a table originally published in Clarke, Lembke, Hampton, & Hendricker (2011). MBA = Mini Battery of Achievement; MBSP = Monitoring Basic Skills Progress; M-CBM = Mathematics CBM; OC = oral counting; SESAT = Stanford Early School Achievement Test; TEN = Test of Early Numeracy; WJ-AP = Woodcock Johnson Applied Problems; WJ-BM = Woodcock Johnson Broad Math Score.

3 Progress monitoring

NCTM; 2000, reported that assessment in mathematics should be more than a test to gauge learning at the end of instruction. But instead, assessment should become a foundational component of the instruction that guides teachers and enhances students' learning. NCTM recommends that teachers continually gather information about student performance and make appropriate decisions about instruction in real-time, content, pacing, review, and remediation for students who may be struggling. NCTM warns that assessment practices that are out of the realities of with curriculum and instruction, give inaccurate findings to all those concerned with learning.

Any assessment of mathematics learning should, first and foremost, be anchored in core mathematical content. It should reflect topics and applications that are critical to a full understanding of mathematics as it is used in today's world and in students' lives after their education has been completed (NCTM, 2000). Although CBM for screening has previously been discussed, CBM is also an excellent, research-based tool for progress monitoring.

3.1 Implementation of Progress Monitoring

CBM serves as an EBP tool for progress monitoring in that it meets the requirements for ease of classroom teacher use, sensitivity to instructional effectiveness, ability to frequent monitoring progress of student performance, adaptability for use in determining the effectiveness of the particular intervention, and relevance to the issue of measuring multiple skills contained in acquiring mathematics proficiency (Clarke & Shinn, 2004; Fuchs, Compton, Bryant, Hamlett, & Seethaler, 2007; Lembke, Foegen, Whittaker, & Hampton, 2008; VanDerHeyden, Witt, Naquin, & Noell, 2001). CBM has numerous distinctive features, but most critical is the technical adequacy of CBM measures that validate the ongoing assessment of student progress and instructional decision making (Hosp, Hosp, & Howell, 2007; Stecker, Lembke, & Foegen, 2008). Progress monitoring allows teachers to chart student data on a regular and ongoing basis, and measures student progress over time (Lembke et al., 2008). For more information about progress monitoring in mathematics, see a review of the literature conducted by Foegen, Jiban, and Deno (2007). More detail about the reliability and validity, as well as growth rates, for elementary mathematics measures specifically can be found in Table 1. These growth rates can help teachers as they set individual goals for students by multiplying the suggested growth rate by the number of weeks until the end of the goal period.

4 Tiered Intervention Framework

The RtI framework resembles a prevention science model by providing a tiered approach to academic intervention (Lembke, McMaster, & Stecker, 2010). Whereas the prevention science model suggests universal, selective, and indicated prevention cycles (National Research Council & Institute of Medicine, 2009), RtI employs three tiers of academic intervention: universal (Tier 1), strategic (Tier 2), and intensive (Tier 3; Fuchs & Fuchs, 2006). Students are assigned to various tiers of intervention based on instructional need. Students who fail to respond to research-based interventions at a tiered level may be moved to receive a more intensive intervention. Lembke et al. (2010) further explain that students unable to respond to multiple tiers of intervention may be referred for special education services. Students are assigned to tiers based on data gathered during the screening process.

5 Conclusion

Although not as much has been written about and applied in schools for RtI in mathematics compared with RtI in reading, the essential features, such as implementing, screening, progress monitoring, intervention implementation, and data utilization, remain important fixtures of best-practice teaching. In fact, incorporation, or improvement of one of these elements would result in productive changes for a school or district. As school members explore how to begin using an RtI structure in mathematics, they can capitalize on any work that is already completed in reading and can also complete a needs assessment on RtI practices to determine where to focus productive and effective instruction.

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