VPI Information Brief 6

Elementary Math Assessment and Progress Monitoring Systems

CLASSROOM SCENARIO

Marty Grahbeeds is relaxing one evening in the summer following his first year teaching. He is a certified elementary math teacher who, while pleased with his undergraduate teacher preparation program, found himself overwhelmed with both the everyday instructional challenges of the Comprehensive Curriculum and the needs of his students, some of whom struggled mightily to succeed in completing his assigned work. While thinking back over the successes and struggles of the year, Mr. Grahbeeds is reminded of a teacher's lounge conversation one day about DIBELS (which he later learned stood for Dynamic Indicators of Basic Early Literacy Skills) and its progress monitoring potential in early reading development. That summer evening, Mr. Grahbeeds decides he is going to find and faithfully implement an effective progress monitoring program for all of his math students in the coming year. What can he do?

Deciding to implement an effective progress monitoring program is a great first step for Mr. Grahbeeds. He will realize there are likely to be a number of advantages to such a systematic approach. The advantages include garnering concrete evidence of individual students' learning strengths and weaknesses, tracking individual student progress (or lack thereof) while instruction is taking place (rather than after the fact), and providing students with scientifically based instruction and interventions based on frequent, ongoing assessment.

Researchers and teachers in reading who have faithfully implemented effective reading instructional programs tied to ongoing progress monitoring know the potential benefits of these systems. Reading research over the last 20 years has identified effective – and brief (e.g., one minute) – assessments designed to let teachers and parents know which students are meeting benchmarks for reading. That is what DIBELS does, as Mr. Grahbeeds learned during lunchtime in the teachers' lounge. The results allow schools to target resources to those students who are not meeting benchmarks. Resources include additional reading time devoted to development of phonological awareness skills and / or other skills determined to predict later reading success or struggle.

Mr. Grahbeeds' investigation reveals progress monitoring is a type of Curriculum-Based Measurement (CBM) begun over 25 years ago by Stanley Deno at the University of Minnesota. Progress monitoring in math and the necessary norming for targeted populations is approximately 5 to 7 years behind reading. It is becoming more widely accepted, in part, because of the success of DIBELS in the area of reading.

Researchers across the country are: (a) identifying specific kindergarten and first grade skills that help predict later math success or failure, and (b) developing and testing monitoring systems that will allow elementary math teachers a greater chance to catch possible deficits early and remediate them (e.g., Clarke & Shinn, 2004). Researchers like Lynn Fuchs, David Geary, Russell Gersten, and Nancy Jordan are also identifying critical early math skills that are important to later math success. These skills include: (1) fluency and mastery of arithmetic combinations, (2) maturity and efficiency of counting strategies, and (3) understanding of number sense.

Arithmetic combinations are often thought of as math facts. These are your basic addition, subtraction, multiplication, and division "facts" such as 2 + 4 = 6 or 5 x 5 = 25. Students who are successful in math early on may differ from those who struggle in the ability to quickly retrieve correct responses to arithmetic combinations. Not being able to quickly retrieve this information, then, seemingly makes understanding math concepts more challenging (Gersten, Jordan, & Flojo, 2005). Counting strategies are those actions children take in solving math problems like the ones listed above. They range from

counting on fingers to the most sophisticated mental manipulations. Children who struggle with math may use less sophisticated strategies – their fingers versus their mind – and / or carry out the tasks less efficiently. Number sense has been hard to define by researchers, but examples include the abilities to mentally calculate problems in different ways, estimate, judge magnitude, and recognize an answer that makes no sense given the present context (Kalchman, Moss, & Case, 2001). Children with limited number sense, for example, have a hard time determining that 6 is bigger than 3, let alone that 6 is twice the size of 3.

Mr. Grahbeeds needs to find an effective progress monitoring program that assesses those three areas over the kindergarten and first grade years. The program must also provide benchmarks which enable teachers and others to ascertain if a student's math skills are developing appropriately or starting to lag behind.

Currently, there are a few math CBM programs on the market. AIMSweb provides math probes based on expected computational skills for Grades 1-6 with 40 alternate forms per grade for use in benchmark assessment, strategic monitoring, and frequent progress monitoring. The system also makes instructional recommendations. Yearly ProgressPro provides a comprehensive set of CBM assessments that can be delivered weekly. These assessments provide detailed diagnostic information on students' academic progress on a defined set of skills. Both programs have progress graphing and data management systems.

Additionally, a comprehensive screening measure called the *Number Knowledge Test* (Okamoto & Case, 1996) has received favorable reviews (Gersten et al., 2005). Moreover, Geary (2003) and Clarke and Shinn (2004) are in the process of evaluating the effectiveness of brief measures of magnitude comparison, counting knowledge, number identification, and working memory.

Mr. Grahbeeds may find more progress monitoring information at the American Institute for Research or the Research Institute on Progress Monitoring at the University of Minnesota. Be sure to stay tuned to the researchers and websites listed herein as well as legislation encouraging use of multi-tiered intervention systems.

References:

Clarke, B., & Shinn, M. (2004). A preliminary investigation into the identification and development of early mathematics curriculum-based measurement. *School Psychology Review*, *33*, 234-248.

Geary, D. C. (2003). Learning disabilities in arithmetic: Problem solving differences and cognitive deficits. In H. L. Swanson, K. Harris, & S. Graham (Eds.), *Handbook of Learning Disabilities* (pp. 199-212). New York: Guilford.

Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities*, *38*, 293-403.

Kalchman, M. Moss, J., & Case, R. (2001). Psychological models for the development of mathematical understanding: Rational numbers and functions. In S. Carver & D. Klahr (Eds.), *Cognition and instruction* (pp. 1-38). Mahwah, NJ: Erlbaum.

Okamoto, Y., & Case, R. (1996). Exploring the microstructure of children's central conceptual structures in the domain of number. *Monographs of the Society for Research in Child Development*, *61*, 27-59

Websites

http://www.aimsweb.com

http://www.pbs.org/wgbh/misunderstoodminds/mathbasics.html

http://www.studentprogress@air.org

http://www.yearlyprogresspro.com

Questions for Reflection

1. What skills do AIMSweb and Yearly ProgressPro target for assessment in kindergarten and first grade?
2. How can schools, colleges / universities, and departments of education work together to implement effective statewide progress monitoring systems?
3. What scientifically-based math interventions are available in your school?
4. What do your own experiences tell you are the differences between children with good and poor math skills in the elementary grades?

Discussion Board Link:
http://www.validatedpractices.com/flexiforums/login.cfm?fid=0