

SPRCC 2009 Application Packet

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Scott A. Methe, Ph.D. Research Agenda

The overarching goal of my research program and personal research agenda is to use early numeracy curriculum-based measures to enhance school capacity to treat young children struggling to develop mathematical competence. Methe, Hintze, and Floyd (2008) indicated that “Matthew Effects” in mathematics are evident, and suggest that early intervention and prevention driven by data-based formative assessment are reasonable goals for enhancing student achievement. One primary reason for achievement gaps and poor intra- and international achievement scores is that a well-articulated set of “big ideas” in early mathematics are missing from the literature (Methe & Riley-Tillman, 2008). Articulating big ideas in beginning reading led to significant improvements in data-driven instruction. Because the alphabetic and numeric systems are structured symbolic systems, there is evidence that early mathematics improvement can be modeled on key improvements in early reading (Chiappe, 2005).

Focusing on early education can assist schools in preventing problems before they begin. This is especially true if the curricular focus is on a defensible sequence of enabling prior knowledge. Large-scale longitudinal analyses, assessment studies, and developmental research have identified a core set of skills more commonly referred to as those comprising a “number sense” (Gersten, Jordan, & Flojo, 2005). Methe and Riley-Tillman (2008) conceptually arranged a hierarchical framework of numeric knowledge taken from the seminal work of Clements, Sarama, and DiBiase (2004), summarizing over 30 years of cognitive research in early mathematics. Such a framework is useful in arranging the extensive work of direct-instruction proponents, who have identified dozens of specific sub-skills related to early math (Howell & Nolet, 1999; Witt, Elliott, Daly, Gresham, & Kramer, 1998).

The following research questions provide a timeline and foundation for an approximate 5-year research plan. First, it is important to ask, what early knowledge and skills predict differential levels of achievement? I am currently working with a large rural elementary school to address the following questions: (a) do sub-skill mastery measures that operationalize key number-sense areas demonstrate tenets of reliability (especially when examining item consistency) and construct validity and (b) does the order of skill progression using these measures appear theoretically predictable? The second broad research question asks how the information gathered earlier can be used to design assessment and assessment-linked intervention approaches to help children with early mathematics problems. To build a foundation for this stage, I have proposed a set of multiple-baseline designs useful for identifying which measures demonstrate instructional sensitivity under the conditions of randomized intervention start-points. Further, at this stage it becomes important to examine a set of hypothetical benchmarks and cutoff points that predict later performance. The longer term research question involves consumer-driven acceptability and utility toward larger-scale program evaluation, asking specifically how this knowledge can be applied to school system improvement.

Implications for improving school psychological practice and contributing to further research are relevant when considering how early reading assessment has contributed to schoolwide improvement efforts. Although we are working with a different subject, Deno (1989) and Methe, Hintze, and Floyd (2008) indicate that both reading and mathematics are cultural imperatives necessary to provide a foundation for future skill development. Using Fuchs (2004) as a framework as well as 30 plus years of research on reading CBM as a reference point, if the examination of early numeracy curriculum-based assessment progresses at its current pace and identifies a key set of “big ideas,” the implications for research are tremendous.

Multisite Project Abstract

Enhancing the capacity of early educational settings to identify and treat children who struggle to learn early mathematics requires a foundation of curriculum-based formative assessment. Early numeracy assessment is a growing field, but lags behind the advances made by data-driven assessment approaches in reading. To build and sustain a multi-site collaboration, field-test data suggests that each of the following issues need attention: (a) identifying skills to be measured, (b) delivering and administering measures with integrity, (c) enhancing procedural integrity, and (d) maintaining positive site relations. Each of these three concerns is addressed through the proposed project. First, the project seeks to build collaborative expertise in examining existing data using sophisticated linear techniques and techniques useful for identifying reliable and valid content. Second, current research and creative activities have established a basic means through which to disseminate existing packaged measures to schools. The proposed project seeks to enhance the scope of the current capabilities by developing means to enhance the integrity of training and implementation of assessments through both web-based and computer-based media currently being field tested. Multiple advantages and challenges are outlined, and center around identifying contacts and implementing recommended practices.

Scott A. Methe, Ph.D. Multisite Project Proposal

To support multi-site collaborative research using early numeracy curriculum-based assessment to enhance the capacity of schools to identify and treat struggling students, two primary issues need to be operationalized: (a) specific instructional and curricular content that predict later skills and (b) instrument validation studies. Once the goals of these two areas are operationalized, a stronger picture emerges for personnel, roles, functions, and needs. Further, these two issues relate directly to the goals of the research agenda.

Issue 1: Examining Existing Datasets for Instructional and Curricular Content

The content of subskill-mastery type (Hintze, Christ, & Methe, 2006) early numeracy measures can be enhanced by examining current data. Existing data (N=92) from the data used in Methe, Hintze, and Floyd (2008) is available to be examined at the item level. It is proposed that sets of binary item responses will be analyzed using Item Response Theory (IRT) methods to examine the equitability of the items in terms of whether they measure the same underlying latent trait. Methods will require the recoding of test protocols and procedural integrity checks. Items that meet IRT parameters will be selected for inclusion on instruments that have demonstrated reliability in terms of the underlying construct (see instrument development studies below). A second robust source of data is the Early Childhood Longitudinal Study (ECLS-K), which has followed a cohort of kindergarten students through eighth grade. DiPerna, Lei, and Reid (2007) have used the ECLS to examine predictors of mathematical growth. The ECLS followed over 17,000 children from fall of their kindergarten year to spring of their fifth grade year. Participants were sampled cross-sectionally from across the United States. To examine the influence of leveled variables, robust correlations derived from bivariate analyses on the ECLS database will be included in studies using hierarchical linear modeling (HLM). Such studies will

examine the predictive capabilities of identified variables by attenuating the influence of autocorrelations among nested data, and improving the heterogeneous nature of the dataset.

Issue 1: Personnel, Budgeting, Advantages and Challenges of a Multi-Site Program

To address these research concerns collaboratively, it will be necessary to recruit collaborators who have developed expertise in IRT and HLM methods. It is suspected that attendance at the SPRCC would enhance the primary goal. Given that Issue I calls for the analysis of static, existing datasets, the challenges remain relatively straightforward, and are associated with time and contacts. A proposed budget in this category would focus on meeting the fees of statistical consultants who provide methodological and statistical analyses. Many experts' fees range from \$150-200 per hour. The proposed budget would thus range from \$3000 - \$5000 for this level of analysis. A secondary approach would be to utilize graduate students across institutions. Challenges in building a multi-site analytic collaboration will be first identifying expertise in the field as well as identifying sites currently working on such projects. Relative advantages to seeking such contacts could result in specialist-level school psychology trainees having the opportunity to contribute to research under the auspices of thesis and project requirements. This issue will be directly addressed if I am chosen to attend SPRCC.

Issue 2: Instrument Validation Studies

The second area of study concerns the development and field testing of valid instruments that can guide the instructional process. Two primary goals in this area will be to (a) disseminate currently available early numeracy measures across sites and (b) to train, administer, and use the measures in schools across different media (paper, web-based, and computer-based formats). To support such aims, methods include field-tests where instruments containing reliable items are administered to students in K-2. Based on current research I am conducting, I have developed a

set of videos, training manuals, and laminated test items. I have contacted local personnel and computer consultants that advised me about the potential of using these measures in a powerpoint format when administering the measures. This issue can greatly enhance portability in conducting these studies across sites, as paper-and pencil measures often require a greater deal of effort in implementation. I have built a publicly-available website (www.enumeracy.com) that I have begun to test as a portal for making these measures available to others.

Issue 2: Personnel, Budget, Advantages and Challenges to Instrument Validation Studies

Based on current field test results, significant effort in maintaining procedural integrity and positive school relations are necessary. The relative advantage to conducting these studies are that many schools have been required to improve mathematics achievement, and preliminary data suggest that the early numeracy measures are perceived as useful by teachers. Making the measures available through the internet and through powerpoint software is useful, but does not address the challenge of training and procedural integrity. The primary goal to enhance a multi-site collaborative study will be to (a) write procedures to enhance both procedural integrity and positive site relations. Because I am currently field-testing select components of this project with funding from SSSP, I have a strong sense that the main budget items to address these challenges would include: (a) \$1000 for color laser printer toner and paper to disseminate progress reports and teacher newsletters to sites, (b) \$2000 to purchase 3 laptop computers for field-testing powerpoint media for delivering assessments, (c) \$300 to cover mailing costs for disseminating measures and training booklets, and (d) \$3000 as a stipend to a web-based consultant to develop web-based training (upload videos, create a conditional prompting system for school personnel to report results of training and assessment integrity checks).

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