

EXPLORING AND EXAMINING QUANTITATIVE MEASURES

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The purpose of this working group is to bring together scholars with an interest in examining the research on quantitative tools and measures for gathering meaningful data, and to spark conversations and collaboration across individuals and groups with an interest in synthesizing the literature on large-scale tools used to measure student- and teacher-related outcomes. While syntheses of measures for use in mathematics education can be found in the literature, few can be described as a comprehensive analysis. The working group session will focus on (1) defining terms identified as critical (e.g., large-scale, quantitative, and validity evidence) for bounding the focus of the group, (2) initial development of a document of available tools and their associated validity evidence, and (3) identification of potential follow-up activities to continue the work to identify tools and developed related synthesis documents (e.g., the formation of sub-groups around potential topics of interest). The efforts of the group will be summarized and extended through both social media tools (e.g., creating a Facebook group) and online collaboration tools (e.g., Google hangouts and documents) to further promote this work.

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Introduction

There is value in the knowledge that large-scale quantitative research can bring to the field in terms of generalizability to educational practice when appropriately conducted (American Statistical Association, 2007; Hill & Shih, 2009). The American Statistical Association's report (2007) on *Use of Statistics in Mathematics Education Research* states:

If research in mathematics education is to provide an effective influence on practice, it must become more cumulative in nature. New research needs to build on existing research to produce a more coherent body of work... Studies cannot be linked together well unless researchers are consistent in their use of interventions; observation and measurement tools; and techniques of data collection, data analysis, and reporting. (pp. 4-5).

As education has shifted more towards data driven policy and research initiatives in the last 25 years (Carney, Brendefur, Thiede, Hughes, & Sutton, 2016; Hill & Shih, 2009), the data for policy-related aspects are often expected to be quantitative in nature (e.g., end-of-course assessments and numerical value of reform-oriented teaching). Funding agencies encouraging research (i.e., National Science Foundation and Institute of Education Sciences) often request proposals to employ quantitative measures with sufficient validity evidence (see <http://ies.ed.gov/> and <http://www.nsf.gov/>).

Measure (instrument) quality strongly influences the quality of data collected and relatedly, findings of a research study (Gall, Gall, & Borg, 2007). Measures with a clearly defined purpose and supporting validity evidence are foundational to conducting high quality large-scale quantitative work (Newcomer, 2009). There are few syntheses of quantitative tools for mathematics educators to employ and even fewer discussions of the validity evidence necessary to support the use of measures in a particular context. Syntheses of measures for use in mathematics education can be found in the literature but these are typically not intended as a comprehensive analysis. For example, Carney et al. (2015) conducted a brief review of self-

report instructional practice survey scales applicable to mathematics education. Boston, Bostic, Lesseig, & Sherman (2015) conducted a review of three widely known classroom observation protocols to assist mathematics educators in determining the appropriate tool for their particular research question and context. Both reviews provided a background on existing measures and their associated validity evidence in relation to a new measure under development. It is important that this type of work continues and is encouraged by the field. Thus, this working group aims to increase conversation around quantitative tools for use on a large-scale with this working group. We share three goals for this proposed working group: (a) To bring together scholars with an interest in examining the research on quantitative tools and measures for gathering meaningful data; (b) To spark conversations and collaboration across individuals and groups with an interest in large-scale tools and those conducting research on student- and teacher-related outcomes; (c) To generate products to disseminate widely across the field of mathematics education scholars.

Session Organization and Plan for Engagement

The purpose of this working group is to gather individuals across North America interested in synthesizing the literature on quantitative tools in mathematics education that can be used in studies with large samples to examine student- and teacher-related outcomes. When considering the process for conducting a synthesis of quantitative tools and measures, it may be helpful to think of identifying and compiling tools and measures and their associated evidence separately from summarizing and evaluating the quality of the evidence. A synthesis includes both compilation and evaluation. The sequencing of the activities for the purposes of a working group will begin with compilation followed by evaluation in subsequent follow-up activities. It is important for the group to come to consensus on the parameters and frameworks for the synthesis. We recognize that the scope of the working group sessions proposed for PME-NA 2016 must be greatly narrowed. Therefore, we primarily focus on our first two of the three goals for the conference, which are shared here:

1. Bring together scholars with an interest in examining the research on quantitative tools and measures for gathering meaningful data.
2. Spark conversations and collaboration across individuals and groups with an interest in tools for large-scale studies and those conducting research on student- and teacher-related outcomes.

Session 1

The first session will begin with introductions, in conjunction with discerning the interests and areas of expertise of those in attendance. This will be followed by a group discussion about the stated purpose and aims of the group and the following guiding questions: (a) What do we mean by the term quantitative tools? (b) What do we mean by the term ‘large-scale’? (c) How will we define these terms within the working group? We anticipate this discussion will elicit several additional topics that can be further explored during session 1 and potentially sessions 2 and/or 3. Ideally we will conclude by summarizing the discussion from session 1 including potential definitions for the terms identified as critical (e.g., at-scale, large-scale studies, and quantitative) that will be necessary for bounding the subsequent discussion of currently available tools. At the conclusion of session 1, we will present a tentative framework (see table 1 below) for organizing our subsequent discussions around quantitative tools that can be used with large samples to examine student- and teacher-related outcomes. We will request that session participants return to sessions 2 and 3 with ideas for tools that potentially fit within different areas of the framework.

Session 2.

The second session will begin with a discussion on current perspectives in validity related to the argument-based approach (e.g., Kane 2001, 2016). Finbarr Sloane, an NSF-program officer with expertise in mathematics education, measurement, and evaluation has offered to provide a brief overview and facilitate discussion regarding the argument-based approach to validity. Following Dr. Sloane's presentation, the remaining part of session 2 will involve whole-group discussion around potential measures that address the identified areas using the organizational framework for student- and teacher-related outcomes. A brief overview of the organizational framework will be used to ignite the discussion of specific instruments. Table 1 presents the initial organizational framework that will be presented with the full expectation that the group may modify it during sessions 1 and 2. Group facilitators and attendees may begin by placing some relatively well-known tools within the framework to ensure we have a common understanding of the process.

Table 1: Initial Organizational framework for discussion of measures

	Knowledge	Beliefs	Practice
Teachers			
Students			

Session 3

The third session will primarily focus on placing tools within the organizational framework including any associated citations related to publically available or published validity evidence. Depending upon the size of the group, this work may be conducted in small-groups with a whole-group share-out towards the end of session 3. While a long-term aim is to develop syntheses of the literature related to available tools, we see the primary aim of the working group's meeting at PME-NA 2016 as bringing together individuals interested in this conversation and working together on future collaborative efforts in this area. By the end of the third session, we intend to have an initial draft document of some available tools and their associated validity evidence but we do not anticipate this will be a comprehensive document. We will conclude session 3 with a discussion of anticipated follow-up activities to determine the level of interest and commitment from the group in continuing with this work.

Anticipated Follow-up Activities

As a result of our working group discussion and document development, we anticipate several potential follow-up activities. Participants will greatly influence the specific follow-up activities; however, we outline a potential progression of activities to guide discussion of potential 'next-steps'.

One outcome of the working group sessions is a draft document outlining some of the available tools and their associated validity evidence. An anticipated outcome will be to determine how this document should be further refined and later distributed. This will include explicit discussion of next steps to develop a comprehensive synthesis of the literature for wide dissemination to the mathematics education community.

We see several possible venues for further conversations and work related to developing syntheses of the literature on quantitative tools in mathematics education that can be used with studies of large-scale samples to examine student- and teacher-related outcomes. First, we anticipate using both social media tools (e.g., creating a Facebook group) and online collaboration tools (e.g., Google hangouts and documents) to promote these syntheses. Second, we anticipate using mathematics education conferences venues to further the conversations and synthesis work around the project. More specifically, we plan on proposing to continue the PME-NA working group at the 2017 conference. In addition, we anticipate submitting for a symposium at either the 2017 or 2018 conference of the Association of Mathematics Teacher Educators. Lastly, there is potential to apply for grant funding through a NSF CORE Research proposal to support a conference with a focused outcome of a monograph synthesizing the research literature within a particular area.