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Epilogue
What Do We Need to Know? Items for a Research Agenda

Eight working groups at the 2004 MSRI conference "Assessing Students' Mathematics Learning: Issues, Costs and Benefits" were charged with formulating items for a research agenda on the topic of the conference. The moderators of the working groups were:

Linda Gojak, John Carroll University
Hyman Bass, University of Michigan at Ann Arbor
Bernard Madison, University of Arkansas
Sue Eddins, Illinois Mathematics and Science Academy
Florence Fasanelli, American Association for the Advancement of Science
Emiliano Gomez, University of California at Berkeley
Shelley Ferguson, San Diego City Schools
Hugh Burkhardt, University of Nottingham

The following items were identified by these working groups. Any item mentioned by more than one group appears only once.

1. On the topic of productive disposition, as used by Robert Moses and others (e.g., *Adding It Up*), the following questions could be studied. How does one actually define this? How does one measure it? How does knowledge of a student's position on a "productive disposition" scale affect assessment? What are the symptoms of an unproductive disposition? (For example, perhaps a student response to a request to work on a task by saying, "I am not working on the task. I am waiting to be told how to do it.") Is an unproductive disposition a learned behavior? If so, what can be done to change that? What items (e.g., classroom setting, teacher, materials) are important in developing productive dispositions?
2. Confirm or deny the following. Hypothesis 1: Productive disposition, as described in Item 1, declines from the early grades to the middle grades. Hypothesis 2: The decline has become worse over time.

3. How do students interpret questions on assessments? How can assessment tools be designed so that the assessor and student interpretations coincide?
4. Results from a high-stakes assessment and an intensive effective assessment (e.g., a well-designed interview conducted by an expert interviewer) could be compared and contrasted.
5. Practical tests could be designed to give results that are similar to "impractical" methods (e.g., interviews). This is the thrust of some work by Ed Dubinsky and others.
6. Treating mathematics as a language: How students learn and practice this language and become proficient in it, and how one can assess this linguistic mastery, should be researchable issues.
7. Is it appropriate to teach for mastery before proceeding? If so, how does one assess actual mastery?
8. What could be learned from extensive interviews with students and their teachers, with the interviews of the groups either held separately or interspersed?
9. Although we know what many people say students are being taught, do we really know what skills and concepts are actually being taught, and are our assessment tools up to the challenge of identifying this? Opinions seem to differ greatly.
10. How can teachers identify and use information about individual students' backgrounds before attempting to teach them? Some method is needed for identifying background, and attaching that information to assessment and achievement, if potential is to be identified.
11. How do students view the need for precision, and how can they be expected to achieve it? How can we assess whether they have done so?
12. What is the connection between the precision used by the teacher and that used by the student? How precise does the teacher have to be for students at each grade level? Are students being taught in precise enough ways to be able to be precise themselves? How do we then actually assess precision?
13. The ability to form generalizations is an important aspect of a student's mathematical development. How does one assess this? How much does a child have to "know" to generalize mathematics concepts, and how "solid" a background is needed to assure that they are not forgotten? How can this background knowledge and solidity be assessed?
14. What is the actual role of assessment of student knowledge in the improvement of teaching and learning, in both theory and practice? How can a large-scale assessment be productively used to improve teacher development?
15. How much of a large-scale assessment should be published ahead of time?

16. How can standards and assessment be aligned, and how much emphasis should actually be placed on such alignment?
17. How can assessment be individualized so that at various points in a student's career an educational plan for the student's further development can be created?
18. It would be interesting to collect a set of assessment tasks on a particular topic and map these to a conceptual space of understanding that might serve as a diagnostic tool. A series of studies could be done on this, perhaps across groups (universities, leadership groups in education, teachers, and so forth).
19. At the high school level, what components are needed to motivate underperforming students to be successful in college preparatory mathematics in order to be accepted and successful in college, and what is the role of assessment in this? Some possible components that were suggested are resources, teacher quality, class time, class size and load, curriculum and pedagogy, assessment, administrative support, student engagement, parental involvement, and transferability of innovation into the classroom.
20. A longitudinal study is needed to determine the impact on student learning of various types of summative assessment. What impact do teacher knowledge, and various curricula have on student performance on high-stakes testing? What impact does high-stakes testing have on student learning? What about the same sorts of questions for formative assessments (interviews, quizzes, embedded assessments, Freudenthal Institute methods, and so forth)?
21. There is a need for comparative studies of a variety of assessment and accountability systems which are promising for the development of mathematical proficiency for *all* student populations.
22. There is a need for comparative studies of conceptions of mathematical proficiency. How are these conceptions reflected locally, nationally, and internationally in assessments, curriculum, professional standards, and practices?
23. What assessment practices (and more generally what pedagogical practices) contribute to a dislike of mathematics? While on the subject of dislike of mathematics: Is stating such a dislike in class by the students acceptable, or does it affect class attitude?
24. How can one make effective comparative assessments across grade levels of difficult (to many students) mathematical concepts such as equivalence relations?