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END NOTES

INTRODUCTION: WEATHERING THE STORM

1. The article, *The Politics of California Mathematics: The Anti-Reform of 1997-1999* (Becker, J. and Jacob, W., 2000), gives readers a detailed account of a campaign to associate low scores in mathematics with standards-based curriculum materials. The authors note that not only did the argument “ignore the compelling evidence that drill-and-practice classrooms have short-changed students for decades...for the most part, today’s students with unacceptable scores have *not* experienced the reformed mathematics curriculum materials. In California, the claim that the 1992 framework had failed its elementary students was widespread by early 1995, in spite of the fact that the curriculum materials aligned with the frameworks would not be available to teachers until the fall of that same year.” The authors reported that concerns about the “failed reform” led legislators to reverse themselves and adopt a back-to-basics instructional model similar to the one that had failed students in the past.
2. The book *Thinking for a Living; Education and the Wealth of Nations* (1993) provides a well researched account of emergence of the Carnegie credit system of education at the beginning of the century a system designed to produce low-skilled workers for the nation’s emerging factory economy . The authors address the mismatch between an education system designed for another era and the need today for an integrated learning system that prepares all students for increasingly complex work environments and civic responsibilities.
3. In testimony to Minnesota’s House Education Policy Committee on January 23, 2001, prepared by Linda Baer, Chancellor of Academic Affairs, MNSCU, and Joanne McKay, Dean of the College of Education, St. Cloud State University, the two academic executives reported that in 1999 only 17.9% of freshmen were judged ready to start college level mathematics (college algebra and above) in the community colleges, and only 37.8 % in the MNSCU university system. Data from the University of Minnesota 2000-2001 Course Summary from February 27, 2001, indicates that of 7,003 freshmen enrolled, 872 are enrolled in no-credit math courses in the General College, and 3,246 are enrolled in math below the level of calculus in IT.
4. In a 1998 survey of teachers, Minnesota Council of Teachers of Mathematics (MCTM) learned that elementary teachers appear to be more supportive of reform efforts and to have a more positive outlook on Minnesota’s Graduation Standards than their secondary counterparts. In the Twin Cities metro area, the need and support for reform was higher than elsewhere (p. 4).
5. Scott Thompson’s (2001) article draws a distinction between “test based” standards (otherwise known as high stakes testing), and “authentic standards” which are fundamentally concerned with access to challenging learning opportunities. Authentic standards reject the sorting typical in factory-style education, and insist that all students be held to high expectations, and receive the same high levels of support. The confusion caused by two such opposite approaches to student learning are confounded by calling both systems “standards.” Minnesota’s Graduation Standards

embody authentic standards as described in this article and as represented by NCTM's *Principles and Standards for School Mathematics (2000)*.

6. SciMath^{MN} has a number of helpful resources available for districts in the planning and or implementation stages of adopting standards-based curriculum materials. See their web site: www.scimathmn.org.

ONE - OPENING UP THE PROCESS

1. Parents' hopes for their children's mathematical learning are similar to the goals of standard based mathematics as described in these sources: In the report *Adding It Up (2001)*, the editors' description of mathematical proficiency includes, among other things, the capacity for logical thought, ability to formulate mathematical problems and to explain and justify thinking, as well as a "habitual inclination to see mathematics as sensible, useful, and worthwhile" (p. 5). In *Principles and Standards for School Mathematics (2000)*, NCTM's Equity Principle requires high expectations for all students while the Learning Principle insists that students build new knowledge through well chosen tasks (p.3-5).
2. Parents' common sense about what children need reflects the practical expectations industry has for graduates. Futurist David Zack (2000) writes that what employers seek is not measured in grades. They need employees who have curiosity and imagination. Arguing that "it is the height of arrogance to impose today on tomorrow" he suggests children need to believe they have a share in the future, and they need the freedom to make mistakes (p. 10-11). In this context, mathematics programs that encourage students to become confident in their ability to tackle difficult problems and to seek multiple solutions to those problems are best preparation for a future that is yet to be written.
3. Michael Battista (1999) documents the failure of traditional mathematics. "The results of testing by the National Assessment of Educational Progress indicates that only about 13% to 16% of twelfth graders are proficient in mathematics. And according to the National Research Council, 75% of Americans stop studying mathematics before they complete career or job prerequisites" (p.426).

In a letter to California's Board of Education, Luther S. Williams, the assistant director of the National Science Foundation describes the failure of traditional mathematics education: "The wistful or nostalgic 'back-to-basics' approach that characterizes [California's] standards overlooks the fact that the approach has chronically and dismally failed. It has excluded youngsters from engaging in genuine mathematical thinking and therefore true mathematical learning, and has produced a disproportionate mathematically illiterate citizenry" (in Burns, M. 1998).

4. *The Art of Focused Conversation (2000)*, edited by R. Brian Stanfield, is a very readable and useful guide to preparing conversations to focus thinking through dialogue rather than debate. Based on the principles of inquiry, the book provides a practical overview for structuring conversations, pitfalls to avoid, and 100 "model" conversation outlines for numerous situations leaders encounter.
5. See chapter 1 in the SciMath^{MN}'s *Minnesota K-12 Mathematics Framework* for a succinct presentation of the "Case for Change" and the meaning of mathematics.

6. Project 2061 of the American Association for the Advancement of Science (AAAS) has developed procedures for evaluating mathematics textbooks based on coverage of mathematics content and including, among other things, the ability of the curriculum materials to identify a sense of purpose by connecting mathematics, provide first-hand experiences with mathematical concepts, promote mathematical thinking, and be aligned with assessments. They also have published their evaluation of middle school learning materials and high school algebra programs. To learn more about Project 2061 check their web site at www.project2061.org.
7. In terms of leadership, the adoption of standards-based mathematics curriculum materials represents a quintessential adaptive problem because it requires leaders to help stakeholders align values with circumstances, where the values must change (Heifetz, p. 35). Adaptive work requires people to decide “what matters most and in what balance and with what trade offs.” Inclusion of competing value perspectives may be the most essential element to the leader’s success (p. 23).

TWO - BUILDING TEACHER CAPACITY

1. In a 1998 survey of teachers, Minnesota Council of Teachers of Mathematics (MCTM) learned that elementary teachers appear to be more supportive of reform efforts and to have more a positive outlook on Minnesota’s Graduation Standards than their secondary counterparts. In the Twin Cities metro area, the need for and support of reform was higher than elsewhere (p. 4).
2. The disparity between expressed beliefs and classroom practice indicate that old cultural scripts continue to prevail. For example, mathematics teachers in the United States say that students’ mathematical success depends on their grasp of mathematical concepts, but observations of typical lessons suggest that teachers really believe school mathematics can be reduced to a set of rules. In addition, teachers break mathematical information into manageable pieces for students, suggesting that teacher are unwilling to allow students to do their own learning. By contrast, in Japan, teachers believe confusion is part of the natural learning process; they think students learn best through a variety of activities, including struggling with a problem first and then discussing it later (National Research Council, 1999).
3. Cultural scripts about autonomy create norms within the teaching profession that suggest teaching is an idiosyncratic, mysterious technique that teachers develop individually over time. In that mode goals can only be ambiguous, and definitions of teacher success highly individualistic. Elmore (2000) argues that effective schools and student success require, instead, a coherent set of instructional goals that provide teachers and districts with direction that give meaning to learning and impetus to collegiality. The role required of district leaders is to promote a view of teaching as a body of knowledge and set of skills that can be learned over time (p.16-17).
4. Nationally, one-fifth of high school math teachers have neither a major nor a minor in mathematics, and the typical elementary teacher takes three or fewer math courses in college. In view of new standards in mathematics that require more challenging instruction, this deficit is critical. Susan Loucks-Horsley criticizes current professional development saying “it is typically weak, limited, and fragmented, incapable of supporting [teachers] as they carry the weight of adequately preparing future citizens. Programs fall short of helping teachers develop the depth of understanding they must have of mathematics content, as well as how best to help their students learn it” (ENC, p.2).
5. Teachers at a professional development session were asked to rate the importance of certain ideas on a scale of 1 to 10, where 10 signified high agreement. Some of their responses: Math problems have

only one right answer (8); all students can learn important and challenging math (3); Effective teachers explain HOW to work problems (8); students should NOT use calculators until they master the basics (8); reading and writing belong in language arts, not in math (8)... These responses indicate how far professional development has yet to go in shifting teachers' thinking about mathematics.

6. Best Practice: New Standards for Teaching and Learning in America's Schools, 2nd edition (1998), by Steven Zemelman, Harvey Daniels, and Arthur Hyde. Published in Portsmouth, NH.
Arthur Hyde and Beyond Arithmetic: Changing Mathematics in the Elementary Classroom (1995), by Jan Mokros, Susan Jo Russell and Karen Economopoulos. Published in Palo Alto, CA: Dale Seymour.
7. MASP² stands for Minneapolis and St. Paul Merging for Standards-based Practice. Directed by Dr. Thomas Post from the University of Minnesota, MASP² is an NSF project to help acquaint districts with NSF-funded mathematics curriculum materials.
8. An occupation becomes a profession when it assumes responsibility for developing a shared knowledge base for all its members, and for transmitting that knowledge through professional education, licensing and ongoing peer review. Professions put the interests of clients first and apply the best of current knowledge to those interests. Professionalism is a continuous process looking for practical means of accountability and that socializes its members to an ethic of concern for all clients (Darling-Hammond, 1997, p. 298-299).
9. Successful schools, like other successful organizations, reduce specialization, work in teams that have access to learning and authority. They rely on principles of human performance and motivation by providing opportunities to make a difference and do something well. (Darling-Hammond, 1997, p. 150-152).

THREE - RETHINKING BUILDING LEADERSHIP

1. Elmore (2000) defines improvement as "change with direction" that is sustained over time and that moves entire systems to raise the average level of performance. He suggests that instead of principals who function as buffers that solve the daily problems of school, they reclaim their roles as leaders in instruction, and orient their other work around that (p. 14-15).
2. A report from the Institute for Education Leadership's Task Force studying the principal's job said that "the principal of tomorrow will lead diverse schools, subject to volatile change and focused on achievement. As centers of the community, principals will need to be an instructional leader, a community leader capable of sharing the big picture of schools—an advocate and community partner—and a visionary leader whose energy and commitment motivates others in and outside the building in the belief that all children can learn." www.iel.org.
3. In an article entitled *Growing Your Own*, the author describes the coming shortage of principals in the context of increasing professional responsibility, and mediocre salaries. He quotes the executive director of Virginia's Association of Secondary School Principals, "The frustration level for principals is at an all-time high. We're caught in a time warp. We're launching a new era of accountability, but we're doing it with a Model T Ford mechanism...The support is not in place for principals to be instructional leaders."
4. Brad Board (2000) links improved student achievement to the principal's role: Among other things, he suggests principals need to be well informed about the big picture of change, be knowledgeable regarding best practices and research on student learning, be able to work with curriculum committees and the community to bring about long-term, systemic change in mathematics instruction, and actively participate with teachers and curriculum committees to promote changes in mathematics.

5. Visit SciMath^{MN}'s web site for information on tools that help parents adjust to the new standards-based curriculum materials : www.scimathmn.org
6. A description of The Beloved Child exercise can be found in SciMath^{MN}'s *Minnesota K-12 Mathematics Frameworks* in chapter one and in part one of this report.
7. See SciMath^{MN}'s website: wwwscimathmn.org.
8. "I have also come to understand that the context principals should strive to create in their schools is the collaborative culture of a professional learning community. Creating a collaborative culture has been described as 'the single most important factor' for successful school improvement initiatives, 'the first order of business' for those seeking to enhance their school effectiveness...and the most promising strategy for sustained, substantive school improvement" (DuFour, 2001).

FOUR - ALIGNING GOALS

1. In his book *Radical Equations, Math Literacy and Civil Rights*, Robert Moses and co-author Charles Cobb claim "the most urgent social issue affecting poor people and people of color is economic access. In today's world, economic access and full citizenship depend crucially on math and science literacy." They acknowledge that lasting change must come from communities of people who organize to make demands, and in the process transform themselves.
2. Thompson distinguished authentic standards from test-based reform:

AUTHENTIC STANDARDS are concerned with equity, departing from the tracking, factory-style schooling of the past. Standards hold high expectations and provide high levels of student support for all teachers, students and educators. Assessments are aligned with standards and student performance is evaluated in a variety of ways over time.

TEST-BASED REFORM measures student progress by a single indicator that has high stakes attached, such as moving to the next grade or receiving a diploma. The effect of high-stakes tests is to narrow the curriculum, reducing instruction to "test prepping." Ultimately, test-based reform leads to higher drop-out rates and equity becomes the casualty. A politically warped version of what is arguably the most promising school reform, testing suits political expediency for rapid, quantifiable results (that the public can digest without much thought) and so poses a threat.
3. Although Americans suggest that public schools are the heart of their communities, and one-fourth of them define their community by their local school district, 25 percent say they take little or no responsibility for the quality of their schools and "51 percent say they are not involved in making schools better themselves" (*Action for All, Washington Post*, April 16, 2001).
4. David Labaree (2000) suggests that people who think schools should produce competent citizens draw on the familiar belief that education opens doors to democratic equality; they appreciate the potential standards bring in terms of cultural competence and the reduction of the differences between the advantaged and disadvantaged children. Those concerned about training productive citizens, believe schools serve as an efficient mechanism to maintain an appropriate labor pool; they are likely to endorse standards because they raise the level of human intellectual capital in the work place. Both of these views see education as a public good. When people see education in terms of social mobility, however, they see it as a private good and want to maintain a system that allows some children to gain a competitive edge over others. Whether acknowledged or not, the goal of this perspective "is to preserve the advantages and increase the distinctions that arise from the way individual consumers

currently work the education system." Today's standards movement aims to raise the level of learning in schools and overcome the "intense game of 'how to succeed in school without really learning'" that has been prevalent for so long (p.28-33). Comments from parents in this study suggest that many hold all three views and so are conflicted; they want both the public and the private good.

5. Elmore (2000) writes that accountability requires a reciprocal relationship; that authority cannot require others to do something without providing the necessary means to make that responsibility possible (p. 21). In this case, state legislators who require achievement standards but do not support stable policy or adequate funding appear to fall short on their side of the bargain.
6. For a downloadable document filled with current graphs and data about the success of public education, see the publication, *Do You Know the Good News about American Education?* It can be found at www.ctredpol.org.
7. The Glenn Commission report, *Before It's Too Late* (September 2000) states: "The most direct route to improving mathematics and science achievement for all students is better mathematics and science teaching." Students do better when their teachers are fully certified and when they majored in the subject they were teaching (p.18). More recently, an article titled *Teacher Quality and Student Achievement: Recommendations for Principals* (BULLETIN, The National Association of Secondary School Principals, November 2001) says that "teacher preparation is a stronger correlate of achievement than class sizes, overall spending, or teacher salaries, and accounts for 40% to 60% of the total variance in achievement after taking students' demographics into account. The article cites extensive literature on the subject.
8. Test data in Minnesota is beginning to show the same positive results seen in other states. Students prepared with standards-based mathematics curriculum materials do well, but it will take a few years before Minnesota's pattern is fully revealed. A sample of the results so far include the following:
 - Districts that participated in the study are gathering data on student achievement that they will share with their districts. For example, one participating district, after its first year with standards-based mathematics curriculum materials showed a marked improvement in its Iowa Test of Basic Skills (ITBS) scores. Both in second and fourth grades, scores went up between 7 and 14 points in both mathematics and reading, though the only curriculum change they had made was in their math program.
 - Other districts participating in the study have reported that not only has the percent of students passing the Minnesota Basic Skills Test (BST) gone up, but they are passing with more correct answers than in the past.
 - A few years ahead of study participants, Minneapolis data reveals several insights. During the 1996-97 school year, nine middle schools in Minneapolis implemented the *Connected Math Project* (CMP) curriculum materials (Winking, Bartel, and Ford, 1998). Of the nine schools, five fully implemented CMP and four partially implemented CMP (i.e., routinely used other mathematics curriculum materials as well as CMP or the teachers did not receive professional development) with forty teachers participating in the study across the nine middle schools. The study evaluated student academic performance in mathematics and changes in attitudes of students and teachers about teaching and learning mathematics after one year.

Among the key findings of the Minneapolis study was that most eighth graders in full implementation CMP schools scored significantly better than their non-CMP peers on the State Basic Standards Mathematics Tests.

Also, seventh-grade CMP students in the full implementation schools "scored significantly better than their non-CMP peers on the CAT/5 Math Concept Subtest" (Winking, Bartel, and Ford).

The study also notes that students in partial implementation CMP schools "scored no better or worse than their non-CMP peers on all measures."

The study findings also showed that after using CMP, students were less likely to make negative comments about math and that teachers' beliefs tended to change to be more consistent with the philosophy underlying the CMP curriculum.

- The North St. Paul, Maplewood, Oakdale school district (District 622) was not a participant in our study, but has done extensive tracking of their students' achievement. Since implementing standards-based curriculum materials, there has been a marked increase in scores on the Iowa Test of Educational Development (ITED). In a comparison of the class of 1997 (who took the ITED in the fall of 1994) with the classes of 2002, 2003, and 2004, there is a clear pattern of significant achievement. While the class of 1997 had only 17percent of its student scoring at the 76th percentile or higher, the classes of 2002, 2003, and 2004 had between 52 -55percent of students in that top quartile. On another measure (the PLAN test which is similar to PSAT test and is taken by sophomores before they take ACT college test), students in this district did significantly better than the national average. While nationally only 4% of the students scored in the 24-32 range, 11 percent of the students from District 622 scored in that top range.
9. "When Bill Jacob denounced the 1987 [California] framework draft at the committee's final meeting, saying it was a return to the curriculum of the 1960s, he was corrected by another math professor on the committee who told him that the framework represented the curriculum of the 1950s and that he was proud of it. With \$500 million already appropriated for the new materials, we think all citizens should be concerned that California's students will begin the 21st century preparing for the job market just as their grandparents did." Becker, J and Jacob, B. (2000).

LESSONS LEARNED - ENGAGING THE PUBLIC

1. The publication *Math Makes Sense* came out of this series of meetings with community, parents, teachers and students. For additional resources that support the adoption of standards-based mathematics curriculum materials, see SciMath^{MIN}'s web site at www.scimathmn.org, or go to www.mathematicallysane.com.
2. In their article on the politics of the California anti-reform efforts, Becker and Jacob (2000) describe the mixture of myth and misinformation that precipitated California's return to "the basics." "The rapid changes in California's mathematics policy followed a persuasive (albeit deceptive) campaign alleging the failure of the current reform movement in mathematics education...and they failed to note that for the most part, today's students with unacceptable scores have not experienced the reformed mathematics curricula." The attention the media gave to California's reversal of its mathematics education policy magnified the misinformation across the country, making headlines in newspapers and TV news broadcasts.
3. Besides the *Action for All* article ([Washington Post](http://www.washingtonpost.com) (April 16, 2001) cited in part four of this report, Public Agenda has tracked American attitudes about public education for the last ten years. While participation in the work of schools is low, opinions about education are explicit. See www.publicagenda.org.
4. See footnote 8 in part three of this report for a sample of the early data coming in.

5. The cover graphic represents visually the meaning of public engagement. Rather than a mass communications effort or large public forums, the expanding ripples suggests that *public engagement results from multiple opportunities schools create to involve stakeholders meaningfully in decisions that affect them*. As the circles expand and intersect with each other, a wider understanding of the issues become prevalent in the community.

The process study participants described applies to each circle of engagement: 1) begin with a small, representative group who help identify the current challenge; 2) build the knowledge bases of those who will make the decision; 3) give the decision makers the responsibility of bringing that decision to their peers but support them with the tools and data they need; and 4) focus or frame the immediate challenge within the larger goals and expectations of the community. At every opportunity, district leaders need to give stakeholders a clear picture of what public education looks like today, how the task has changed, what we now know about how students learn, and the demands an increasingly technological world will make on student achievement goals.

