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A New Equation for Mathematics Education

Math literacy = ALL students

A message from the editors

Joan Kingrey, editor, and Kevin Foster, assistant editor, *Curriculum in Context*

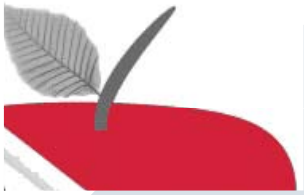
Mathematics education is one of the most important challenges of our time. There is ample evidence that we are not doing

well at math and it is commonplace, and acceptable, for adults to pronounce that "I never was any good at math." Unlike literacy, an expectation for all of us, we expect mathematical proficiency of only the few, and have treated it as a rare talent to be discovered rather than something to be systematically learned, practiced, and deeply understood by everyone. Like literacy, mathematics is a language that is used to represent our world and our thinking. It includes the facility to think in terms of symbols and patterns and is an essential capacity for all of us. And yet, most of us do not have the vocabulary, the fluency, the conceptual understanding, or the developed ability to reason mathematically. Just 51 percent of Washington 10th graders met the standard in mathematics on the 2005-06 WASL (Washington Assessment of Student Learning). On the National Assessment of Educational Progress (NAEP), only 23 percent of 12th graders were proficient in mathematics and just 61 percent were at or above the basic level. The reason for high enrollments in remedial, non-college level mathematics in our community colleges and universities becomes obvious. And, given the lack of proficiency it is not surprising that so few students successfully pursue degrees in the STEM disciplines: science, technology, engineering, and mathematics.

Almost everyone has an opinion about math education. Unfortunately, much of the rhetoric is poorly informed and a product of outdated systems that have allowed the development of mathematical competency as an option, not an expectation for everyone. But today's world has changed all of that. Math is as much a part of the equation for productive citizenship as are reading and writing. When students do not succeed in mathematics, they also do not succeed in science. Their level of achievement in math and science defines their choices for post-secondary education, creating either a barrier or a passport to continued educational opportunity and promising careers. Mathematics has become the gatekeeper for our students and the predictor of their futures. Bob Moses, founder and president of *The Algebra Project*, has advanced math literacy as a civil and human right. In his book, *Radical Equations: Civil Rights from Mississippi to the Algebra Project* (2001), he states: "Today, I want to argue, 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. I believe that the absence of math literacy in urban and rural communities throughout this country is an issue as urgent as the lack of registered Black voters in Mississippi was in 1961. . .I know how strange it can sound to say that math literacy – and algebra in particular – is the key to the future of disenfranchised communities, but that's what I think and believe with all my heart" (p. 5).

So, what is to be done? None of the contributors to this issue suggest simplistic solutions or quick fixes. Mathematics reform will be rooted in an examination of what we believe about math learning and whether or not we decide to commit to high quality mathematics instruction for everyone. It will require professional learning communities of educators to study and determine best practices, and will necessitate K-20 partnerships and curriculum alignment in order to get it right. It will demand a coherence of content and pedagogy. It is much more than passing the 10th grade WASL in mathematics because the real benchmark is meeting college-ready standards. It will take research and informed decision making about the changes that must be made. It will include initiatives to educate the public and redesign of the ways we prepare teachers and support them through professional development. We are fortunate to live in a state where our governor is a champion for math and science education. *Washington Learns*, the recent review of the state's educational system, specifically targets math and science education as essential priorities for the state's economic development and for the individual well-being of all students. Strategic investments in math and science education are proposed and policy improvements are recommended. We are also fortunate to have considerable mathematics expertise in our state; the authors in this issue are making significant contributions to the ways we think about mathematics education and the work of math reform.

What we do about mathematics education will become the measurement of our commitment to educational access and opportunity. We need a new equation for math, one where math literacy equals ALL students. This issue of *Curriculum in Context* explores the complexity of crafting this new equation and the changes that must be made in the way we ALL think about mathematics.



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Supporting elementary mathematics through long-term professional education

by Elham Kazemi

Around the state, there is a buzz about improving mathematics teaching and learning. We are bombarded, almost daily, with what our students and schools cannot do. Transforming mathematics teaching and learning is not likely to happen overnight, but it does depend on our efforts to build capacity for systems to learn and to learn together. The good news is that there now exists an array of professional resources to help. When embedded in a long-term, coherent plan and used skillfully, these resources can support schools and districts to develop more coherent and robust instruction that aims for mathematical fluency for all students. In this article, I will describe some of the work I am doing with a team of colleagues at the University of Washington through the *Mathematics Education Project*[1] to support capacity building in elementary and middle schools. Our goal is to help systems make and carry out plans to support the professional education of teachers, teacher educators and administrators and to learn how to effectively engage with families.

Building understanding of student learning

We developed our goals for the *Mathematics Education Project* from our understanding of the challenges schools and districts face to create coherent plans for elementary mathematics professional development and the research literature on teacher learning. Research has shown that well-organized, long-term professional development is needed to support teachers to create the ambitious instructional practices that will allow all their students to learn (e.g., Ball & Cohen, 1999; Loucks-Horsley et al., 1998; Wilson & Berne, 1999). New resources in elementary mathematics education have recently become available to deepen teachers' content knowledge, help them elicit and interpret student thinking, and imagine instructional practice that will help advance children's ideas (see Lampert, 2001). Resources also exist to help administrators and parents understand their key roles in supporting mathematics learning.

We draw upon many of the newest and most comprehensive resources for supporting teacher, administrator and parent education in elementary mathematics education: *Cognitively Guided Instruction; Developing Mathematical Ideas; Young Mathematicians at Work; Implementing Standards Based Instruction; Building Support for School Mathematics;* and *Lenses on Learning: Classroom Observation and Teacher Supervision in Elementary Mathematics* (see brief descriptions which follow). Because the facilitation of these new materials is both complex and demanding, it requires much systemic knowledge for districts and schools to make wise use of them. We still see too many districts adopting a one-shot approach to professional education. We're committed to helping schools and districts learn what these resources offer them in order to be able to create a long-term plan to engage teachers and the broader system in substantive ways about their own teaching (Hatch, White, & Faigenbaum, 2005; Little, 1999; Spillane, 2000).

At the core of our work with teachers, teacher educators, administrators and families is the view that teachers should use a deep understanding of students' mathematical thinking as well as a clear understanding of mathematical content to guide instruction. We introduce and help leaders understand how particular resources can support knowledge and skill building. Educators, leaders, and families appreciate how students' thinking develops when they are given opportunities to share and explore students' understanding and their confusions. Our selection of particular resources for professional learning and capacity building reflect goals to deepen subject matter understanding and bring to the surface the significant work that teachers do when they anticipate, elicit, and respond to students' mathematical ideas. Our view is that teachers' efforts to understand student thinking can deepen their own disciplinary knowledge and should guide their consideration of how to pose mathematical problems and facilitate mathematical work in the context of their classroom. The professional education resources we introduce to schools are designed not only to push on subject matter understanding but also to make visible the instructional thinking and decisions that teachers make as they engage with their students' ideas.

[1] Part of this work is currently funded through a grant from the National Science Foundation to Strategic Organization, Assistance, and Resources (SOAR) for Washington Mathematics (Award# 0554541). To learn more about the Mathematics Education Project, e-mail the author at ekazemi@u.washington.edu.

Description of professional development resources used in the mathematics education project

Below is a short description of the materials we commonly use in our partnerships with schools.

Developing Mathematical Ideas (DMI) is a curriculum designed to help teachers think through the major ideas of K-6 mathematics and examine how children develop those ideas. There are seven modules, each focused on a different strand of the elementary curriculum: number and operations, data, geometry, measurement, and algebra. The curriculum offers teachers opportunities to explore mathematics; to share and discuss the work of their own students; to plan, conduct, and analyze mathematics interviews of their own students; to analyze lessons taken from innovative elementary mathematics curricula; and to read summaries of related research (Schifter, Bastable, & Russell, 1999).

Cognitively Guided Instruction (CGI) is a K-3 professional development program. It provides a framework for teachers to understand the development of children's computational fluency. Teachers deepen their knowledge of number and operations as they understand how to elicit and build on children's strategies for problem solving. There is a strong research base that supports the effectiveness of using CGI to guide instruction with children from diverse ethnic, language, and social class backgrounds (Carpenter et al., 1999).

Young Mathematicians at Work are video-based materials through which participants study how teachers introduce and run mathematical investigations and mini-lessons. Student work can be studied and followed across several days of instruction. The teachers' use of representations and

decisions in facilitating mathematical discussions can be analyzed closely. The PK-3 materials focus on early number sense, addition and subtraction; the 3-5 materials deal with multiplication and division; the 5-8 materials involve fractions, decimals, and percents (Fosnot & Dolk, 2003).

Implementing Standards-based Mathematics Instruction is a set of written cases focused on middle grades instruction. The cases allow participants to analyze the cognitive demand of tasks and how instructional practices affect the intended cognitive demand. Often cases are paired so that readers can analyze differences in the same lesson taught in two ways. Casebooks are available that focus on particular topics such as rational numbers, geometry, and algebraic thinking (Stein et al., 2000).

Building Support for School Mathematics: Working With Parents and the Public is a series of sessions developed to help parents and the public learn to recognize and support quality mathematics programs in schools. The sessions are presented in a handbook that details work with parents and the public and all materials necessary to offer the parent sessions in local communities (Parker, 2006).

Lenses on Learning: Classroom Observation and Teacher Supervision in Elementary Mathematics provides an opportunity for administrators and teacher leaders to think through ideas that underlie standards-based reform in mathematics teaching and learning and to relate those ideas to their own work. Participants discuss implications of reform for their responsibilities as instructional leaders. Assignments encourage administrators

to use focused criteria when observing and debriefing mathematics lessons in K-8 classrooms (Grant et al., 2006).

Conclusion

Districts and schools across the state are adopting curricula in elementary mathematics that require teachers to have deep content knowledge, facilitate discussion-intensive classrooms, and document and facilitate students' mathematical fluency in mathematical concepts, argumentation, and procedures. The resources that we use in the *Mathematics Education Project* can greatly assist schools in meeting these demands for teacher learning. We aim to connect schools and districts in the state in a larger network that allows them to learn from each other's planning, successes, and struggles. For the schools and districts we have worked in, participants understand that offering one-shot experiences built around any one of these resources by itself will not lead to long-term changes in student understanding. These resources are tools for impacting teacher, parent, and administrator knowledge about content and pedagogy. A long-term commitment to and plan for continual improvement that includes the strategic use of some of these tools will more likely impact student achievement.

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References

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession* (pp. 3-31). San Francisco: Jossey-Bass.

Carpenter, Fennema, E., Franke, M. L., Levi, L., & Empson, S. B. (1999). *Children's mathematics: Cognitively guided instruction.* Portsmouth, NH: Heinemann.

Fosnot, C. & Dolk, M. (2003). Young *mathematicians at work.* Portsmouth, NH: Heinemann.

Grant, C., B.S. Nelson, B.S., Weinberg, A., Sassi, A., Davidson, E., Holland, S. (2006). *Lenses on learning.* Parsippany, NJ: Dale Seymour.

Hatch, H., White, M.E., Faigenbaum, D. (2005). Expertise, credibility, and influence: How teachers can influence policy, advance research, and improve performance. *Teachers College Record,*107, 1004-1035.

Lampert, M. (2001). *Teaching problems and the problems of teaching.* New Haven, CT: Yale University Press.

Little, J. W. (1999). Organizing schools for teacher learning. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 233-262). San Francisco: Jossey-Bass.

Loucks-Horsley, S., Hewson, P. W., Love, N., & Stiles, K. E. (1998). *Designing professional development for teachers of science and mathematics.* Thousand Oaks, CA: Corwin.

Parker, R. (2006). *Supporting school mathematics: How to work with parents and the public.* Portsmouth, NH: Heinemann.

Schifter, D., Bastable, V., & Russell, S. J. (1999). *Developing mathematical ideas.* Parsippany, NJ: Dale Seymour.

Spillane, J. P. (2000). Cognition and policy implementation: District policymakers and the reform of mathematics education. *Cognition and Instruction,* 18, 141-179.

Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2000). *Implementing standards-based mathematics instruction.* New York: Teachers College Press.

Wilson, S. M., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. In A. Iran-Nejad & C. D. Pearson (Eds.), *Review of Research in Education* (Vol. 24, pp. 173-209). Washington, D.C.: American Educational Research Association.