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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 Unfortunately, much of the rhetoric is poorly informed and a product of outdated systems that have allowed the development of mathematical competency as an option, not an expectation for everyone.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.

Curriculum in Context

A New Equation for Mathematics Education

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Securing a bright future for all students through math and science

by Governor Chris Gregoire

Math and science are the foundation for our future. As a language of patterns, math and science make sense of the world in which we live. They are the

language of nature and the language of technology, describing plant growth and weather patterns, driving search engines, revolutionizing markets and creating new products and services.

In order to compete in the global economy, our children must learn the language of technology, the language of innovation, the language of math and science.

As *New York Times* journalist Thomas Friedman explains, in his widely-acclaimed 2005 book *The World Is Flat,* with technology directing the global supply chain for services and manufacturing, anything can be outsourced – to China, India and elsewhere. This flattening of the global economy requires us to adapt and to invest in the skills that give our children the opportunity to master technology. We need better math and science education, for students that are better equipped to compete.

Yet schools struggle daily to provide math and science to students who often shun these subjects as "too hard" or "too nerdy," with a shortage of qualified teachers and in an environment of shifting standards and fragmented curricula.

Our students are at risk. This year, only 51 percent of 10th graders met the standards on the math WASL. Thirty-two percent of Washington high school students who go directly to college must take remedial math classes before they can take college-level courses. These statistics show a systemic failure. Our schools are failing our kids when it comes to math.

When high school students are not well-prepared in math and science, they tend not to pursue careers or college degrees that require the skills most in demand by our economy. These jobs are not just for engineers, computer scientists and health professionals; increasingly, jobs in the skilled trades, from construction to automotive repair, also require math and science skills. Many students with inadequate preparation in math and science who enter the workforce directly are finding it more difficult than they thought to land a well-paying job.

We are faced with a challenge. We need to fix our math and science education system. That is why *Washington Learns,* a recent review of our entire educational system, calls for renewed focus on math and science education.

We must tackle this challenge on several fronts simultaneously. In the short-run, we cannot penalize today's students for shortcomings in the educational system. That is why Superintendent of Public Instruction Terry Bergeson and I have proposed a temporary change in the math graduation requirement, to provide an additional option for students who have not passed the high school math WASL. These students would be allowed to graduate if they continue to take rigorous math classes until they either graduate or pass the test. This option would apply for three years – for the graduating classes of 2008, 2009 and 2010. This three year window will allow us to address some of the policy issues that underlie our poor overall performance in math.

I've also called for special help for students struggling to pass the WASL. Intensive learning options, test preparation and tutoring will be provided at school along with additional mentoring and tutoring at after-school programs, such as the Boys and Girls Clubs.

Meanwhile, over the next several years, we will undertake a comprehensive math and science reform effort that will include helping young children learn these subjects, revising standards, getting serious about the curriculum, improving teaching, and making math and science more exciting to students.

Math and science fundamentals should be introduced early to build a strong foundation and create interest and confidence. Young children are naturally curious and learn as they play, counting and stacking toys, sorting them by color, playing in water and watching insects and animals. *Washington Learns* calls on the Department of Early Learning along with the Superintendent of Public Instruction and the State Board for Community and Technical Colleges to enhance the materials and training used by early educators with very young children.

We must revise our math and science standards to make them world-class. Currently, students from the United States compare poorly against students from other nations on mathematics achievement. A recent study by the American Institutes for Research, *Reassessing U.S. International Mathematics Performance: New Findings from the 2003 TIMSS and PISA,* shows that United States students consistently under-perform, especially at the middle- and high-school levels.

Washington Learns has assigned the State Board of Education the task of adopting international performance standards for math and science, and high school graduation requirements will then be aligned with those standards – raising expectations and making our students more competitive against their global counterparts.

We must end the curriculum chaos that academically handicaps so many of our students. Today, students who move from one district to the next, or even from one school to another within a district, often encounter texts and materials that teach math and science in very different ways – and that's not fair to the students. If a child starts school in Aberdeen and finishes in Ritzville, she should be learning the same material. *Washington Learns* calls on the State Board of Education and the Office of the Superintendent of Public Instruction to identify no more than three curricula for elementary, middle and high school, along with diagnostic and other materials that are aligned with the new standards.

Currently, only half of our math teachers have a math degree. We need a new and better system to prepare prospective teachers and to provide current teachers with professional development to improve the teaching of math at all levels. All prospective teachers must have more math and science education so they can be full partners in comprehensive teaching. In addition, we should invest additional resources in our schools so that math and science class sizes do not exceed the nationally recognized standard of 25 students to 1 teacher.

Our goal is to recruit 750 additional math and science teachers, using loan incentive programs to encourage more people to teach, and specialized preparation programs for professionals with math and science expertise. Instructional coaches can demonstrate proven teaching strategies and connect math and science to other subjects. Teachers who achieve certification through the National Board for Professional Teaching Standards should be recognized with a bonus for teaching in schools with students needing the most help, and an additional bonus if they are certified in math and science.

Students with first hand experience using math and science become tomorrow's engineers, designers, computer programmers, builders and scientists. In partnership with the private sector, we need to help our kids explore the real world applications of math and science.

In science, we know that students learn better through hands on instruction. Expansion of the Leadership and Assistance for Science Education Reform (LASER) program, a public-private partnership that provides complete toolkits for science projects, with teacher training and research-based models for learning, will bring hands-on instruction into 1,000 more K-8 classrooms across the state.

A new public-private scholarship program can make math and science careers affordable and accessible for Washington students. The GET Ready for Math and Science Scholars program will provide an incentive for middle and high school students to perform well in math and science and pursue related degrees in college. The College Success Foundation will match state dollars to provide scholarships for eligible students.

The best way to grow our economy and secure a bright future for all students is to make smart, strategic investments in math and science education. With the investments recommended in my 2007-09 budget proposal, and the policy improvements recommended by *Washington Learns,* we will help our schools prepare our students to master math and science and compete successfully in the global economy.

Chris Gregoire is the governor of the state of Washington.

Reference notes

The *Washington Learns* report may be found at: www.washingtonlearns.wa.gov/FinalReport.pdf

The power of teachers working with teachers

by David Slavit, Tamara Nelson, Anne Kennedy and Wendi Laurence

Across the United States, there is a resounding call for support to improve mathematics and science teaching and learning. Washington State has done much to focus attention in these disciplines in the past decade. However, WASL scores, classroom observations, and ongoing controversy over instructional methods and curriculum reveal the need for further work.

Too often, teacher professional development is disconnected from classrooms and schools (Little, Gearhart, Curry, & Kafka, 2003). Additionally, professional development often involves only one or two teachers from any particular school, decreasing the odds of the innovation being implemented school-wide (Sarason, 1996).

Research-based recommendations (Borko, 2004; Grossman, Wineburg, & Woolworth, 2001; Little, 2003; Palincsar, Magnusson, Marano, Ford, & Brown, 1998) suggest that professional development should: 1) engage teachers and administrators in critical dialogue that is grounded in specific classroom practices and student learning goals; 2) lead to teachers taking actions based upon issues identified through this dialogue; and 3) provide external facilitation to support an inquiry-based stance toward analyzing and improving teaching and learning.

PRiSSM: A model of supported collaborative inquiry

In light of the above recommendations, a three-year professional development project called the Partnership for Reform in Secondary Science and Mathematics (PRiSSM) was implemented in in spring 2004. PRiSSM is a model of supported collaborative inquiry (Nelson & Slavit, in press) through a professional learning community structure. With the support of a facilitator, secondary mathematics and science teachers come together as co-learners/co-researchers to negotiate an inquiry question. The teacher groups collectively gather classroom and school-based data, implement a plan for instructional change, and analyze the impact of that change on student learning.

PRiSSM is a $1.4 million, three-year project funded by the U.S. Department of Education. The funding was awarded by the Washington State Office of the Superintendent of Public Instruction. The specific goals of PRiSSM are to: 1) establish a vision of high quality teaching and learning (HQLT), 2) improve student learning, 3) develop and support teacher groups engaged in collaborative inquiry, and 4) plan for continuous improvement (making decisions about what to change and modify based on ongoing data collection and analysis). Inquiry, as we use the term, is both a process for conducting research on classroom practice and a stance or "habit of mind" that describes how teachers conduct their work groups.

PRiSSM has extended to 22 schools, engaging over 200 secondary teachers in six school districts in southwestern Washington. The districts are Evergreen (Clark County), Goldendale, Kalama, Klickitat, North Thurston, and Washougal. Teachers participating in PRiSSM are mathematics and science teachers from related middle and high schools. The structure of PRiSSM supports the forming of cross-disciplinary inquiry groups among teachers in the related schools. District administrators were involved in teacher selection, with leadership, vision, and relationships with colleagues surfacing as common selection criteria. PRiSSM uses a model of collaborative inquiry as the framework for designing the professional development. Specifically, this model emphasizes teachers working with teachers on inquiry into an area of their choosing. Support is targeted in two broad areas: 1) the actual inquiry work of the teachers, and 2) utilizing and negotiating the broader educational contexts in which the teacher work is embedded (Nelson & Slavit, in press). Support for the inquiry work was primarily provided by a PRiSSM facilitator assigned to each teacher group. Logistical support involved things such as setting dates and structuring meetings. But facilitators also provided specific facilitation "moves" that enhanced teamwork and resources that supported the inquiry work of the teachers, including protocols for looking at data (such as student work) as well as protocols for establishing collaborative norms and modes of communication. The facilitators provided relevant research, ideas for collecting data, and a critical lens in support of the overall inquiry process. Support for the broader educational contexts involved attempts at raising awareness of the work of the teachers with school and district administrators, negotiating the focus and work of the teacher group with ongoing and emerging school and district initiatives, and providing a public voice for the teachers' work.

The facilitators were from varying backgrounds. In the larger districts, mathematics or science specialists filled these roles, while specialists from the local educational service district (ESD 112) worked with teachers in the smaller, rural districts. The facilitators met regularly with the project leadership team and conducted their own inquiry into facilitation (Nelson, Slavit, Perkins, & Hathorn, in press); however, facilitation varied widely, largely due to the needs of the teachers and the strengths of the facilitators.

A large amount of the professional development focus of PRiSSM involved the negotiation of a vision of HQLT, which then led to negotiations about specific inquiry foci inside the teacher groups. PRiSSM is a model that encourages teachers to surface their beliefs and identify the issues they feel need to be addressed, and then provides specific supports that help teachers answer these questions. In some sense, PRiSSM can be thought of as constructivist professional development, in which teachers identify, ask, and answer questions about their practice, while being guided by a facilitator knowledgeable in both the content focus and inquiry process.

The first year of PRiSSM focused on developing leadership capacity among a core group inside each participating school. The following two years extended this work by grounding the teacher inquiry in a single school context, and shifted the facilitation role more to the teachers themselves.

PRiSSM: Year 1

Year 1 of PRiSSM was focused on nurturing teacher leaders in each PRiSSM building through cross-school, cross-grade, cross-disciplinary teacher collaborative inquiry. With a variety of supports from project personnel, the teacher groups in Year 1 began to develop a common vision of high quality learning and teaching, and collaboratively developed and pursued an inquiry question focused on instructional practice and improved student learning. Initial support came from a week-long summer institute that focused on the establishment of collaborative norms inside the teacher groups, the initiation of a discussion about a vision for HQLT, and support for framing and enacting a collaborative inquiry project. The teachers met throughout the year to hone their inquiry, with logistic and intellectual support provided by the group facilitator. The teachers and their facilitator generally met after school, approximately once per month. A one-day academy in February was provided to share progress and provide additional support for the group inquiry process. Administrators were invited to this event to raise their awareness and involvement regarding the project and the specific work of the teacher groups.

In one of the larger school districts, one mathematics and one science teacher from two middle schools joined with one mathematics and one science teacher from the related high school to form a collaborative inquiry group. During the summer institute, these teachers, alongside other teacher groups, began to negotiate their beliefs about HQLT. Model lessons were provided, as well as videotape from “traditional” and “reform-oriented” secondary mathematics and science classrooms. Although many ideas were shared inside this teacher group, some of the conversations did not surface the meaning of key terms (such as “student-centered”). At this time, all groups were introduced to specific inquiry techniques for conducting research on classroom practice and student learning, and were provided ample time to examine student achievement data from their building in the negotiation of a common inquiry focus that would serve as the focus of teacher collaboration for the coming year.

During the school year, the group met at a local restaurant approximately once per month with their facilitator, the district mathematics specialist. This particular group spent an enormous amount of time negotiating an inquiry focus that was valued by every member of the team. The teachers also conducted observations in each others’ classrooms and shared their analysis of student work samples. At the end of the year, the group decided to use project funds to meet for an entire day. At this event, each teacher brought scored student work samples and negotiated their scoring criteria and methods. The group found this extremely useful at surfacing specific beliefs about teaching, learners, and content, and the event provided a nice ending to a slightly difficult year.

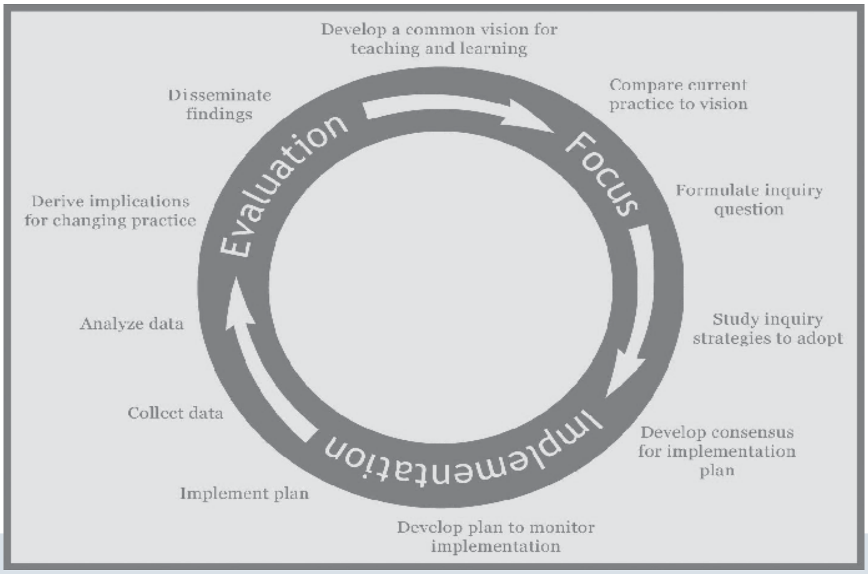
Not all groups were composed or functioned this way. Smaller districts contained only one group, with as few as three teachers. Some groups found an immediate focus and transitioned to a smooth inquiry process. Some teacher groups had large amounts of administrative support, while others did not. The variety among the ten groups in the first year of PRiSSM was in line with the variety often encountered among students in a given classroom.

PRiSSM: Years 2 and 3

PRiSSM envisioned that the teacher leaders would be able to sustain highly-functioning collaborative inquiry groups at the end of the three-year project. To this end, the structure and goals of the PRiSSM project changed significantly in the final two years. With an established cadre of teacher leaders, the project was ready to move to school-based collaborative inquiry, largely facilitated by the teacher leaders’ themselves. With the continued support of a project facilitator, the two Year 1 lead teachers in each building began to work with their building colleagues in the negotiation of an inquiry focus and subsequent inquiry process. Some buildings continued to have mathematics and science teachers working together (with both lead teachers), while other buildings saw the formation of two distinct teacher groups in mathematics and science. Therefore, the professional development shifted to the support of school-based collaborative inquiry, while simultaneously continuing to support the leadership capacity and facilitation skills of the lead teachers.

While the model of project facilitation was drastically different in the final two years, the teacher groups followed the same inquiry approach as that modeled in Year 1 (see Figure). In order to celebrate the work of the teachers and

Inquiry cycle used by teachers in the PRiSSM project.



add a specific point of internal accountability for the teachers' work and raise awareness amongst administrators and other stakeholders, district showcases were held in May that consisted of stories and specific findings from each of the teacher groups.

Lessons learned

Several key findings have emerged thus far from our experience working with the teachers, facilitators, and project leadership team:

Teachers need dedicated time to conduct collaborative inquiry on teaching and learning.

A caring and dedicated group of teachers can develop appropriate inquiry skills, cohere as a functioning group, and intellectually challenge each other to pursue an inquiry focus in support of their own practice. And all of this can be done outside the context of the school day. But this is an enormous amount to ask of teachers, particularly given their daily responsibilities to 25-150 students, the growing certification and "highly-qualified" demands being imposed, and the ongoing stresses related to student achievement results and the manner in which these now drive instructional and curricular decisions. Why would teachers want to pursue inquiry into their practice?

Despite the presence of a facilitator and specific resources that allowed teachers to utilize time both within and outside the school day, the teachers felt time pressures to do the work necessary to conduct inquiry into their own practice. We believe that, for teacher inquiry to truly be enacted, a significant revaluing of teacher reflective processes needs to be considered, and a corresponding shift in the structures of schooling needs to be made. An increased amount of non-instructional time in the school day is required for teachers to truly reflect on their practice in both an individual and collaborative manner. An obvious shift in funding priorities is required for this to be taken seriously.

Teachers need technical support for doing inquiry work.

Careful thought needs to be given to the kinds of technical assistance needed by a group of teachers engaging in supported collaborative inquiry. At each phase of inquiry work, specific skills and knowledge need to be developed. These include negotiating a shared vision for science and mathematics teaching and learning, how to find research relevant to the inquiry question, how to construct and implement a data collection plan, how to analyze data, negotiating changes to practice based on findings, and how to make meetings work effectively and efficiently. Each school and district has expertise in some of these areas, but often this expertise resides in different parts of the system. A fundamental question for long-term sustainability is: How do districts develop and coordinate the expertise they need to help teacher teams become increasingly sophisticated in their ability to conduct research on practice?

Teacher buy-in requires specific approaches and techniques.

The teachers found the ability to identify their own professional development focus, and then be supported in inquiry around that focus, to be an extremely important reason to become part of and continue in the PRiSSM project. The teachers found the control they possessed in both the nature and direction of their inquiry to be refreshing and highly useful to their own professional development goals. Further, having a facilitator and other project staff advocate for their work at the school and district level added an additional level of buy-in to the importance and potential impact of their collaborative inquiry.

Teacher collaboration can be enjoyable.

Generally, the teachers enjoyed working together in the co-investigation of their own classroom practices. The importance of an ongoing negotiation of a vision of HQLT cannot be understated. This negotiation led to additional collaborative norms that supported positive communication among the teachers. The willingness of the teachers to take risks and support each other also played very important roles. While not all teachers worked well together, and while nearly everyone experienced various levels of frustration with the process or their colleagues, the teachers overwhelmingly expressed their affinity for the inquiry work as well as their perception of its importance to themselves, fellow group members, and to contexts beyond the teacher group.

Collaborative teacher inquiry is mentally, physically, and emotionally taxing.

While enjoyable, many teachers began to question the cost-benefit of their inquiry work. This was especially the case for some of the lead teachers during the project's final year. Despite the perception that the work was highly important, many teachers were questioning the benefits of this work when taken in context with their daily teaching demands, their perceptions of the impact of their work beyond the teacher group, and various personal issues.

Difficulties and assumptions about measuring impact on student learning.

Despite the data-based focus of the work, it was difficult to measure the true impact of the inquiry work on student learning. Many teachers stated they "felt" there was a difference, and some of these impressions were derived from analyses of student work samples. However, teachers had trouble letting go of a quantitative model for determining student learning results, and disregarded some powerful and revealing data. This may have been due to the dominance of the Washington State achievement test which permeated the school cultures, and also impacted the direction of many teacher groups' inquiries. Although most teachers eventually came to value alternative ways of illustrating student learning, many teachers were limited in their efforts to document the impact their work had on their students.

Teacher work does not always immediately mesh with larger initiatives and contexts.

PRiSSM project personnel worked to provide ways for the work of the teachers to be useful to the larger school contexts in which it was embedded. In some cases districts were quite ready to find common ground and purpose; in other instances, this was much more difficult. For example, some lead teachers were asked to formally take on leadership positions to expand collaborative inquiry across schools and districts. Some schools attempted to go school-wide with collaborative teacher inquiry models as a result of the work of the teachers. In other cases, however, school and district initiatives worked against the goals and processes of the teacher groups. In these cases, some teachers were forced to rethink their inquiry focus while others attempted various levels of compromise between their goals and those of the larger context. The many attempts embedded in the work of PRiSSM to engage administrators in conversations about HQLT in mathematics and science, combined with specific activities that allowed administrators to become closer to the overall work of the project, were key reasons why the teacher work was sometimes able to mesh well with, and in some cases help define, these larger contexts.

A teacher's view

Cameron, one of the original teacher leaders, offered her insights on the lessons being learned in the PRiSSM project: "If there is going to be change in math education, I think it is going to be through a process that looks like this. I'm a different teacher now than what I was a couple years ago, and I know that many factors contributed to that, but (the inquiry work with my teacher colleagues) has been very powerful in my professional learning."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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.

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[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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Achieving mathematical fluency

by Terrie Geaudreau

When applied to how children learn mathematics, the word *fluency* has many interpretations. Because we describe things in a way we have experienced them, our own educational background colors our interpretation. So, those of us who were told we could not pass from the third grade to the fourth until we knew our basic multiplication facts hear the word fluency and think "memorizing basic facts." Those who grew up taking timed tests equate fluency with correctly computing a specific number of basic facts in one minute. Traditionally, fluency is most often used in reference to computational fluency. But, as we step into a new century, mathematical fluency and the definition of basic skills have, as they must, taken on an expanded meaning. In their *Position Paper on Basic Math Skills,* the National Council of Supervisors of Mathematics supported the expansion of the definition of basic skills because, "The present technological society requires daily use of such skills as estimating, problem solving, interpreting data, organizing data, measuring, predicting, and applying mathematics to everyday situations" (NCSM, 1977). The business world is calling for a workforce that can attack new and unique problems and collaborate with others. Fluency in mathematics includes not only basic computational skills but also the fluent use of mathematical vocabulary, facility with the use of common formulas, and effortless recognition of common mathematical relationships such as those between fractions, decimals and percents. The definition of a basic skill changes as the level of learning increases. Writing for the group Mathematically Correct, a group not usually associated with reform mathematics, Martha Swartz (1999) states, "What is basic changes with the age of the child" (p. 2). She goes on to give examples ranging from rote counting for the very young through the "magical insight that anyone can assign a variable to represent an unknown quantity, then write an equation and solve it."

According to the National Council of Teachers of Mathematics (NCTM) computational fluency is achieved when a student computes efficiently and accurately. "Students exhibit computational fluency when they demonstrate flexibility in the computational methods they choose, understand and can explain these methods, and produce accurate answers efficiently" (NCTM, 2000, p. 152). This stands in sharp contrast to the oft-held belief that fluency is synonymous with speed. When addressing computational fluency through the lens of flexibility and efficiency, the importance of speed fades as the focus sharpens on accuracy.

The problem with equating fluency with speed is that we then have to define a speed to reflect mastery. When I was in elementary school, 60 basic facts in one minute was the standard. When practicing basic facts we drilled with flash cards, then once a week had a written, timed test to show what we had learned. When I became a mathematics teacher, I realized that factors such as students' fine motor skills and mental processing speeds might interfere with their ability to complete a typical basic facts timed test. My answer was to drop my expectation to 30 facts in one minute. I later realized that drilling orally and testing in written form might also be a problem, so I allowed some students to complete the timed test orally. During my 20 years of teaching mathematics to struggling students, I was very successful in getting my students to memorize basic facts and pass timed tests. Students who came in knowing no multiplication facts at all could correctly compute 30 random facts in one minute by the end of the year. The problem came the next year, when the same students returned and again knew very few of the same facts they had 'mastered' the year before. This is the same phenomenon classroom teachers experience every year when new groups of students enter their classrooms. Whatever the reason, sixth grade teachers say "These kids don't know their facts!" Fifth grade teachers ask, "Didn't they teach basic facts in fourth grade?" I recently had a group of middle school teachers ask, "How can a student get out of elementary school without knowing their basic facts?" And on and on it goes.

Even those kids who do manage to remember basic math facts do not use them consistently when performing multi-step computations. Rote memorization without conceptual understanding does not transfer to new situations (Leinwand & Fleischman, 2004). Pesek and Kirshner (2000) found that "initial rote learning of a concept can create interference to later meaningful learning" (p. 537). There are many students who move from grade to grade who are required to spend large portions of their math time relearning basic facts and reviewing computational algorithms, but they never seem to get it. We keep teaching the same old things in the same old way even though we can observe that the students are not really learning.

There is no question that computational fluency is essential. Having certain skills at automaticity facilitates their application to more demanding tasks. However, computational fluency must be built on a foundation of conceptual understanding. Conceptual understanding is more than knowing. We must expect our students to apply, synthesize and evaluate mathematical content, solve novel problems and communicate their solutions clearly and succinctly. One cannot understand content at a deep level without applying it to solve problems. "Jerome Bruner says all learning is connected to the task and context of the learning. In other words, the process and content are interwoven. To teach one without the other is to have incomplete learning" (Payne, 2002, p. 24). Students who understand the concepts underlying their computational strategies eventually became computationally fluent as well. That is, they efficiently and accurately apply their computational strategies to unique, complex problems.

When allowing students to construct their own meaning, trusting they will eventually become masters of computation is difficult. It challenges what many believe it means to teach. Our definitions still equate teaching with the imparting of knowledge even though research on how humans learn indicates that self-construction of knowledge is required for true understanding. If we are to truly prepare our students to be successful in a global economy, our mathematics instruction must shift from the teaching of isolated procedures and skills to facilitating the learning of an interconnected body of knowledge within mathematics. Teachers must become facilitators of learning rather than imparters of knowledge. That's easy to say but not so easy to put into practice. We cannot expect teachers to simply shift on their own. Supportive leadership and collaboration with peers and experts are crucial.

The most important leader to support improvement in math instruction is the school principal. Not that all principals need to be experts in mathematics and the teaching of mathematics, but rather that the principal is aware of what it means to teach mathematics for understanding and able to recognize effective practices in the classroom. What better way to gain this knowledge than to spend time in classrooms, observing, reflecting and talking with teachers about what they are doing and why they are making specific choices in their instructional practice? One of my former principals actually worked along side me with students in one class every day. She was committed to understanding what it meant to be an effective mathematics teacher. The work not only gave her the personal experiences she needed to be a supportive leader and evaluator, but also sent the message to teachers and students that she personally valued mathematics and embraced the difficulties in both teaching and learning the discipline. Perhaps not all principals would be able to make as large a commitment as this one did. However, every principal can find time to spend in mathematics classrooms every week. The principal's regular visits and collaboration with teachers pays huge dividends in improved instruction and student achievement.

Again, changing the role from imparter of knowledge to facilitator of learning is a huge shift for many teachers. The job is too big for teachers to do alone. We must break down the isolation and open the doors between classrooms. Teachers must see other teachers at work, spend time in dialogue about classroom practice and collaborate around evidence of student learning. Although we have been saying this for years, we have not put the structures in place to ensure that it happens. Teaching has been such an isolated and individualized practice for so long that some find it very threatening to collaborate so closely with others. Teacher collaboration is the strongest strategy for improving mathematics instruction. To realize the promise of collaboration, schools must:

- create time within the day so teachers can collectively plan and reflect on mathematics lessons.
- create time within the day when teachers can visit each others classrooms.
- provide content experts when needed.
- provide facilitation of collaborative groups.
- intentionally build the capacity of teacher leaders in mathematics.

Once the structures for collaboration are in place, there remains the problem of how to collaborate. You cannot just put people together and expect they will naturally work together on a worthwhile problem. Those who have not had experience with a collaborative model of professional development most likely will not know what to do with the time. Teams need skillful facilitators who understand the underlying issues and can pose the kinds of questions that will cause teachers to inquire deeply about their practice. It is easy to agree on the big ideas like improving student learning and using best practices. However, if we spend all our time discussing the importance of these broad concepts without addressing the specifics, we will just go in circles.

We agree less easily on specific questions like:

- How will we know when student learning is improving?
- What constitutes worthwhile mathematics?
- How are specific practices best implemented? When and for whom?

Lucy West, former Deputy Superintendent of District 2 in New York, has a vision of professional development through collaboration sites where teachers can refine and develop teaching practices and deepen their mathematical content knowledge at the same time. West (2003) suggests that collaborating teachers and coaches begin with questions: "What are your major mathematical content goals for your students this year? What aspects of the content do you feel confident teaching? Which aspects are you less secure about? What are you curious about in relation to teaching and learning?" (p. 28). These are the kinds of discussion points that groups of teachers, reflecting together, can use to change their practice in a positive direction.

Fluency in mathematics, specifically computational fluency, is an important skill for all students to have. The question is how that fluency is achieved. We must remind ourselves that fluency is not about speed so much as it is about efficiency and accuracy. Mathematics is more than facts and procedures. Although some skills and conventions are necessary tools, the emphasis must be on teaching mathematics at the level of conceptual understanding. All students must develop their abilities to think, reason, and communicate about mathematics. Mathematicians rely on these basic skills. This is a shift in practice for many teachers and requires a change in beliefs. That change requires working collaboratively with colleagues and the support of strong instructional leaders.

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A teacher's voice

By Mike Shappell

The journey starts. I formally "quit" being a math teacher sometime during the fall semester 2000. I was teaching a diverse group of courses for my school's international baccalaureate (IB) and advanced placement

programs. The courses were in three different disciplines: mathematics, computer science and applied philosophy. Now one might think I quit because I was trying to prepare students for five different exams in two different disciplines, but that would be wrong. No, I quit because of that last course in applied philosophy called Theory of Knowledge (TOK). In TOK students explore various areas of knowledge (math, science, ethics, history, arts), and try to flush out what it means when they claim "I know (fill in the blank)." It really is an applied epistemology course that gets students to take knowledge out of the tidy cubby holes we call disciplines and investigate connections among them, and the problems found in "knowing" them.

Now I should confess at this point that I did not literally quit my job. Rather, I went through a professional paradigm shift in how I viewed myself as an educator. I observed my students' wrestling with the concepts of TOK, and had my own big TOK "aha!" It was the explicit realization that I was not a "math teacher." I had it all backwards; I was a teacher first, and my primary venue just happened to be mathematics and computer science that year. To help see the importance of this shift, think of what we want for good math students. Ideally, successful math students can peer at the world around them through the lens of mathematicians, see why things work and then disseminate their understanding to others. They are learners using the constructs of mathematics as their framework and language to represent and communicate what they know and understand. Successful students are using mathematics as a tool while actually studying something else. They have authentically immersed and engaged themselves in the ideas they are studying so it becomes their own knowledge. They quit being math students, and become students working in multiple disciplines where connections and facts integrate to construct knowledge. So, my own paradigm shift as a teacher is parallel to what I expected and hoped for in my students. Achieving this shift requires me to teach my students with an authentic, context based curriculum and class environment where the parallel journey continues to this day.

So, what is "an authentic, context based curriculum?" I propose to briefly examine a couple of the meta-contextual issues surrounding curriculum and explore how these can help drive students to be active, engaged learners. Let's begin by recalling a lesson where your students were showing the success I described above- using math as a functional tool to explore and construct new understandings. Now I want to pose a couple of questions: Were you looking through the same or a similar lens as your students? If not, then when was the last time you did? Have you ever shared a bona fide "aha!" moment with your students? I know that most teachers I am around cherish the light turning on for their students, but with all the things to do as a teacher and mentor, it is easy to disconnect as a learner with the students. What I am hinting at is I believe that the teacher is the foundation of "authentic context based" learning, and needs to be on the journey with the students in some fashion to give credibility to what we are expecting of them. By being in the thick of it with them, it is easy to share authentic passion, engagement, freshness and, of course, the excitement of failure.

A second meta-contextual issue involves connecting curricula and the processes of learning. When I look at students successfully using math as a tool, I would like to think they are using it with the same fluency as they do their cell phones. They utilize their phones to communicate visually with video and pictures, verbally with voice and text, and they even utilize codes that abstract complex ideas into more condensed forms. Not only can they do this, but they can also explain why and how! I see the skills and reasoning it takes to make the com-

"Have you ever shared a bona fide 'aha!' moment with your students?"

munication happen with their cell phones as synonymous to a well functioning curriculum. The hardware and software interface have to be learned, including the limitations and innovative extensions like the codes of text messaging. All of this is connected in a context that in turn connects people in an exchange of ideas intimate to their daily lives. Without the need to connect to their friends, would they learn the complicated system of their cell phones? They are engaged by an authentic need to know.

Now contrast the cell phone with our old friend the quadratic formula. I challenge you to make an extensive list of all the math operations and all the connections that need to be in place in order to understand it well enough to communicate visually, verbally and yes, in the code of algebra, how and why the quadratic formula works. Oh, and do it because you were told you need it for your future. I've digressed here into poking fun at what we do. I know our students need to know those skills and processes. But, I believe our students miss the most important connections because of a lack of authentic ties to what they are studying. Without need or want, they cannot learn at deep levels because there is no relevance. So an important piece of teaching a contextual curriculum is to put in place connections relevant to each student. Those connections become the context, and drive students' need and want for knowledge.

These two issues motivate what I do with my classes in terms of interpreting the curriculum and guiding my students. The implementation lies between pedagogy and the art of teaching. From a pedagogical stance, I utilize my understanding of my discipline and good researched based teaching practices for preparing and executing lessons and assessments. A good context based curriculum provides a great necessary skeleton to build from. But, to make it come alive I believe it needs to be more than a recipe to be followed for preparing a successful math student. The art and passion of teaching have to come into play to make those lessons resonate with the students' and the teacher's voices. It is here one must be a risk taker, willing to feel the pain of occasional failure along with the elation of success.

So, how do I get in and become an active participant with my students? I start by living mathematics the way I hope and expect them to. I find shared interests that hook all of us. I look and listen for the common connections we have with the world and look for where they are a suitable fit for our studies. These always include things I know to varying degrees, but also things I don't but I am curious about and willing to learn. I share my current passions, and observe my students reactions to see if they have similar curiosities that could be explored and even ask if they are interested in pursuing them. Most days in class are parts of a year long conversation, where I foster students' curiosities by following and guiding their interests in the direction the curriculum is going. Sometimes I have the time to go nuts with it, other times I have to pass and write it down for another year. This has caused a rather diverse list of fun adventures thus far including: Cartoon Guides to Vectors and Matrices, Parabolic Solar Hotdog Cookers, The da Vinci Code Final – a Global Positioning System Receiver (GPS) based treasure hunt, and Sinusoid Transformations with a Vacuum Tube Amplifier. Once I have a possible activity I make sure it is feasible and works with the curriculum. To integrate it with the curriculum, I require it to tie in with what we are doing, and also link it to skills and ideas from previous topics as well as planting seeds for future needs. It is this last part that I work hardest at, as it is difficult create authentic connections that matter to the students enough to internalize the knowledge. The curricular reward is a foundational idea for the students to build from when studying other topics. This of course all takes time, but I only try to do a couple of big adventures a year, and the habit of it creates numerable little adventures daily that keeps the students and me fresh.

The goal is to have those magical teaching moments when a lesson has enlightened a class, group or individual to be mathematicians…or as the late, eccentric Hungarian mathematician Paul Erdös put it, they are "born"[1]. They may even avoid an Erdös "death" until they leave.

Mike Shappell has been a teacher for the last fifteen years teaching mathematics and computer science to ninth to twelfth grade students including Advanced Placement and International Baccalaureate programs. His current position is at Blaine High School where he teaches a variety of math from pre-algebra to AP calculus and AP computer science.

1. Paul Erdös (pronounced Air-Dersh) was the most prolific mathematician of all time writing almost 1500 papers. He also had his own language – if a person had "left", they had died, but if they had "died", they had stopped doing mathematics.

The mathematics education "problem" in Washington State: A personal view

by Jerry Johnson

In my first year of teaching mathematics, I thought my middle school students had done well on their fraction test. That is, until I engaged in an after-school conversation with a student named Helen. On the chalkboard, I wrote the problem:

1/2 + 1/2 + 1/2 = ?

Helen smiled, picked up the chalk, wrote 3/6, and asked if she should reduce it. On my "yes," Helen proudly wrote:

1/2 + 1/2 + 1/2 = 3/6 = 1/2.

Then, below her solution, I wrote (actually included diagrams as well): Half of a pie + half of a pie + half of a pie = ?

Again, Helen quickly responded: One and one-half pies. Finally, I asked Helen if she was bothered at all by the fact that "1/2 + 1/2 + 1/2 = 1/2" and "half of a pie + half of a pie + half of a pie = 1 1/2 pies"? Helen's response: "No, the first is the answer with numbers and the second is real-life!"

Now, after 35 years of teaching mathematics at almost every level, I continue to reflect on and be impacted by Helen's response. Helen was a "model" student who worked hard and performed well in a skill-based environment, but she did not connect the classroom mathematics to a real-world. Also, Helen's learning approach and motivations did not include wanting to understand the conceptual aspects of a mathematical process. Helen's constant request still echoes resonantly: "Show me exactly what to do, give me some problems to practice, and then I will show you I can do it. . .and please stop trying to get me to understand why all this math works."

Admittedly, this was my first year as a mathematics teacher. Yet, I still find a great many students operating in the same learning mode, but now they are in my mathematics courses at the university. Something seems very wrong here. In English classes, is it acceptable for students to spell correctly or read words aloud, but not be able to write coherently or read with understanding? In a history class, is it acceptable for students to memorize dates and names, but not be able to analyze and learn from historical events? In the sciences, is it acceptable for students to memorize terms and formulas, but not understand relationships and processes? In music, is it okay to be able to play notes in sequence, but not understand how these notes combine to produce great symphonies?

Furthermore, this episode with Helen and its implications seem to reflect quite well the tone and content of current discussions regarding mathematics education in Washington State. Perhaps most frustrating is the continuing claim that mathematics is different. That is, in mathematics, it is okay:

- To focus on the performance of rote algorithms,
- To not understand or have any meaning for mathematics as a process,
- To not connect mathematics as a useful tool in to the real-world,
- To say "I can't learn mathematics," and
- To go through twelve years of schooling and not learn any mathematics of value.

Something seems wrong here, and these claims have seemed wrong during my entire teaching career.

My concerns

Due to well-publicized WASL results in Washington State, mathematics education is the current bulls-eye for discussions. Everyone seems to have opinions and solutions, though too often they are stated as facts. As a mathematics educator, I too am concerned about the mathematics "problem" in Washington State and suggest these additional concerns:

- Our apparent lack of time to find a "solution,"
- The "destructive" rhetoric that receives too much press,
- A widening range of abilities, knowledge, and commitment amongst mathematics teachers,
- The inconsistent support and commitment of important stakeholders to solving the mathematics problem,
- The lack of money (state-level, district-level, and classroom-level) and the "throwing" of money at quick solutions,
- The many views of mathematics teaching, mathematics learning, and even mathematics itself, that are "clouded" by both tradition and misassumptions,
- An unwillingness and a willingness to lay blame on the part of key stakeholders.
- The growing impact of external forces such as publishing companies, testing agencies, federal mandates, and self-proclaimed mathematics education experts, and
- A felt need to find an "easy fix," seemingly based on the assumption that such a fix exists.

Amidst all of these concerns, the big question remains: How can we approach the problem of mathematics education in a logical, unemotional manner?

The problem

Stanford Professor Larry Cuban suggests that "A problem is a situation in which a gap is found between what is and what ought to be."[1] Cuban's view describes the problem of mathematics education in Washington State quite well. A gap certainly exists, but unfortunately few agree on either what is or what ought to be. Amidst ongoing emotional debates and a multitude of proposed solutions, we need to differentiate between "applying a band-aid to cover the problem" and "finding and implementing both a cure and a prevention for the problem." And, it is ironic that mathematics, the one discipline often defined as "the solving of problems," has become such a problem itself.

So, where do we look for the "obstacles" that have created this "gap," a gap which ironically has probably existed for more than a century? The naming of potential culprits is easy, as one has only to read local newspaper articles:

- Culprit 1: The mathematics curriculum being implemented in our school districts,
- Culprit 2: The performance-based assessments (WASL) being used in Washington State,
- Culprit 3: The Washington State Standards (EALRs and GLEs) currently in force,
- Culprit 4: The research used to make decisions about how mathematics is both taught and learned in our classrooms (assuming someone could even identify that research and its role in the decision-making process), and
- Culprit 5: Mathematics teachers—both their qualifications and their quality.

On a surface level, the "math problem" definitely is impacted by a combination of these items. But, I suggest that the root causes of the "math problem" lie much deeper than the usual obstacles. In fact, the root causes are fundamental elements that pervade both education and society at a level so deep and embedded that no surface-level change will have any lasting impact, nor will it narrow the "gap" significantly. These fundamental elements are not specific to mathematics but are anchored in societal attitudes towards:

(1) The role and use of tools in society. Those who assume that mathematics is "only a tool" carry forward the societal assumption that one merely has to know how to use a tool, not how or why it works as a tool. And, tools often are used in situations they were not designed for (e.g. using a hammer to crack walnuts), with the related danger being that the tool's power is misused (e.g. using statistical notions to deceive[2]).

(2) The idea of what it means to be a literate citizen in society. The standard definition of literacy as "mastering the basic skills of reading and writing" seems passive, outdated, and limiting in our technological world. My take is that a literate person must be able to use their reading and writing abilities proactively to function and improve their life situation, which implies that a literate person both recognizes and uses the power of their literacy. In these terms, mathematics literacy involves much more than quantitative skills and becomes an empowering quality.

(3) Teaching as a profession in our current society. In the United States, common views of the teaching profession include ones of little respect, views of public servitude, and teachers as educated blue-collar specialists. These views contrast directly with those held in other countries such as Japan. American teachers assert themselves as professionals while they grow weary of trying to explain why they deserve fair wages and the reasons that their work hours are not the traditional 9 to 5.[3] Thus, when discussing "hot" issues in mathematics education, community stakeholders do not always approach the discussions with an attitude of respect for the teacher as a professional who knows mathematics and pedagogy and who is a key decision-maker in the process.

(4) What it means for an individual to learn something of value. Because they have gone to school, too many people become instant experts on what it means to learn something, how young students learn best, and what needs to be learned. Unfortunately, this misuse of logic complicates discussions and creates barriers of mistrust. Specific to mathematics education, the goal is to help students gain the mathematical knowledge and problem-solving skills needed so that they can continue to learn and adapt as adults in a changing world. This goal is far different from the claim of some advocates that a student needs only to master arithmetic skills through the grade six level.

Though it will take time and patience, stakeholders must begin discussions regarding these fundamental elements in order to reach a shared understanding of what is possible in mathematics education and move to making changes at multiple levels. No long-lasting solution seems possible without a willingness to engage in a much deeper probing of the problem itself. On the part of educational leaders and all other stakeholders in Washington State, this analysis will take valuable time, extensive resources, and an agreement to suspend the emotional confrontations.

Some false assumptions about math education

In the meantime, we must confront the false assumptions that permeate efforts to discuss the "math problem" rationally:

- Years K-8 of school mathematics prepare students for years 9-12

- Students view mathematics classrooms as exciting environments
- Most mathematics teachers view their classrooms as exciting environments
- The cause of our "math problem" is known—State Standards, the WASL, reform curricula, etc.—Change these things and all will be fine
- The curriculum choice between skills and concepts is an "either-or" situation
- Student achievement gaps, especially according to racial and economic categories, are being addressed and responded to as a priority.
- Mathematics teachers know how mathematics connects to the real world
- Anyone can teach mathematics—just give them a book and an ample supply of worksheets
- College-level mathematics educators "know" the real-world of teaching mathematics on the K-12 levels
- People credentialed to teach mathematics know mathematics and know how to help all students learn mathematics
- Mathematics professors who know advanced mathematics can teach mathematics and are "experts" in both what and how mathematics should be taught
- Mathematics teachers are informed decision makers with regard to the curricula, pedagogy, and assessments they implement in their classrooms

Unless these and other false assumptions are carefully identified, understood, and corrected, all on-going discussions will get nowhere and regress into meaningless polemics.

Is there a solution?

While we work to craft the larger solutions that will be necessary for improving mathematics education, I offer a "Top Ten List" of suggestions of places to start. These suggestions are not being proposed as "solutions" to the "math problem" in Washington State, but as ideas that could move us in a positive direction. Since public opinions and educators' opinions probably will not support all of these suggestions, I am offering them as personal reflections on my part.

Suggestion #1

We need to change our educational structure so that those who teach mathematics from grades 3 and up are people who specialize in mathematics, enjoy mathematics, and can focus on improving how they help students learn quality mathematics. Rooted in American traditions, the current system forces too many elementary teachers to teach mathematics when they neither enjoy mathematics nor have a deep understanding of mathematics themselves.

Suggestion #2

We need to encourage mathematics teachers to construct their own student assessments at the classroom level, using state-level assessments as models and textbook tests as problem resources. This would help push mathematics teachers to become decision-makers as to what mathematics content is and should be being taught in their classrooms, rather than to leave it in the hands of textbook publishers.

Suggestion #3

We need to hire and support mathematics teachers with as much concern and optimism as we do coaches for sports (Note: I was a coach in four sports). That is, school districts need to hire, support, and retain teachers who enjoy mathematics, want to help others learn quality mathematics, and are committed to teaching as a profession.

Suggestion #4

We need to develop special plans for supporting and keeping "new" mathematics teachers in the profession, especially in classrooms with students. Given the shortage of qualified mathematics teachers and current data trends, we cannot afford to lose approximately 50 percent of each new teaching cadre within their first five years.

Suggestion #5

We need to stop advancing or giving inflated grades to mathematics students for the wrong reasons, such as to make a student feel good, to avoid administrative or parental criticism, or to avoid dealing with a student anymore. Such a "reward" pattern creates false perceptions of student abilities and only pushes potential conflicts further up the pipeline.

Suggestion #6

We need to get all stakeholders—superintendents, principals, legislators, parents, business people—to stop saying: "I didn't understand or like mathematics myself." In addition to having negative effects on young learners, this traditional retort is little more than an admission of self-ignorance that too many people unfortunately wear as a badge with pride.

Suggestion #7

We need to convince both parents and students that they need to take greater responsibility for the mathematics learning that occurs or does not occur. It is very difficult to teach anything (skills or concepts) if students are openly apathetic or negative towards learning. Also, based on future societal and occupational needs, the idea of learning and understanding mathematics must be supported in homes.

Suggestion #8

We need to teach reading in mathematics classrooms, while also teaching mathematics in reading, English, science, history, art, and music classrooms. The entire process of reading (literacy, decoding, comprehension, analysis, and communication) plays a strong role in a student's ability to do mathematics, especially in applied situations.

Suggestion #9

We need to give mathematics teachers time to reflect about what they do daily, and also assist them in learning how to reflect about their actions and decision-making in the classroom. Reflection is a key part of a teacher's growth, their acceptance of responsibilities as a teacher, and their view of teaching as a profession.

Suggestion #10

Teachers, students, and the public need to view and define mathematics as a subject area, complete with a rich history and ideas that are interesting, motivating, intriguing, magical, and beautiful. That's right, mathematics and beauty were linked in the same sentence. Unfortunately, most view mathematics as merely a tool that is a cold, austere "hurdle" that must be circumvented at best.

Is it possible?

My early interactions with Helen continue to both haunt and help me. She introduced me to the complex "problem" of mathematics education, a problem that I continue to wrestle with as a teacher and on a wider level as part of the mathematics education profession. I am constantly asking myself about the possibilities:

- Is it possible to teach both skills and concepts to students who want to focus on regurgitation or rote algorithmic performance?
- Is it possible to teach mathematics as an active, useful, exciting, problem-solving process. . .rather than as the subject that everyone seems to hate?
- Is it possible for mathematics teachers to motivate the growing number of unmotivated students?
- Is it possible to give mathematics teachers the professional support they need, from their first entry as novice teachers into a classroom to the veteran teachers who have become calloused to the cyclical calls for change?
- Is it possible for all stakeholders to look beyond personal agendas and suspend the rising rhetoric in order to work together in improving mathematics education?

If we develop consensus that these things are possible, the next step is to raise and consider the related "How Can. . ." questions.

Finally, we need to recognize and celebrate the positive changes that do occur in mathematics education—whether at the student, classroom, district, or state level. And, we must hold ourselves to a higher standard as stakeholders, knowing it is far too easy to focus on negative results and engage in the blame game. If not, students and the discipline of mathematics will become the true losers, a sacrifice that we should be unwilling to make.

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Reference notes

1. Larry Cuban, *How can I fix It? Finding solutions and managing dilemmas* (New York: Teachers College Press, 2001) p. 4.

2. See either Gregory Kimble's *How to use (and misuse) statistics* (Englewood Cliffs: Prentice-Hall, 1978) or John Henshaw's *Does measurement measure up? How numbers reveal & conceal the truth* (Baltimore: John Hopkins, 2006).

3. See Johns Wilson's "The teaching profession: A case of self-mutilation." *Journal of Philosophy of Education* (1986: 20 (2), pp. 45–250) and Harold Stevenson/Roberta Nerison-Low's (1996) *To sum it up: case studies of education in Germany, Japan, and the United States* [http://www.ed.gov/pubs/SumItUp/chapter5.html]

4. http://www.sbe.wa.gov/gradreq/caa/docs/JointMathActionPlan-11-22-06.pdf

Asking good questions:

If it's good for students, it's good for math teachers

by Scott Smartt

In the 1990s, when the national and state standards were released, the focus was on content. "What do our students need to learn?" was the question.

The companion question, "How do we best teach students?" didn't get much consideration. However, over the past five or so years, I have noticed my supervisors and peers beginning to ask really tough questions about what good math teaching and learning look like. The winds of change are starting to blow.

Teachers' and administrators' lack of understanding of what constitutes good math teaching is a major roadblock to the success of our students. Without professional development, teachers tend to teach the way they were taught. Most math teachers were taught in a traditional, 'stand and deliver' method. Unfortunately, many of the students that could survive that system ended up as math teachers who perpetuated the cycle of ineffective teaching, believing, "It worked for me, it will work for my students if they just work hard enough."

The effect of this philosophy is that all students do not have access to math. It has become a filter to sort who is "math smart" from who is not. We have created a culture of math-phobia.

Breaking the cycle

I was taught in a traditional way in a tiny school in southern Oregon. I didn't receive any different training in my college work, and therefore I taught the same way I had been taught. I identified the objectives of the section, I explained them to my students, showed them a few examples, and gave them work to do in class. When individuals got stuck I would help them. The next day I would go over homework problems, and then start the cycle over again. At the end of the chapter, we would do some application problems and have a test.

But today what I do in my classroom looks very different. I start with an essential question. The students plan how we could address the question, gather and sort information, make conclusions and then evaluate their solutions. I give as much support as necessary, use assessment to drive my instruction, and have students track their learning. I ask more questions and give fewer answers.

As I reflect on what caused the changes in my way of teaching, I see three main forces: National Board work, a curriculum that supports good teaching, and instructional coaching.

In 2001, when I began work on my National Boards, I was forced to continually ask myself "why?" Why did I ask that student that particular question? Why did I decide to design my lesson that way? I was being asked questions I had never had to deal with before. It was exciting to really be forced to dig into essential qualities of good teaching. I finally learned that good teaching had more to do with the student, and less to do with the teacher.

Good curriculum makes a big difference. In 2003, I began teaching a standards-based math program. Previously, I had spent hours developing lessons to support effective learning because our textbooks provided only examples and exercises. Our books did not support conceptual, long-term learning; they supported "follow the leader" learning. The new curriculum, *College Preparatory Math,* used the same method I had been trying to invent on my own. Now, the time I had spent developing lessons could be spent assessing student work, preparing authentic assessments, and working with students on an individual basis. The curriculum has given me the chance to ask the students fewer "what do you know" questions and more "how do you know" questions.

In 2004, when I first experienced instructional coaching, I was exhilarated. The process allowed me to ask a question, have another trained teacher observe my class, then lead me in a reflective dialogue to pursue an answer to my question. It was like the National Board process on steroids! I was challenged way beyond anything I had ever experienced before.

These three forces have forever changed who I am as a teacher, and therefore changed the classroom experience for my students. The responsibility for learning has been placed on the students. They are doing the thinking. They are doing the math.

Focus on good teaching, not good teachers

So, what can districts do to support good math teaching? Clearly, professional development such as the National Board process and instructional coaching are great opportunities. Choosing a curriculum that supports good teaching and providing the necessary training to implement it is also important.

But what can a principal do to help a teacher take the next step?

The main thing I would suggest is that supervisors make it clear that they are not evaluating teachers, but evaluating teaching. Obviously they have to first make sure that a teacher is good enough to hire next year. But once that is established, the teacher and the supervisor can work on what matters: better teaching. If we focus only on the qualities of the teacher, then any question that challenges what is done in the classroom is threatening. If we focus instead on the teaching and how it impacts students, we are free to engage in reflective, non-threatening, dialogue focused on student learning.

Back to the root of the problem

If we can have a common understanding of what good teaching looks like, then we are on our way! But that is the problem. I don't think there is common agreement on what good math teaching looks like. Not only that, but there isn't common agreement on what good math learning looks like.

The question of what learning math looks like is complex. Every teacher has different ideas, and for every student there may be a different path. For me, I believe that learning math is best done by making connections between what we already know and what we want to know. Sometimes the connections are clear, but often students need some scaffolds to help them bring things together. I believe that students learn math by doing it, not by watching it.

I understand, however, that my way is not the only way, nor is it necessarily the best way. I need to be able to describe why I do what I do, and my students need to show improvement. It is up to all of us; teachers, schools, and districts to continually ask how good math learning should look in our classrooms.

The myth of math

I believe that math teachers get away without being challenged because math class is, to many people, a place of mystery and magic. But that is just not true. Good teaching is good teaching. Good learning is good learning. Supervisors can ask tough questions and expect reasonable answers. If the teachers don't have good answers, then they should spend some time learning with peers, reading, and reflecting.

Asking good questions and working together on quality answers is what we expect of our students in the classroom. It's also what we should expect of teachers as they collaborate to improve their practice.

Asking good questions

What questions should we be asking math teachers? The same ones we are asking all teachers: How are you differentiating? How are you using formative assessment? What does learning look like in your discipline? How is your class rigorous and relevant? How are you addressing both content and process standards? How are you teaching your kids to problem solve and to communicate mathematically? How are you involving parents? How do you use grouping in your class?

Each of these questions demands its own extended answer, as they are essential to teaching. When supervisors and coaches know what good answers to these questions should sound like, they will be able to challenge math teachers to dig a little deeper.

Winds of change

Today, dedicated math teachers are continually asking themselves and their colleagues those same questions. At math conferences, it seems every year there are more sessions addressing questions about how to teach students and fewer about what to teach students. There are more sessions about learning and fewer sessions about clever tricks to entertain students.

Math teachers, given support from administrators and coaches, time to collaborate, quality curriculum, and maybe some reading materials, can address these questions. There are not, of course, easy answers. There are essential questions that should be considered constantly as we try to grow as professionals. But without prompting and encouragement, teachers may remain stagnant. Supervisors with insight into good math instruction should step forward with tough questions and demand thoughtful answers.

If math teaching doesn't improve, too many students will continue to see math as inaccessible and irrelevant. If math teachers can successfully create a rigorous, relevant, standards-based learning environment for all students, then we will develop a culture that values math and understands the power mathematical thinking brings to creative problem solving and complex decision making.

Scott Smartt is a math teacher and instructional coach at Bellingham High School. He achieved National Board Certification in 2002 and enjoys trying to figure out the big pictures of teaching math and learning in general.

The Washington Transition Math Project

by Bill Moore

"Policy ought to start with the recognition that the prime locus for raising standards is the classroom, so that the over-arching priority has to be promotion and support of change within the classroom. Attempts to raise standards by reforming the inputs to and measuring the outputs from the black box of the classroom can be helpful, but they are not adequate on their own. Indeed, their helpfulness can be judged only in light of their effects in classrooms."

(Black & Wiliam, 1998)

There have been several substantive education-related articles in my local Olympia newspaper recently, including at least two lengthy analyses focused on mathematics. Not there's anything wrong with that, as Jerry on *Seinfeld* might say; I suppose those of us who are educators in Washington should be grateful for thoughtful coverage of any kind these days, especially given the seemingly ever-rising public anxiety about K-12 testing in general and student math performance in particular.

What struck me, however, is that all of the articles either basically described schools or districts engaged in noisy and difficult change processes involving the surface structures of education—in one instance discussing the shift from trimesters to semesters, in another the thorny issue of whether sixth-graders should be included in middle or elementary schools, two others focusing on math curriculum adoption processes debating two very different textbooks in a search for the "best way to teach math."

These issues, curriculum in particular, are important, but on their own they fail to address the classroom issues that Black and Wiliam's (1998) convincingly argue are fundamental to improving student performance in a genuinely standards-based system. Too often, state-, district-, and/or school-level policy debates leave the impression that changing these structures is the end of the discussion rather than only the beginning. The issues we face in mathematics, both in Washington and nationally, are too pervasive and deep-rooted to settle for simple surface solutions. Addressing them in a meaningful, long-term way will require messy and multi-faceted interventions involving multiple stakeholders. This article describes one such intervention currently underway in Washington—the *Transition Math Project* (TMP).

Background & context

A growing array of researchers, experts on education and national organizations (Conley, 2005; Kirst & Venezia, 2004; Achieve's American Diploma Project, 2004; and ACT, 2005, among others) have argued in one way or another that high school and college mathematics curricula are fundamentally detached from one another by both design and practice, even while these curricula attempt to address very similar math content. This math "disconnect" is one key element in what some have called a disturbing betrayal of the American dream of college success for many of today's high school students, particularly students of color, and is part of an even larger concern about American students' general deficiencies in math skills relative to their international peers. One consistent recommendation regarding how to begin to address this issue is that there should be some common expectations defined around what students need to master in high school and entry-level college courses, with efforts like the *American Diploma Project* and *Standards for Success* being examples of national attempts to specify these expectations.

Acknowledging these critical concerns, and growing out of specific joint discussions among educational leaders in both public K-12 schools and higher education, the *Transition Math Project* is Washington state's effort to address this disconnect. Begun in April 2004, TMP has been a collaborative statewide venture involving educators from K-12 schools, community and technical colleges, baccalaureate institutions, community-based stakeholders and business leadership. This K-16 effort is supported and managed by the State Board for Community & Technical Colleges, the Superintendent of Public Instruction, the Higher Education Coordinating Board and the Council of Presidents, and funded by grants from the Washington State Legislature and the Bill and

Melinda Gates Foundation.

The first phase of the project focused primarily on developing a clear consensus set of standards defining what students need to know and be able to do to be ready for college-level math. The second phase of the project (hereafter, TMP II) shifts the primary emphasis to implementing those standards by building math capacity—for students and for teachers—using the College Readiness Standards as the foundation, supporting standards-based curricula and instruction, and developing a variety of local solutions that can lead over time to significant statewide impact. The long-term goals of the work proposed in TMP II are to improve the math achievement of high school students as they make the transition to post-high school opportunities, both in college and the workplace, and to increase the percentage of recent high school graduates in Washington entering college prepared to do college-level work in math without remediation.

Phase I work: building consensus

The primary purpose of TMP Phase I was to address the need for clear and common expectations by defining College Readiness Standards for entry into college-level mathematics courses and courses with strong quantitative components. The project identified standards for the mathematics knowledge and skills high school graduates need to ensure they are ready for college-level work in Washington, meet minimum admission requirements, and avoid remediation upon enrolling in an institution of higher education. The standards parallel the structure and language of the Essential Academic Learning Requirements (EALRs) and Grade Level Expectations (GLEs) in mathematics, which already exist for K-10. Subsequent follow-up work, led by the Office of Superintendent of Public Instruction, developed new GLEs for grades 11-12 that represent an instructional bridge to the College Readiness Standards in a format integrated with the existing K-10 GLEs.

The College Readiness Standards were drafted in summer 2004 by a development team consisting of math experts from all three educational sectors in Washington: K-12, community and technical colleges, and baccalaureate institutions. This draft was reviewed and refined by a larger team of over 70 math and non-math faculty and curriculum specialists from all three sectors, along with representatives from business and industry. Over a period of 18 months, extensive feedback was gathered from math faculty and a variety of educational stakeholders; based on this feedback, the final version of the College Readiness Standards document was released formally in March 2006 (and available for download at http://www.transitionmathproject.org/assets/docs/standards/crs_march23_2006.pdf).

Phase II work: building capacity

In addition to developing the College Readiness Standards, TMP Phase I also included an emphasis on supporting, at least on a small scale, new and existing high school/college partnerships around math achievement issues, along with improving and expanding communication to high school students about the critical need for math skills and the implications of taking too little math in high school. All of the work in Phase I—defining standards, communicating to students and parents, and supporting local partnerships—has provided a solid foundation for addressing the longer-term goals of improving students' achievement in math and reducing the number of students needing math remediation at college entry in Washington, and has helped numerous school districts and colleges make progress in the area of cross-sector articulation and collaboration. At the same time, it has been clear from the beginning that making significant progress on these goals requires a sustained commitment over an extended period of time. Alan Schoenfeld (2002) has observed that "conversations about the mathematical needs of American students must focus not only on what mathematics the students should learn, but also on how we as a nation can ensure that all students have the opportunity to learn it" (p. 14). As the lead quote from Black and Wiliam's (1998) compelling international research on the power of classroom assessment also suggests, this focus demands that we move beyond the policy world of standards-setting to the messy complexities of influencing real classrooms and real teachers. If Phase I was first and foremost about consensus-building around a clear framework of standards, Phase II is about capacity-building for teachers and schools to address the enormous challenges of helping more students achieve those standards, providing these students with both improved math skills and a broader range of opportunities as they graduate from high school in Washington.

A central question to be addressed, of course, is what kind of capacity do we need to build, and how? The stock answer to the "what" question has been "standards-based math curriculum and pedagogy," but this notion clearly needs some additional clarification. Richard Elmore (1996) argues that education reform usually fails because it rarely addresses what he calls the "core of educational practice," i.e., teacher beliefs about teachers' and students' roles in teaching and learning as well as the nature of knowledge itself, that influence significantly their day-to-day classroom practices. For math teachers, these core beliefs and understandings center on three essential areas:

a) subject matter: the critical concepts, processes, and methods of inquiry and argumentation of the math content being taught

b) student learning: the ways that students' mathematical thinking develops

c) teaching practice: the nature and effects of different instructional approaches on students' acquisition of knowledge , skills, and mathematical reasoning

To make a real and lasting difference in math achievement for a much broader range of students, particularly students not inclined to view or learn math in the way that math teachers do, TMP Phase II work is pursuing a variety of strategies that address this core set of concerns. These strategies revolve around instructional materials and practices, including problem sets, curricular guides, and math case studies—that will provide rigorous math options for students and support for their teachers as they work to prepare students for a successful transition to post-high school opportunities.

How to approach this kind of capacity-building also involves thorny issues; as Elmore (1996) observes, influencing these core beliefs and practices is extremely difficult in most existing school settings, and innovative practices that entail changing this core typically do not travel very far beyond the situations in which they originate. Partly because of this difficulty, and despite what many want to believe, there is widespread evidence in the literature of educational change that fundamental improvements in education can be achieved only slowly—largely through programs of professional development that build on existing good practice. Moreover, research into the professional development of math and science teachers (Ball, 1997; Kennedy, 2006) suggests that these teachers learn best not from generic workshops focused on general principles but from collaborative work built around core principles translated into concrete examples of practice, preferably demonstrated by respected peers. Much like the professional fields of science and mathematics, this kind of teacher inquiry does not thrive in isolation, so developing professional learning communities in which teachers can articulate and examine conceptions about mathematics, student thinking, and instructional practice is essential for generating and sustaining significant and lasting teacher change.

Specific phase II approaches

The focus of Phase II of the Transition Math Project, again supported by a public-private partnership between the Legislature and the Gates Foundation, is to use the following strategies in order to build the capacity of the educational system to address the long-terms goals noted earlier, namely, to improve the math achievement of high school students as they make the transition to post-high school opportunities and to increase the percentage of recent high school graduates in Washington prepared to do college-level work in math when they enter higher education:

- Align college placement tests with the College Readiness Standards and develop a strategy for math diagnostic and placement testing for Washington higher education.
- Increase curriculum alignment between high schools and colleges using the College Readiness Standards and 11/12 GLEs as frameworks.
- Develop and disseminate standards-based instructional materials (supplemental classroom tasks, assignments and assessments) built on the College Readiness Standards and the 11/12 GLEs.
- Reach more students and parents, especially those under-served by higher education, with specific and clear messages on the College Readiness Standards and how to effectively use them in college and career planning.
- Gather better information on current math curricula and student course-taking patterns and performance in high school and college math.

The overall intent of the project is to combine a coordinated statewide effort with a diverse range of local/regional partnerships in order to have as broad an influence as possible on students and teachers around the state but avoiding, as much as possible, specific statewide solutions. One respondent in the TMP Phase I evaluation study, commenting on what is needed now that the standards have been developed, referenced the environmental slogan from the late 1970's: "think globally, act locally." We believe that this approach is essential to a successful implementation phase for TMP. Building on the work begun in phase I and using the College Readiness Standards as a foundation, TMP II is currently funding 13 local or regional high school/college partnerships, supported and connected by the statewide TMP consortium. This kind of "think globally, act locally" strategy is designed to utilize the College Readiness Standards and Grade 11-12 GLEs as frameworks for aligning curricula and improving standards-based instruction in local and regional contexts around the state. All of the local/regional partnerships will have direct involvement in shaping the project through a process of distributed leadership in which the overall project management team consults closely throughout the project term with a group of designated local project leads. For an example of a comparable collaboration, see Foster & Noyce's (2004) description of the *Mathematics Assessment Collaborative.*

This kind of "small solutions" approach has proven to be successful in creating more ownership and energy around the work of change than would be possible with top-down mandates or policy levers alone, but by itself is insufficient if the ultimate goal is to influence systemic change. However, combined with robust statewide support and coordination, such an approach can generate both local innovation and broad systemic influence. The coordination and connections provided by the statewide project will allow us to leverage the work of the local/regional partnerships, learning from and promoting a variety of innovative, home-grown practices proven to be successful and sustainable in local contexts. To serve in this role most effectively, the contribution of the statewide component of TMP II is taking several specific forms, including:

1) Defining the framework within which the local partnerships are operating, helping to ensure a consistency of focus on the College Readiness Standards across the various projects;
2) Convening regular meetings of partnership leaders to collaborate in shaping the agenda for the overall project;
3) Helping coordinate activities and resource-sharing across the projects in order to gain greater statewide benefit from resources being used and to extend the reach of and scope of the local projects;
4) Identifying and connecting with outside resources of potential benefit to multiple projects and/or TMP as a whole—e.g., the Charles Dana Center (UT-Austin), Mathematical Association of America (MAA), the Mathematics Assessment Resource Service.
5) Pursuing activities that are complementary to the work of the local projects but that are best served by statewide discussions (e.g., math placement testing).

Local partnerships will focus on strategies for implementing the College Readiness Standards, developing resources that can be disseminated statewide, such as model curricula, standards-based math problems and instructional materials, and college/high school outreach efforts with high school students and their parents. These strategies could take a variety of forms; examples include:

- integrating the College Readiness Standards into relevant courses
- creating guidelines for teacher knowledge and understanding (including instructional techniques, activities and learning experiences for students) geared to the College Readiness Standards
- adapting a curriculum planning model for use with the College Readiness Standards, and supporting the work with teachers inside schools by enlisting parents to reinforce the messages about the specific math knowledge and skills students need to be successful in college.

Grounded in support and coordination from the statewide TMP effort, all of the projects will be asked to use an evaluative inquiry model to gather formative feedback about the work, particularly to address issues of the sustainability (through and beyond the grant period) and potential adaptability (to other settings and contexts) of project activities. The overall goal is to encourage focused and successful innovations by emphasizing collaborative teacher inquiry and experimentation framed by the parameters defined by TMP, not to implement or re-create a specific and discrete set of instructional practices.

With respect to math placement testing, the advisory group has already been assembled and has begun preliminary work as a follow-up to the statewide gathering sponsored by TMP in November 2005. The group, comprised of educators from K-12 and higher education with a particular interest and expertise in placement testing, affirmed at their initial meeting a commitment to exploring the feasibility, implementation issues, and implications of developing a statewide math placement test (similar to the math test used currently by the Washington public baccalaureate institutions) and developing a separate, aligned diagnostic assessment.

Conclusion: ongoing challenges and hopes

In many respects, the *Transition Math Project* is unlike any other project currently operating around the country, both in terms of scale and approach, and given the complexity of the work has more than its share of challenges. While there is a growing body of evidence nationally that systemic alignment and sustained professional development can make a significant difference in student math achievement, situations in which these conditions have been created are extremely difficult to find. In the current educational context in Washington, math is a particular problem as the current basic requirement for a high school diploma is two years of unspecified math, making it likely that many high school students stop taking math well before they enter college. Moreover, there is significant attention being paid to students meeting the new high school graduation requirements, especially the WASL. This focus makes it particularly difficult to engage in work that brings to light that the math standards assessed by the WASL, while forming a solid foundation for college-level work, are inadequate for college readiness. This paradox makes garnering K-12 administrative and teacher support for this work problematic.

Work related to improving student achievement in math is difficult enough within a given school or district; in explicitly pursuing teacher-to-teacher high school/college partnerships as a central aspect to the project, TMP II faces the logistical complexities of different educational systems, norms, reward structures, curricula, calendars, etc. These complexities are most evident, and most significant, in pursuing approaches to professional development around curriculum and pedagogy, which of course represents the central focus for the work we believe essential to the success of TMP II. These challenges are compounded by the wide variety of math curricula being used. Given this range of challenges, and the need to build consensus and collaboration around standards where neither had existed before, an even bigger "meta-challenge" is the pressure for a "quick fix" solution to the problem of student math performance.

At the statewide level, the most significant challenge for the project is maintaining a clear focus on addressing the core areas of educational change noted earlier. This focus offers the most effective long-term strategy for meaningful, sustained improvements in system capacity to improve student achievement in math, and the local/regional cross-sector partnerships we are supporting are the best vehicle for implementing those strategies. The challenge in maintaining this focus is that the "math crisis" has seemingly become everyone's number one priority, with all sorts of project proposals, agency recommendations, and legislative mandates being put forward as the solution, or part of a solution. While there is much to be said for the overall energy directed at math-related issues and many of the specific ideas being proposed, the struggle for all of us will be to find ways to integrate and coordinate all of the work that needs to be done in such a way that there is some coherence overall and that neither students nor teachers are overwhelmed by the variety of interventions, assessments, and additional "support" that is being offered The *Transition Math Project*, and in particular the College Readiness Standards, can provide that much-needed coherence by providing a clear focus for grade level expectations at the end of high school, not just the 10th-grade expectations reflected by the WASL. Through college-ready standards, we will give all students the math competence and confidence they need to be fully prepared at graduation for the widest range of post-high school opportunities available to them so that the choices they make are theirs, and not made for them because they are not well prepared in mathematics.

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A student's voice

By Erika Murphy

I started my freshman year at a big high school in Spokane. Just after second semester began, I started skipping classes.

I got involved with some people who were not into school at all. Before long, I lost my connections with school friends and felt pretty much like an outcast. I spent the next year and a half just kind of hanging out and doing nothing. I was pretty much wasting my life away.

About halfway through what should have been my junior year, I was sick of the way my life was heading. I didn't want to have a minimum wage job for the rest of my life. I knew that if I didn't do something soon that's exactly where I would end up. So I enrolled in the GED program at Havermale High School. Not even a month later I was approached by two teachers, Bill Saye and Dale McDonald. They were recruiting students for a new program at Havermale called College Bound Competency (CBC). CBC was started to help students like me who were way behind in credits but still wanted to graduate and go on to college.

I went into CBC during the last quarter of my junior year. There was a lot of work for me to do and it spilled over into summer break. In July, I went on a week long visit to Spokane Community College with a group that my CBC advisor, Bobbi Konshuk, had put together. I realized that I really could go to college if I set my mind to it. During that summer, I wrote essays, worked on reading skills, and did a lot of math on a computer program called ALEKS.

In ALEKS, my teachers helped me keep track of my own progress and fill in the big holes in my math learning. I also took the COMPASS test which showed me what I knew and what I still had to learn to be ready to go to the community college. In the fall, we started doing a math program called Core-Plus. I work in groups with other students to figure out the problems. It seems that between us we know enough to figure them out. Right now we are working on linear equations that model relationships between variables. Before, math had been my worst subject, but now I don't seem to have much trouble understanding the work.

My confidence has gone way up. Here at Havermale, school is much more personal. My teachers know me and push me to do what they now I can do. They don't just give you an F and pass you on. They insist that you keep working until you get it. I know there is still a lot to learn, but I also know I can do it. I am caught up on all of my work and I am getting ready to graduate and go to college. I have decided to pursue a career in advertising. I know the math I am learning will be very important in managing budgets and developing proposals in advertising. I still have a lot of work to do but I am on the right track and have pushed myself to graduate on time and be ready for college.

Erika Murphy is a senior in the College Bound Competency Program at Havermale High School in Spokane. She will graduate in June 2008.

From the executive director

by Kathy Clayton

It is my pleasure and privilege to serve as the executive director for Washington State Association for Supervision and Curriculum Development. My service since being hired last July 1 has been an incredible journey, and one where I learn and grow every day. I am grateful for the mentorship of our former Executive Director, Joann Mychals, as I assume the various responsibilities she so skillfully performed.

During my 32-year career in public schools, I had the pleasure of working in five different school districts in the eastern, western, and south central parts of our state. As a classroom teacher, I worked in Central Valley School District (Spokane), Kennewick, and Northshore School District (Bothell). I also served as a reading specialist, instructional coach, and school administrator in Northshore, and as an elementary principal in Monroe and Cheney. My experiences in different roles and in several schools and districts has fueled my commitment to the profession and to supporting the great work of educators in the work of educating all students.

Before applying for this position, I delved into the WSASCD Strategic Plan, researched financial records, examined the Constitution, probed the Procedural Guidelines, and explored the goals related to the services provided to the membership. I needed to know if this position would be a good fit for me, and one that I could feel passionate about. I was accustomed to having a high level of enthusiasm about my work as a teacher, reading specialist, instructional coach, and building administrator. It was important to know if my background and experience would parallel the goals of the organization, enabling me to support and enhance the good work that is currently occurring with WSASCD.

While each element in my search was integral to my decision, what I did not recognize in the paperwork was the heart of the organization. It lies within the leadership of the organization – the Board of Directors. It starts with the Executive Committee. Janel Keating's superb leadership as our President is only surpassed by her sincere desire to bring quality professional development to our state, and to spread the word to our legislators about the educational practices that are being demonstrated in our schools. President-elect Mike Dunn promotes healthy relationships through his honest, direct, and effective interactions on the board. Serving the Executive Committee as the ASCD Representative, is Mike Nelson. Mike continually reminds us of our responsibility to the membership to promote quality instructional practices, as he advocates for providing the best professional development at a reasonable cost.

Quality teaching and learning, as well as influence and advocacy, have definitely been the focus of the work of our Board of Directors this year. Board meetings have been very informative, insightful, and forward-thinking, largely due to the diversity of thought of the Board. We are fortunate to have the broad perspectives of teachers, principals, superintendents, and university professors, as well as representation from OSPI. I appreciate the viewpoints of Paul Sturm, Jeanine Butler, Missy Hallead, Madonna Hanna, Faith Chapel, Josh Garcia, Carl Bruner, Sharon Mowry, Mickey Lahmann, and Joan Kingrey. The content of this journal, with the specific focus on mathematics, is the direct result of concentrated conversations with the Board of Directors on significant issues facing educators in our state.

Successful organizations succeed because they have leaders at every level who teach others to be leaders. Teaching and learning are at the heart of these organizations. I am pleased to be working with an organization whose mission is to facilitate continuous professional growth, as well as advocating for instructional leadership to assure success for each learner. WSASCD truly is the "practitioner's best friend."

It is definitely the people who make this organization flourish. The past presidents, former board members, and various committee members who continue to be involved in the work of the organization are admirable. Another outstanding team of educators with whom I've had the privilege to work is the 2007 Annual Conference planning committee, led by co-chairs Andrew Lumpe and Tracy Livingston. They, along with committee members from across the state, have planned an outstanding conference that will be an inspiring and worthwhile educational experience!

2007 WSASCD Annual Conference

November 1-3, 2007• Doubletree Hotel SeaTac Airport

You're invited to join educators from across the state at this year's annual conference: "Reaching the Whole Child: Moving from Promise to Practice!" The conference program and speaker line-up support the latest thinking about promising practices for the whole child. Joan Schmidt, Past President of the National School Board Association, will serve as our keynote speaker at our full-day Action Lab program. We are fortunate to have two keynote speakers for the opening session on Friday. Dr. Gene Carter, Executive Director for ASCD International will share insights from his recent work with ASCD's Whole Child Commission. Dr. John Bransford, author of *How People Learn,* will focus on new views of competence and implications for how we instruct and assess.

The Thursday Action Labs will feature the following outstanding experts in education:

Dr. Harvey Alvy

Leadership Practices that Foster Quality Teaching and Student Learning

Dr. Kevin Feldman

Narrowing the Lexical Divide: The Critical Role of Vocabulary and Academic Language in Improving Secondary Literacy across the Curriculum

Dr. Vicki Gibson

Differentiated Instruction

Dr. Jan Hasbrouck

Coaching for Collaboration

Kari Hollandsworth and Colleagues

Using Powerful Classroom Assessments (PCA) in the Science Classroom to Inform Teaching and Learning

Dr. Jerry Johnson

Computation, Algorithms, Mom, Apple Pie and Bathwater: Another Look at Important Concerns for K-12 Math Educators

Dr. Alison Olzendam

Powerful Teaching and Learning into Practice

For the conference finale, two fabulous Saturday Institutes are offered. Dr. Tim Westerberg, a school improvement coach working with Bob Marzano's research on *What Works in Schools,* will present information related to Translating Research into Action without Driving the Faculty Crazy. Dr. Robert Eaker, co-author of several books on the subject of professional learning communities, will present, What it means to BE a Professional Learning Community.'

The 2007 Annual Conference program promises to carry on the tradition of exceptional professional development and networking for educators across the spectrum. On behalf of our fabulous WSASCD board of directors, we hope to see you in Seattle! Check out our Web site at www.wsascd.org for registration information.

Curriculum in Context
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ARE YOU AND YOUR COLLEAGUES serving K-12 students in creative ways? Can you shed light on legislative trends that might benefit educators across the state? Can you illustrate recent educational research claims through stories from schools and classrooms on the front lines? If so, consider taking some time to clearly and persuasively contribute to the intellectual life of the WSASCD community. Please e-mail a 50-100 word preview of your contribution to kingrey@wsu.edu and we will promptly send a submission guidelines form for your 1000-2500 word article. If you have questions, please e-mail editor Joan Kingrey at the above address.

SUBMISSION DEADLINE
Fall/Winter 2007 — July 1, 2007
Spring/Summer 2008 — January 1, 2008