

# MATHEMATICS – FINDING WHAT WORKS – A PERSONAL QUEST

Larry Nyland – AWSP/WASA – June 2008

## HOSPITALS SAVED 100,000 LIVES IN 18 MONTHS

Hospitals are responsible for 90,000 deaths per year ... unrelated to admissions

- A significant number of those deaths are caused by one of six factors ... like MRSA
- A campaign to address those six issues aimed to save 100,000 lives in 18 months

## SAVING MATH LIVES

30,000 students fail to score “proficient” on the 10<sup>th</sup> grade WASL each year.

- Can we find – and address – the six factors that will do the most to save math lives?
- Can we, like hospitals, commit to make the changes that will save math lives?

## COMPARED TO LITERACY THERE IS VERY LITTLE RESEARCH ON WHAT WORKS

There is however emerging evidence from several sources:

- Research on effective districts and literacy
- Reports on co-relational studies in math

## WHY IT MATTERS

The expectation is that 80% of the livable wage jobs of the future will require some college ... which requires a high level of math competency

*“Students now need at least two years of post secondary education to be successful in a work force that requires advanced skills.” - Education Commission of the States*

- New, tougher, world class standards have been (K-8) or will be (9-10) adopted
- A third math credit – possibly Algebra II – will soon be added to WA graduation requirements

## WE CAN DO IT

*“Mathematics is a language that is woven into virtually every part of our lives ... a way of thinking and problem solving that has positively impacted our lives ... a critical part of the skill set students need in order to give them the greatest chance for future success.” - M. Mansell*

- Evidence is emerging from districts that have been closing the gap
- Here is one dozen ... educated guesses ... promising ideas gleaned from:
  - Uri Treisman, Mary Kay Stein, Richard Elmore, Bob Marzano, Doug Reeves
  - Recent mathematics reports ... SBE math panel ... WSECC
  - Everett ... Bellevue ... Montgomery County (MD) ... Dana Center Reports

## WHAT WASHINGTON STATE IS DOING

- New math standards are available now and OSPI is delivering training this summer.
- State board is due to act soon on third math credit
- New text recommendations will be out soon for K-8 (fall?) and 9-10 (spring)
- The new standards are part of the new WASL specifications ... to be piloted in 2009
- Students can meet the WASL math requirement by:
  - Taking a “high school” level math class
  - Participating in a “collection of evidence”
  - Taking a “segmented math course”
  - Testing well on alternate tests ... SAT, ACT ... or having good GPAs

# ONE DOZEN ... EDUCATED GUESSES ... ON IMPROVING MATH SUCCESS

Larry Nyland – Marysville Schools

## 1. AGREE ON COMMON QUARTERLY ASSESSMENTS FOR ALL MATH COURSES

Make time for high school teachers to work together on writing math assessments that parallel the new math standards. Teachers will calibrate their work with each other and become familiar with the new standards. Classroom teaching will then begin focusing on standards, assessments and closing student learning gaps.

## 2. CREATE A RELIABLE, CONSISTENT CURRICULUM WITH GUARANTEED FIDELITY

Adopt research based text materials aligned to the new math standards. Also decide what is most important, what to leave out, and what to supplement. Invest heavily in training teachers to use the materials in the way they were intended. Use the materials district wide, for supplemental services as well as regular education classes.

## 3. INCREASE THE TIME SPENT ON MATH ... ESPECIALLY FOR STUDENTS WHO STRUGGLE

Reeves recommends that you double the amount of time spent on math. Many recommend 60 minutes / day – more for students who need to catch up. Lake Stevens won a national award for extending their middle school periods. Everett received recognition from the Governor for their “double dip” program giving students two math periods per day.

## 4. ACCELERATE LEARNING BY TEACHING STUDENTS THAT EFFORT MATTERS

There is considerable evidence that students can do more difficult work with success. Several programs like AVID, MESA, and AYD pre-load students for success, by building relationships, teaching students that effort matters and pre-teaching problem solving skills. Students start ahead of their peers and often do well for the first time.

## 5. TEACH ACADEMIC VOCABULARY USING RESEARCH BASED METHODS

Even if students know how to do the math they may not get credit on state tests if they don't know the terminology. Tier II academic vocabulary includes terms used in school but not used frequently in non-school settings. Using research based methods to help students understand academic terms is recommended by Marzano and others and has been used with success in Boston.

## 6. USE FREQUENT FORMATIVE ASSESSMENTS WITH SPECIFIC ADVICE ON WHAT TO IMPROVE

Meta-analysis based on 250 studies showed that frequent feedback improves learning by an effect size of 0.4 to 0.7 (Black). The more frequent the feedback, the larger the effect (Marzano). Stiggins and Marzano recommend having students chart their own progress and Marzano provides a rubric template designed to encourage student success.

## 7. USE DATA TO IDENTIFY AND ACT ON INDIVIDUAL STUDENT NEEDS

Everett uses data to place students in double dip classes, reduce F's and provide intervention. They meet regularly with high school administrators to see how students are progressing. Montgomery County identifies individual students (20%) that need help in taking tougher math classes.

## 8. ASK TEACHER TEAMS TO WORK TOGETHER ON SOLVING PROBLEMS OF PRACTICE

Create a collaborative culture in which teacher teams learn, plan and work together to analyze student achievement on common assessments, and develop strategies to improve student learning. Ask teachers to score student work together, develop common lessons, watch each other teach, and talk about what they see.

## 9. ASSIGN TEACHERS INTENTIONALLY TO MEET STUDENT NEEDS

Assign and support teachers based on student needs and teacher abilities. Everett asks all teachers to share in teaching all levels of math classes. Avoid assigning remedial courses to new teachers. Build a safety net for mentoring new teachers. And some, including the U.S. Math Panel, advocate for elementary math specialists.

## 10. RAISE STANDARDS ... TO MAKE EVERY STUDENT COLLEGE READY

Raise the bar for all students. Eighty percent of future living wage jobs will require at least some college and career jobs will require the same type of college ready skills. When we ratchet up performance nearly all students respond and we set a new norm.

## 11. GROW GREAT TEACHERS WHO GROW GREAT STUDENTS

This is humbling work. None of us has the answer for reaching all students. The above steps will help move us in the right direction. Ultimate success depends on a having a skillful teacher, who knows math and is able to use multiple methods to built mathematical thinking skills for each student. Teacher teams, action research and coaches are needed.

## 12. LEAD THE WAY IN SETTING BENCHMARKS AND FIGURING OUT TO REACH THEM

None of the above are “set it and forget it” solutions. All require leadership, engagement and follow through to determine several times during the year whether the plans are being implemented, what the results are showing and what adjustments are needed to make a difference.

## #1 – AGREE ON COMMON QUARTERLY ASSESSMENTS FOR ALL MATH COURSES

***Make time for high school teachers to work together on writing math assessments that parallel the new math standards. Teachers will calibrate their work with each other and become familiar with the new standards. Classroom teaching will then begin focusing on standards, assessments and student learning gaps.***

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Two issues are intertwined in this section:

1. Getting clear on assessment targets (this recommendation)
2. Giving frequent feedback every two to four weeks (recommendation #6 below)

- Doug Reeves advocates teacher work on common assessments as the number one way to reduce dropouts. He has given similar examples of student work to over 10,000 teachers and regularly gets a full range of grading recommendations – from A to F – for the same exact pieces of student work. *“Until we talk together about what we expect of students and look at student work together we do not know what we are really measuring. If teachers do not agree on what the word ‘proficient’ means, then students will get mixed messages about what level of quality is acceptable. Only when teachers look at the same piece of anonymous student work and collaboratively score that work will there be a true professional learning community.”* Reeves urges using this information to create quarterly “common assessments” that ensure consistency in core expectations for students. *“Curriculum mapping is not enough. Teachers must have power standards and common assessments.”* – Douglas Reeves
- In Marzano’s new work on effective districts, his number one strategy is to develop district-wide rubrics for 15-20 concepts per grade/course. Rubrics (described below) include target learning and four levels of proficiency: knowledge with help; knowledge without help, understanding, and application. The idea is that teachers agree on what is most important. Clear and measurable targets are visible for teachers and for students. Teachers and students can then apply their effort and skill to achieving the goals.
- Everett is developing common assessments for K-12 mathematics. They have already in place a set of common assessments in reading and writing. Teachers score their own assessments and then meet for a day to share out results and plan what they will do for the next eight week segment. Coaches serve as leads to help coordinate “review of evidence” days that are held during the middle of each term so that changes can be made as needed before the term is over and it’s too late.
- Uri Treisman, from the Dana Center in Texas, reports that Chicago reduced failure rates in algebra from 45% to 12% by creating common exams which give teachers and students a common sense of what they need to know. Treisman calls for a common set of tasks and goals for math learning coupled with professional adult inquiry into which approaches work best in helping students reach these goals. The Silicon Valley Math Initiative keeps track of what works best and transfers that information to each new generation of teachers.
- Improving Adolescent Mathematics, a report on research by NW Labs, says that *“continuous, descriptive feedback is critical”* and makes the following recommendations:
  - Monitor each student’s learning with frequent and timely formative assessments.
  - Provide students with comments on written and oral responses, rather than grading only.
  - Use questions to provoke student thought and to uncover misunderstandings.
  - Analyze student answers.
  - Teach students the skills of peer and self-assessment to promote deeper learning.

## #2 – CREATE A RELIABLE, CONSISTENT CURRICULUM WITH GUARANTEED FIDELITY

***Adopt research based text materials aligned to the new math standards. Also decide what is most important, what to leave out, and what to supplement. Investing heavily in training teachers to use the materials in the way they were intended. Use the materials district wide, for supplemental services as well as regular education classes. This recommendation is Marzano's number one goal for creating effective schools in his meta-analysis, What Works in Schools.***

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*“One of education’s best kept secrets is that kids learn what we teach them.” - Larry Lezotte*

- Top performing districts have standardized their curriculum and provided support for teachers. Scores shoot up when schools get clear on what is taught. Low performing districts have different texts and different teaching in each school and often in each grade or classroom. Poor kids move more frequently and have more difficulty with transitions. Also important to adopt a coherent curriculum that uses similar approaches K-12. – Uri Treisman
- OSPI will be rating each of the most commonly used math texts against the new state standards. The best matches between commercial text books and state assessments is in the 70% range. That means that adopted text books do not cover 30% of the state standards. We also know that U.S. text books are a mile wide and cover far more content than a teacher can teach in one year. Therefore districts and hopefully the state, would be well served by identifying specific topics in texts that are essential ... and noting those standards not covered in the adopted text.
- A survey of high school math teachers in Washington – from schools that outperform on the WASL indicated that:
  - 36% rarely used the GLEs to explicitly align curriculum, instruction and assessment.
  - 35% have not had training in how to use the adopted curriculum materials
  - 38% say that lack of materials for struggling students is a moderate to great challenge
  - 52% say that they do not have time to adapt the adopted curriculum to student needs
    - Teaching Math in Washington’s High Schools
- The U.S. Math Panel *“recommended that math curriculum should include fewer topics, spending enough time to make sure each is learned in enough depth that it need not be revisited in later grades. That is the approach used in most top performing nations, and ... many states have been revising their standards to cover fewer topics in greater depth.” - New York Times article (Report Urges Changes in Teaching Math, by Tamar Lewin, March 14, 2008) on U.S. Math Panel*
- Denver has decided to do away with supplemental materials for special education. They use the same materials for all students (different levels depending on readiness). This enables all teachers to learn the same content, allows students to use the same material in both regular ed and special ed and creates a common language between regular ed and special education teachers. – Uri Treisman
- Teach teachers to use new adoptions. Provide extra time for *protocol driven* department meetings. Frame tasks and accountability. Survey teachers. Meet frequently to discuss how the new textbook adoption is being implemented. – Uri Treisman

### #3 – INCREASE THE TIME SPENT ON MATH ... ESPECIALLY FOR STUDENTS WHO STRUGGLE

*Reeves recommends that you double the amount of time spent on math. Many recommend 60 minutes / day – more for students who need to catch up. Lake Stevens won a national award for extending their middle school periods. Everett received recognition from the Governor for their “double dip” program giving students two math periods per day.*

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*Time* is near the top of Marzano’s best selling meta-analysis list of *What Works in Schools*. He links time – the opportunity for students to learn – with a guaranteed and viable curriculum, identified above.

*“Provide extra time and support to students who are having difficulty learning.”*

- Improving Adolescent Mathematics; findings from research
- Everett’s Accelerated Learning Support Classes give students accelerated content over two math periods per day. Students get a regular math credit plus an elective math class designed to accelerate their learning. In most cases the regular classroom teacher is also the teacher for the elective acceleration course and has a smaller class size. Everett does this for math (and reading) at the middle and high school levels. They found that pull out programs caused students to miss something else and were not aligned with the higher expectations. Kids were reluctant in the beginning but now find that they are excited about their learning success. Marysville Middle School saw many students make one year of gains in one semester using this approach.
- CPRE’s report on schools that doubled performance found those schools, *“used time more productively, often increasing time allocations for core subjects, protecting classes from interruptions during core periods, and in secondary schools, offered double class periods in subjects where students were struggling to achieve standards.”* - CPRE Policy Brief, February 2007
- Step Up to High School is designed to ease transition into high school for Chicago students. It is based on Uri Treisman’s success in helping students of color do well in college mathematics. Students get extra time with mathematics in summer school, are assigned challenging work and strong freshman teachers. They also work on building academically based peer relations with students and adults. Students who participated saw increased algebra pass rates. Chicago also implemented two period algebra to help students increase pass rates. – Step us to High School – Chicago Math & Science Initiative.

## #4 – ACCELERATE LEARNING BY TEACHING STUDENTS THAT EFFORT MATTERS

***There is considerable evidence that students can do more difficult work with success. Several programs like AVID, MESA, and AYD pre-load students for success, by building relationships, teaching students that effort matters and pre-teaching problem solving skills. Students start ahead of their peers and often do well for the first time.***

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- In addition to the subject area content, each of these programs features concepts of efficacy, resiliency, and the importance of effort. Federal research on assigning an extra literacy class to struggling 9<sup>th</sup> grade readers showed progress but not nearly enough. *“What we found in our work with these adolescents is that the absolute first step is to gain their trust and entice them into re-engaging into the academic enterprise.”* - Cynthia Greenleaf, Reading Apprenticeship Academic Literacy Program
- *“Research demonstrating that beliefs about effort matter and that these beliefs can be changed is critical. The [U.S. Math] Panel recommends that teachers and other educational leaders use research-based interventions to help students and parents understand the vital importance of effort in learning mathematics.”* - U. S. Math Panel
- AVID – Advancement Via Individual Determination. Avid pulls students out of unchallenging courses and puts them on the college track: acceleration instead of remediation. AVID provides one course per day during the regular student day that teaches writing, inquiry, collaboration, tutoring. *“Most AVID students are underrepresented minorities – Latinos and African-Americans – who may lack a college-going tradition in their family and whose success is critical to closing the achievement gap. Sixty-one percent of AVID students take algebra in 8<sup>th</sup> grade – [compared to the] national average of 22 percent. Seventy-five percent of 2006 AVID graduates were accepted to a four-year college.”* - AVIDonline website research page.
- Academic Youth Development is a program designed to give students a two week boost prior to the start of school. Students selected are those on the bubble, the ones who will likely struggle. The summer school teacher is the same teacher they will have during the year. For example, the teacher may have 20 students in summer school – that could mean that four summer school students will be assigned to each of the five regular classes that teacher has in the fall. These four students will already know the teacher and they will have developed resiliency skills and math problem solving skills. The idea is that those four students will help the teacher tip the balance of the entire classroom toward a culture of learning and effort and success.

## #5 – TEACH ACADEMIC VOCABULARY USING RESEARCH BASED METHODS

***Even if students know how to do the math they may not get credit on state tests if they don't know the terminology. Tier II, academic vocabulary are terms used in school but not used frequently in non-school settings. Using research based methods to help students understand academic terms is recommended by Marzano and others and has been used with success in Boston.***

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- Marzano's third recommendation for effective district work is to use research based methods to teach 20 key background knowledge terms per course. The state of Oklahoma has used Marzano's work to create a state-wide listing of critical background knowledge terms by grade and subject. They report that 50% of the schools in improvement made adequate yearly progress after using Marzano's approach.
- Most students come to school with 4000 words of vocabulary. Poor students may come to school with 600-800 words. Intentionally focus on building background knowledge in pre-school and primary grades. Eric Smith moved Charlotte from bottom quartile to the top in three years by investing Title I dollars in pre-school/primary. – Uri Treisman
- Poor kids and ELL kids don't get exposed to academic vocabulary. Teachers simplify the curriculum. Even if students know the math they can't do well on assessments if they don't know the terms. Systematically build into the curriculum the 300-600 essential terms. Teach academic language to ELL and special education students to get a deeper understanding level. One district has adopted 600 words as a focus for success in middle school math. Boston made huge gains with ELL students by working with students who did math reasonably well but couldn't communicate mathematically. They had students work the problems on the board and then showed them how to use the terminology – building on what the students already knew. Build academic language by engaging students in daily constructive talk. – Uri Treisman
- *“Emphasize vocabulary development and a consistently understood definition for mathematical terms and the symbolic language of mathematics. Students confronted with a new written symbol system need to engage in activities that help them construct meaningful relationships. The symbolic representations in mathematics have their own rules for order, conventions, position, and grouping that must be learned and used correctly and consistently by teachers as well as students. The vocabulary of mathematics can also pose special challenges because the terms such as stable, congruent, equal, and average may be used differently in conversational English than in mathematics. Teachers need to be intentional about the vocabulary they use when speaking, the term they define during instruction, and the vocabulary they expect students to use correctly.”*  
- Improving Adolescent Mathematics: findings from research

## #6 – FREQUENT FORMATIVE ASSESSMENTS WITH SPECIFIC ADVICE ON WHAT TO IMPROVE

**Meta-analysis of 250 studies shows that frequent feedback improves learning by an effect size of 0.4 to 0.7. Consistent use of short (daily) and medium (every 1-3 weeks) cycle formative assessments can double the rate of learning. Stiggins and Marzano recommend having students chart their own progress and Marzano provides a rubric template designed to encourage student success.**

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- “Challenging goals and effective feedback” is number two on Marzano’s list of effective school practices in *What Works in Schools*. Goal setting has an effect size of about 0.5 – about half of a grade point. As frequency increases (from every three weeks to daily) the effective size gets closer to 1.0. In his book, *The Art and Science of Teaching*, Marzano reports on the importance of frequent feedback, meaningful feedback, and student involvement. Marzano advocates a standardized rubric which clarifies goals and charts student progress:

1.0	Student knows basics ... with help	3.0	Student understands and use information
2.0	Student knows basics without help	4.0	Student applies learning in new situations

Rubrics in this format allow students to see the target, set their own goal and work toward it.

- *“INCREASE student feedback, providing daily or weekly feedback. The typical 9-week report card is too late – an educational autopsy. If students are to use feedback to improve performance, then the feedback must be immediate.”* 90-90-90 schools – poor schools that outperform – *“provide frequent assessment of student progress with multiple opportunities for improvement. The schools with significant improvements provided significantly more frequent feedback to students than is typically the case with a report card.”* - Douglas Reeves

“Over the course of a year, the rate of learning in classrooms where teachers were using short cycle [daily] and medium cycle [1 to 3 weeks] formative assessment was approximately double that found in other classrooms. Furthermore, teachers reported greater engagement by students in learning and increased professional satisfaction.” - Wiliam, etal, 2004

- “Effective use of formative assessment has shown a direct correlation to student learning and includes the following characteristics:
  - The learning targets are shared clearly with students from the beginning of the learning.
  - Classroom assessments accurately measure achievement of the important learning targets.
  - Students are given continuous, descriptive feedback that includes evidence about what they currently do understand and what they still need to work on.
  - Students are involved in the assessment, record keeping, and communication of learning.
  - Students understand how to close the gap between the goal and where they currently ‘are.’ (Black & Wiliam, 1998b); Stiggins in DuFour et al., 2005)”
    - Improving Adolescent Mathematics: findings from research.
- Formative assessments can include: on the fly assessments such as listening to student explanations, planned interactions that elicit student thinking, and classroom based assessments. Formative assessments: identify learning gaps, involve students, provide feedback on where students are on learning progressions. - Formative Assessment by Margaret Heritage
- *“Schools with the greatest improvements in student achievement consistently used common assessment. Students are required to complete a task and then very soon – within minutes, hours, or days – they receive feedback that is designed to improve their performance. Great educators use assessment data to make real-time decisions and restructure their teaching accordingly. Common assessments also provide a degree of consistency in teacher expectations.”* - Doug Reeves

## #7 – USE DATA TO IDENTIFY AND ACT ON INDIVIDUAL STUDENT NEEDS

**Everett uses data to place students in double dip classes, reduce F's and provide intervention. They meet regularly with high school administrators to see how students are progressing. Montgomery County identifies individual students (20%) that need help in taking tougher math classes.**

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- CPRE's report on schools that doubled performance says those schools, *"Analyzed student data to become deeply knowledgeable about at the status of student performance and the nature of the achievement gap. This step included analysis of state test score results, as well as "formative" assessments that gave more detailed information. The formative assessments allowed teachers to tailor their instruction to the precise learning needs of their own students."*
- Everett looks at the data to identify students early. They have created a "graduation target trajectory" that helps them identify the near miss students ... the ones closest to the life boat. Everett encourages students to take the WASL one year early in 9<sup>th</sup> grade so they see the importance of the test and get feedback. Everett reports their data on a "green, yellow, red" report. Green students have passed all of their courses. Yellow students have failed two or less but can still graduate on time by completing all remaining courses. Red students are credit deficient and cannot graduate on time without special effort. High school administrators meet regularly to review on time graduation data. Superintendent meets with them quarterly. Their grade distributions summary showed that 40% of students who got F's failed in only one course. By reporting that information back to teachers the teacher realizes this student is not a bad student, they are passing all of their other courses and sees the student as one who can do the work. By depressing the number of students failing one class they are also seeing a reduction in the number of students getting two Fs. They target drug and alcohol support toward the students with multiple Fs.
- Create structured routines to talk about student work. Unless you see the faces of your students in the data, your classroom instruction won't change. Bring a notebook of work by one specific student. Talk about it with your colleagues. Get ideas on what you can do to help that one specific student.  
Treisman urges teachers to focus on one kid that you helped this week ... and learn from that how to help others. Some kids are 15 minutes behind, some 2-3 weeks and some 2-3 years. The idea is to not let them lag behind but to intensify the work to catch them up. – Uri Treisman

## #8 – MAKE TIME FOR TEACHER TEAMS TO WORK TOGETHER ON SOLVING PROBLEMS OF PRACTICE

Create a collaborative culture in which teacher teams learn, plan and work together to analyze student achievement on common assessments, develop strategies to improve student learning. Ask them to score student work together, develop common lessons, watch each other teach, and talk about what they see.

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- Doug Reeves says that action research projects have the greatest sustainability. He advocates having teachers work in teams on ‘high impact research questions,’ collect data on their results, and publish that information for their colleagues. Teachers raise their craft knowledge and continue to use what they have learned without further investments.
- Uri Treisman reports that the Silicon Valley Math Initiative has done similar work. This collection of two dozen districts has created ways to capture the results of action research studies and share those results intentionally with incoming teachers. Treisman also suggests that teachers who work on, perfect and teach lessons together – making their practice public make more gains than teachers who participate in more traditional training to increase their math knowledge. Build support around improving the teaching of high quality lessons. Individual teachers cannot develop lessons of this quality. Share high quality lessons broadly allowing teachers to use them and make them even better.
- CPRE’s report on schools that doubled performance says those schools, “*created ‘professional learning communities,’ with teachers working collaboratively on the instructional program and in the formative assessment analyses.*”
- “*Create a collaborative culture in which teachers learn, plan and work together in teams to analyze student achievement on common assessments, develop strategies to improve student achievement, and help each other build on their strengths and address their weaknesses. ‘Our experience verifies that the possibilities are unlimited once a dedicated school staff goes in search of research and best practices to advance their shared vision of learning for all’ (Lesotte in DuFour et al., 2005, p. 189). When teachers do not work together to clarify goals and objectives for student learning, the friction in the staff carried over into the school community and has a negative impact on student learning (Bagin & Gallagher, 2001).*” Effective use of professional development time [includes the following]:
  - Examine student data – keeps the focus on student learning.
  - Examine student work – deepens content knowledge and assessment.
  - Examine current instructional practices – look carefully at the mathematics students are doing, the kind of thinking students engage in.”
  - Improving Adolescent Mathematics: findings from research, NW Labs
- Regularly schedule opportunities for teachers to work together, to examine student work together, to observe each others’ classrooms, and align curriculum. – Teaching Math in Washington’s High Schools

## #9 – ASSIGN TEACHERS INTENTIONALLY TO MEET STUDENT NEEDS

**Assign and support teachers based on student needs and teacher abilities. Everett asks all teachers to share in teaching all levels of math classes. Avoid assigning remedial courses to new teachers. Build a safety net for mentoring new teachers. And some, including the U.S. Math Panel, advocate for elementary math specialists.**

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- *“High-Impact schools use more criteria than teacher preference to make teaching assignments. Teacher assignments are made to meet the needs of the students, rather than the desires of the teachers. In average-impact schools, teaching assignments are more likely to be determined by staff seniority and teacher preference.”* – Gaining Traction, Gaining Ground. Ed Trust
- Jerry Johnson, Professor at Western Washington, recommends as a top priority, the assignment of elementary math teaching to math specialists. The U.S. National Math Panel suggests that, *“The use of teachers who have specialized in elementary mathematics teaching could be an alternative to increasing all elementary teachers’ mathematics content knowledge by focusing the need for expertise on fewer teachers.”*
- *“Encourage teachers to rotate teaching assignments. Course rotation promotes communication among staff, alignment of course, and a stronger sense of collective responsibility for the success of all students (Stodolsky & Grossman, 2000). It also eliminates the practice of burdening new teachers with the most difficult classes, compounded by a lack of experienced teachers with whom to collaborate.”* – Improving Adolescent Mathematics: findings from research
- *“Provide new teachers of mathematics with mentor teachers who understand mathematics and who demonstrate the use of instructional practices supported by research. It is difficult for new teachers to implement good teaching practices in their classrooms unless they have opportunities to observe good mathematics teaching modeled by teachers they respect. ...provide time for both mentor teachers and new teachers to observe each others’ classrooms and collaborate around improving instruction and learning.”* - Improving Adolescent Mathematics: findings from research
- Mentor new teachers with more experienced teachers. Assign experienced teachers to classes with struggling students. – Teaching Math in Washington’s High Schools
- Provide safety nets for new teacher classrooms. New teachers teach only 2/3 of the content for their first three years – while they are learning to deal with classroom discipline. Provide induction for new teachers – structured apprentice programs that include new teachers in grade level / department meetings. Look at student work together and focus on how to help individual students have success. Goal is for each teacher to say ... even on a terrible day ... I did something to make life better for one student. – Uri Treisman
- *“High school math teachers are good at math, and they learned how to teach mathematics from people who had similar aptitudes. They do a very good job of teaching math to students who ‘get it.’ Many high school teachers are not highly skilled at teaching students who have not mastered 7<sup>th</sup> and 8<sup>th</sup> grade mathematics. Curriculum provided for remediation is usually dull and full of tedious drill in basic skills that students refuse to learn. Some schools give these classes to rookie teachers – they have lots of discipline problems. The long-term solution is to find teachers who are good at teaching in other modalities, and provide all teachers with a more varied repertoire for teaching mathematics.”* - Jim Slosson, Math Coordinator

## #10 – RAISE STANDARDS ... TO MAKE EVERY STUDENT COLLEGE READY

***Raise the bar for all students. Eighty percent of future living wage jobs will require at least some college and career jobs will require the same type of college ready skills. When we ratchet up performance nearly all students respond and we set a new norm.***

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- Set high goals says, CPRE in their policy brief for February 2007 in a study of schools/districts that had doubled their student performance. Montgomery County Superintendent, Jerry Weast, recommends aiming for college readiness standards – proficiency on state exams will increase as well.
- *“High-Impact high schools are clearly focused on preparing students for life beyond high school – specifically, college and career. High-Impact schools have consistently higher expectations for all students and barriers to high-level course-taking are removed. In both high and average impact schools, students who arrive behind get extra instructional time in English and math. But high impact schools provide help in a way that keeps students on track with college preparatory requirements. Average impact schools provide the extra help in a way that delays entry into grade-level courses, making it harder for students to complete college-prep requirements.”* - Gaining Traction, Gaining Ground
- *“We need to raise expectations for mathematics achievement for all our students. We need to abandon the notion that only some students can learn mathematics. All students can learn to do challenging math, but some will take longer; some will need different instruction.”* – Jim Slosson, Math Coordinator
- *“It is now widely understood that preparing elementary students for the increasingly complex mathematics of this century requires ... an approach that cultivates habits of mind that attend to the deeper, underlying structure of mathematics ... beginning in the elementary grades. When early algebra is treated as an organizing principle of elementary grades mathematics, the potential payoffs are tremendous.”* - Algebra: Gateway to a Technological Future
- Montgomery County has two key indicators that they use to keep raising the bar.
  - The number of 5<sup>th</sup> grade students who attain 6<sup>th</sup> grade pre-algebra standards (54%)
  - The number of 8<sup>th</sup> grade students who pass Algebra I (75%).
- Demographics on 8<sup>th</sup> graders taking Algebra I
  - Top Five States 56%
  - Nation 41%
  - Washington 33%Source: BERC Group, 2005
- WASA-IPAC’s survey of school districts in Washington showed the following WASL passing rates by course enrollment by 10<sup>th</sup> grade students:
  - Pre-algebra 5% of students enrolled in pre-algebra passed the WASL
  - Algebra I 25% of students enrolled in Algebra I passed the WASL
  - Geometry 60% of students enrolled in Geometry passed the WASL
  - Algebra II 90% of students enrolled in Algebra II passed the WASL

## #11 – GROW GREAT TEACHERS WHO GROW GREAT STUDENTS

***This is humbling work. None of us has the answer for reaching all students. The above steps will help move us in the right direction. Ultimate success depends on a having a skillful teacher, who knows math and is able to use multiple methods to built mathematical thinking skills for each student.***

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- “*Improving mathematics teaching is key to improving student performance.*” Teachers in Washington schools that outperformed on the WASL:
  - used more strategies
  - participate in strong professional communities
  - share ideas on reaching struggling students
  - work together on content skills
  - observe each other teach
  - emphasized problem solving and critical thinking
  - taught a mix of ability groups
  - Teaching Math in Washington’s High Schools
  
- “*The classroom teacher is a more important influence on learning than any other factor. Effective teachers seem to teach differently and have different roles than less effective teachers (Wenglinsky, 2000). Improving student learning, then would seem to depend on helping teachers gain more knowledge and better instructional skills as well as influencing their attitudes and beliefs about teaching and student learning.*” - Improving Adolescent Mathematics: findings from research
  
- “*Teachers should understand how to provide clear models for solving a problem type using an array of examples, offer opportunities for extensive practice, encourage students to ‘think aloud,’ and give specific feedback.*” - U.S. National Math Panel, March 2008
  
- “*Research shows that it is the instructional coaches who are the critical factor in making professional development work, i.e., leading to change in teachers’ instructional practice that is linked to student learning gains.*” - CPRE Policy Brief on Schools that Doubled Performance, February 2007
  
- Improving Adolescent Mathematics, a report by NW Labs, summarizes research on teaching:
  - Focus on what students know, not just on correct answers or correct use of prescribed processes.
  - Facilitate student learning of important mathematical concepts before the practice or memorization of procedures.
  - Allow time for practice of new skills and procedures.
  - Reduce the amount of teacher talk time.
  - Use structured and flexible collaborative learning groups.
  - Encourage student communication through discourse and writing.
  - Emphasize vocabulary development and a consistently understood definition for mathematical terms and the symbolic language of mathematics
  - Use a variety of materials and methods to help students learn mathematics
  - Integrate technology use into classroom learning
  - Emphasize reasoning and problem solving.
  
- “*Encourage student communication through discourse and writing. ‘Teachers need to do more listening and students need to do more thinking and reasoning’ (NCTM, 1991, p 113). Students need time to talk and write about what they are thinking and how they understand mathematics, to justify their thinking to others, and to reflect on what they are learning.*” – Improving Adolescent Mathematics: findings from research

## #12 – LEAD THE WAY IN SETTING BENCHMARKS AND FIGURING OUT TO REACH THEM

***None of the above are “set it and forget it” solutions. All require leadership, engagement and follow through to determine several times during the year whether the adjustments are being implemented and whether they are making a difference.***

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- Leadership requires learning, leading and teaching along with the other educators in the system. Richard Elmore advocates focusing on “problems of practice.” He does so with a superintendent network that meets regularly and visits in classrooms together. Mike Copland has done similar work with schools through “cycles of inquiry.” He advocates stating the problem as a problem of learning and stated as a question. An example may be: How do we support teachers in ensuring that all 8<sup>th</sup> grade students achieve success in an authentic algebra class? That calls for collaboration in seeking solutions together with the teachers and others. And it calls for frequent feedback and revision – both in setting the original plan, and modifying the plan/implementation during the year.
- 90-90-90 schools – poor schools that outperform – engaged in successful action research and mid course corrections. Accountability plans were not static documents set in concrete ... but dynamic and flexible guides. These faculties and leaders learned from one another.” - The 90-90-90 Schools
- Montgomery County MD, where they have increased performance dramatically, while seeing serving lower SES students, has done by focusing on “trend benders.” They pick specific indicators that matter most: Reading and K and Grade 3; pre-algebra at Grade 5 and algebra at Grade 8; and college readiness for all by 12<sup>th</sup> Grade. They then align data collection systems to those indicators and collect mid course data several times each year. Schools are asked to formulate plans around those targets and report on them monthly. The entire system – 145,000 students – is able to monitor and adjust several times during the year. Staff developers work on providing specific, targeted instruction for moving those indicators ahead. Montgomery County has made major gains and closed the achievement gap for minority students.

## Resources

- Algebra: Gateway to a Technological Future.*** (2006). A report funded by the National Science Foundation. Work was done by the Mathematical Association of America in November 2006
- Black, Paul and Wiliam, Dylan. (2001). ***Inside the Black Box: raising standards through classroom assessment.*** BERA Short Draft. Kings College, London School of Education.
- Bransford, John & Donovan, Suzanne. (2004). ***How Students Learn: Math in the Classroom.*** National Academies Press
- Gaining Traction, Gaining Ground:*** how some high schools accelerate learning for struggling students. Ed Trust.
- Heritage, Margaret. (2007). *Formative Assessment: what do teachers need to know and do?* Phi Delta Kappan, October 2007, p 140-142.
- Hiebert, James, et al. (2000). *Introducing the Critical Features of Classrooms.* Chapter in ***Making Sense: teaching and learning mathematics with understanding,*** 2000. James Hiebert, etal.
- Improving Adolescent Mathematics: findings from research.*** Northwest Regional Educational Laboratory
- Marzano, Robert. (2003). ***What Works in Schools: translating research into action.*** Association for Supervision and Curriculum Development.
- Marzano, Robert. (2007). ***The Art and Science of Teaching: a comprehensive framework for effective instruction.*** Association for Supervision and Curriculum Development.
- Odden, Allan. (2007). *Redesigning School Finance Systems: lessons from CPRE Research.* Consortium for Policy Research in Education, Policy Brief, February 2007.
- Reeves, Douglas. (2000). ***High Performance in High Poverty Schools: 90/90/90 and beyond.*** Center for Performance Assessment.
- Reeves, Douglas. ***Top Ten Things High Schools Can Do to Improve Achievement NOW,*** Center for Performance Assessment.
- Teaching Math in Washington's High Schools:*** insights from a survey of teachers in high performing or improving schools: a report prepared for OSPI by the University of Washington, College of Education, (2007). Center for Strengthening the Teaching Profession. Ana Elfers, Margaret Plecki, Michael Knapp, Gahram J. Yeo, Michelle McGowan. June 2007.
- Final Report of the National Mathematics Advisory Panel,*** U.S. Department of Education: Washington, DC, 2008.
- Wiliam, Dylan, and Marnie Thompson. *Integrating Assessment with Instruction: What Will It Take to Make It Work?* In ***The Future of Assessment: Shaping Teaching and Learning,*** edited by Carol A. Dwyer. 2007. Mahwah, N.J.: Lawrence Erlbaum Associates, 2007.

## Best Web Sites

***The Math Forum @ Drexel University*** includes sections on Ask Dr. Math, Problems of the Week, Math Tools, and Teacher@Teacher. <http://mathforum.org/>

***The Charles A. Dana Center*** at the University of Texas at Austin aims to provide education leaders “new knowledge about teaching and learning.” <http://www.utdanacenter.org/>

***The Northwest Regional Education Laboratory*** provides access to resources, reports and direct services in support of standards-aligned mathematics instruction and assessment. [http://search01.nwrel.org/search?pagenum=1&q=mathematics&site=nwrel&output=xml\\_no\\_dtd&client=nwrel&proxystylesheet=nwrel](http://search01.nwrel.org/search?pagenum=1&q=mathematics&site=nwrel&output=xml_no_dtd&client=nwrel&proxystylesheet=nwrel)

***Academic Youth Development.*** A program to help students transition to rigorous high school work. <http://www.utdanacenter.org/pwoa/downloads/ayd.pdf>

***Step Up to High School.*** A Chicago initiative to jump start student success in more rigorous high school work. [www.utdanacenter.org/uml/Downloads/lakeway06/stepup.pdf](http://www.utdanacenter.org/uml/Downloads/lakeway06/stepup.pdf)

***AVID*** ... has 25 years of evidence behind it. AVID prepares students who are academically average minority students for success in advanced classes. <http://www.avidonline.org/>

***Center for Elementary Mathematics and Science Education at the University of Chicago.*** CEMSE’s work comprises three components: (1) Tool Development, (2) Direct Services, and (3) Research and Evaluation. <http://cemse.uchicago.edu/>

***National Council for Teaching of Mathematics.*** NCTM offers research-based findings (clips) and responses to questions of practice (briefs). <http://www.nctm.org/clipsandbriefs.aspx>