

# Achieving Success for all Students in Mathematics

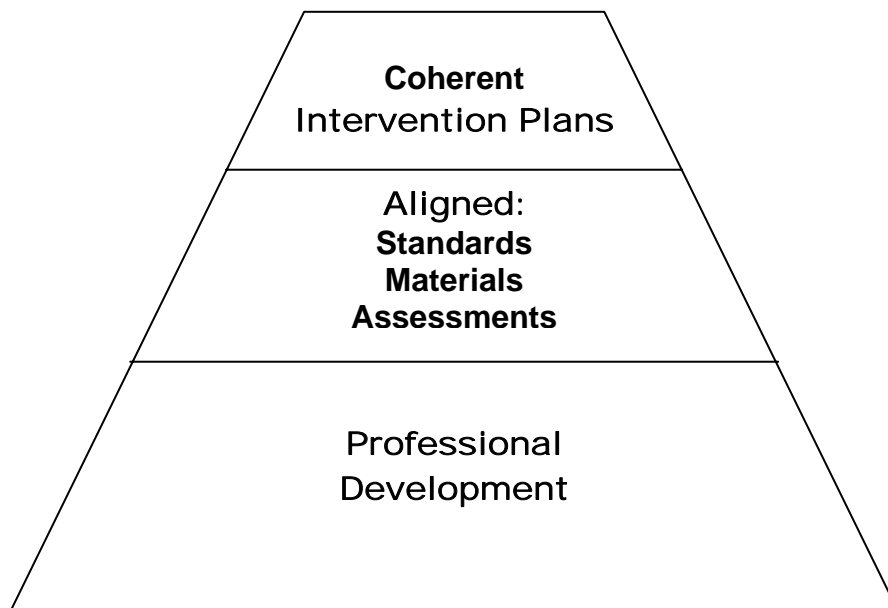
Prepared by Snohomish County Superintendents

## Three Recommendations for Action

High skills and high wages are important to the future of every Washington student. Our state depends, to a higher degree than nearly any other state, on well educated math and science employees. Today, just over half of our high school students in the class of 2008 are on track to pass the math WASL – a requirement for high school graduation. We believe that an overhaul of K-12 mathematics education is essential. Short term fixes (addressed in Appendix A) should not distract us from this long-term need to improve mathematics education.

Creating mathematics success for every Washington student depends on three essential elements: professional development; alignment of standards, materials, and assessments; and coherent intervention plans.

# Three Keys To Mathematics Success



Each of these three elements is critical to improving student achievement in mathematics. If one is omitted, we will continue to see the same unsatisfactory results. Underlying this effort must be a state-wide call to action accompanied by a significant and ongoing investment to deliver a more effective mathematics education.

1. ***Professional Development*** requires a major investment in high quality, ongoing, job-embedded, professional development with the goal of developing students, teachers and instructional leaders who think conceptually and mathematically.

Professional development would provide opportunities for educators to:

- Score WASL-like assessments and learn first-hand what students can and can't do.
  - Learn which GLEs (grade-level expectations) are absolutely essential for their grade.
  - Experience what it is like to learn and teach mathematical concepts that reach every student.
  - See and discuss multiple teaching demonstrations with students like theirs.
  - Work with peer math coaches; colleagues who have had success with teaching mathematics in the classroom.
2. ***Standards, Materials and Assessments*** must be aligned in order to foster real and lasting change in students' mathematics achievement. These elements, that form the core of a mathematics education, must be aligned, communicated, understood and consistently implemented by educational practitioners.

***To align State math standards*** requires an independent review of mathematical expectations that shows consistencies and gaps K-16.

- Align the state math standards with the NCTM (National Council of Teachers of Mathematics) curriculum focal points.
- Streamline curriculum allowing teachers to go into greater depth in each grade level as do other countries that have greater success in mathematics achievement (for example, Japanese lesson study).
- Conduct work state-wide and show how standards are aligned or misaligned.
- Indicate how each standard is reflected in each of the major assessment tools.

***To align teaching materials to standards*** requires adoption of a narrow list of approved texts and/or materials, together with a state bid process, and quality professional development. Information is needed on:

- How well the materials correlate with the GLEs (Grade Level Expectations).
- How user-friendly the materials are.
- The amount and type of professional development required.
- Examples of school districts that have used the materials in an exemplary fashion to achieve exemplary results.

*To align diagnostic assessments* requires WASL math assessments to be well calibrated to the state standards and allow students to meet standards on separate portions of the math WASL as they demonstrate proficiency. Diagnostic tools must be linked to the test specifications to provide real-time and consistent feedback for teachers.

3. *Funding for Interventions* must include both students and teachers. The PAS (Promoting Academic Success) funding for students who don't reach proficiency on the 10<sup>th</sup> grade WASL should be expanded to include students who don't reach proficiency on the WASL at 4<sup>th</sup> and 7<sup>th</sup> grades. Funding is also needed to develop and implement district and school math plans centered on research-based recommendations such as math coaching and professional development, adoption of recommended materials, math curriculum calendars, and regular use of diagnostic math assessments.

### Multiplying our Efforts

For too long, educators and legislators have looked at professional development; alignment of standards, materials, and assessment; and intervention as individual components. The math formulas below illustrate the power of simultaneously addressing these interrelated elements. By looking at each area as a variable in an equation we multiply our gains (Line A below). Results from a reduced commitment in any area (Line B) will likely be less significant. Leaving any one element out (Line C) could leave us with little or no gain.

Line	Consistent Rigorous Standards		Quality Professional Development		Aligned Teaching Materials		Diagnostic Assessments		Intervention Plans		Improved Student Learning
A	2	X	2	X	2	X	2	X	2	X	= 32
B	1	X	1	X	2	X	2	X	2	X	= 8
C	0	X	2	X	0	X	2	X	2	X	= 0

Each entity – state, district, school – must commit to doing their part to consistently and rigorously align all five of these key elements to create success for every student.

## Background

Just over half of today's high school juniors in Washington State received a proficient score on their 10<sup>th</sup>-grade WASL. The other forty-nine percent now have about 20 months in which to become proficient in mathematics in order to receive their high school diploma. Although Washington's success in literacy bodes well for solving similar problems in mathematics, there are several reasons why mathematics proficiency represents greater challenges:

1. The public is embarrassed to be illiterate, but finds it socially acceptable to say "I don't do math."
2. Many elementary math teachers admit that they do not have a solid grounding in mathematics.
3. Many secondary teachers, who excelled in math, find the teaching methods that worked for them don't work for 50 percent of their students.
4. Standards differ between the K-12 and university levels, national and state levels, and between different testing instruments such as the WASL and college placement tests.
5. Students frequently change districts, schools, and teachers during the 11 years between kindergarten and the 10<sup>th</sup>-grade WASL, making the vertical integration of the mathematics curriculum crucial within schools, districts and across the state.

This list of challenges, while not exhaustive, illustrates the complexity of this work. The problem's scope is much larger than any individual math class, course, school or district. The approaches outlined in this briefing paper are investments in our schools, our students and our future. Only vigorous, concerted action over time will help resolve this issue.

## Analysis

*"Evidence makes plain that the teaching and learning of mathematics ... needs improvement. We are not likely to succeed ... without taking into account ... the disappointing outcomes of past efforts. Research and experience consistently reveal ... little improvement is possible without direct attention to the practice of teaching. Improvement of students' learning depends on skillful teaching. Skillful teaching depends on capable teachers ... what they know and can do."*

- Deborah Loewenberg Ball

## A Public Partnership

Broaden public understanding of the importance of mathematics education.

*"There is always a well known solution to every human problem - neat, plausible and wrong."*

- HL Mencken.

Math and science graduates are the lifeblood of Washington's most important industries, yet we rank 38<sup>th</sup> in the number of Bachelor's degrees earned in these areas each year. People from around the world with math and science degrees are taking high-paying jobs in our state that could and should be available to well-trained, well-prepared Washington graduates. Yet in our rush to judgment over test scores, schools are being caught in the crossfire between math facts and math concepts ... between kill and drill and fuzzy math.

There is a growing consensus amongst math researchers that students need to understand math concepts AND have computational fluency to solve real-world problems (*Reaching for Common Ground in K-12 Mathematics Education*). The WASL requires students to read, think, problem-solve, manipulate mathematical concepts and explain their work in writing and illustrations. Poor WASL scores encourage:

- some parents to demand math facts to the exclusion of math concepts and mathematical thinking; and
- some educators to overemphasize concepts at the expense of fluency with mathematical operations.

The National Council of Teachers of Mathematics (NCTM) recently released a new set of *Curriculum Focal Points* which set clearer and narrower standards at each specific grade level. These standards emphasize both computational fluency (facts) and comprehension (concepts and application).

Integrating these skills is not something that we have traditionally required of our students. Learning basic formulas, while necessary, is insufficient to demonstrate successful mathematical thinking. Furthermore, mathematical concepts are sequential and spiraling - meaning that students who fall behind are unlikely to catch up later.

We must develop a ***Public Partnership*** to inform legislators, parents, the general public, educators and media about the importance of both computation and comprehension in the K-12 mathematics curriculum. One strategy is to create a public campaign (similar to the National Institute of Health's campaigns to stop smoking or lower cholesterol) that broadens public understanding and support for students learning to think rigorously about mathematical concepts. Key messages would include the importance of:

- every student learning to think mathematically;
- students learning BOTH concepts and computational fluency; and
- why mathematics enables our students and state to compete internationally.

## **Professional Development**

Develop teaching skills that result in mathematics success for all students.

Teachers do not always feel confident in their preparation or ability to teach mathematics. Elementary teachers may or may not have been taught to think about mathematics conceptually. Many secondary math teachers are asked to teach outside their area of expertise. And even those who teach upper-level courses may be more apt to teach formulas than they are to teach students how to think mathematically and solve problems. Most of us teach math the way we learned it – with methods that now leave half of our students behind (Forty-nine percent of secondary students in the class of 2008 had a proficient score on the math WASL).

Teachers are doing the best that they know how. However, examples of great teaching that reaches every student are rare. This compounds the professional development challenge. Teachers need new skills for understanding math and for communicating mathematical understanding to students who have experienced little success in math.

*Professional Development* requires a major investment in high quality, ongoing, job-embedded, professional development with the goal of developing teachers and students who think conceptually and mathematically. Professional development would provide opportunities for educators to:

- Score WASL-like assessments and learn first-hand what students can and can't do.
- Learn which GLEs (grade-level expectations) are absolutely essential for their grade.
- Experience what it is like to learn and teach mathematical concepts that reach every student.
- See and discuss multiple teaching demonstrations with students like theirs.
- Work with peer math coaches; colleagues who have had success with teaching mathematics in the classroom.

## **Align Standards, Materials and Assessments**

The fundamental building blocks of a mathematics education must work together towards a common goal.

### **Standards**

Better alignment of standards is needed to give schools the confidence and time to align text and teaching to the tests.

Schools are currently being held accountable for multiple and conflicting standards, such as:

- TIMSS standards (Trends in International Mathematics and Science Study).
- National standards – written by the National Council of Teachers of Mathematics.

- Washington standards – as reflected in the Essential Learning Requirements, Grade Level Expectations, and test specifications.
- WASL for 10<sup>th</sup>-grade math does not fully align with Washington’s math standards.
- High school graduation requirements – currently require two math credits.
- College Admission Tests – generally the SAT or ACT.
- College Placement Tests –often require students to take remedial courses.

Lack of alignment across district, state and national levels paralyzes and prevents districts from making needed investments of time, materials and training.

The Transition Mathematics Project has begun aligning Washington mathematics standards K-16; however, this work is not yet completed. Until the standards are aligned districts are caught between competing interest groups and mixed messages.

*To align State math standards* requires an independent review of mathematical expectations that shows consistencies and gaps K-16.

- Align the state math standards with the NCTM focal points.
- Streamline curriculum allowing teachers to go into greater depth in each grade level as do other countries that have greater success in mathematics.
- Conduct work statewide that shows how standards are aligned or misaligned.
- Indicate how each standard is reflected in each of the major assessment tools.

### **Teaching Materials**

Teachers need materials that support student computation and application and are aligned with state standards and assessments.

Teachers do the best that they can with the time and tools at their disposal. With appropriate training, teachers can work with almost any carefully chosen curriculum that helps students learn both computational and application skills. And conversely, even the best materials in the hands of improperly trained teachers will do little to improve math skills.

Selection of materials is a labor intensive and time consuming process. OSPI has begun this work. Identifying a narrow range of quality materials that can be purchased by a state bid could help districts make good decisions more quickly and make it easier to provide related professional development. Greater detail about use and success of the materials would also help. Districts should not start from scratch in matching materials to state standards. The goal is to get quality materials into the hands of well trained teachers who know how to help students learn both computation and application.

*To align teaching materials to standards* requires adoption of a narrow list of approved texts and/or materials<sup>1</sup>, together with a state bid process, and quality professional development. Information is needed on:

- How well the materials correlate with the GLEs (Grade Level Expectations).
- How user-friendly the materials are.
- The amount and type of professional development required.
- Examples of school districts that have used the materials in an exemplary fashion to achieve exemplary results.

<sup>1</sup> *Picking one text statewide would likely create conflict and resistance. Any attempt to select a single curriculum state-wide would likely be heavily influenced by those who did better under the old system of learning and may lead to a selection which quite possibly works well for one group of students while leaving behind those with the greatest needs.*

## **Assessments**

Provide assessments that let teachers know daily what progress students are making.

Aligning the WASL with state standards is essential. Teachers and schools are investing incredible time, effort and energy to address the state's learning standards. When teachers do not see student gains, they lose faith in the assessment and/or in their ability to help students learn. Designing quality assessments, while costly, must be done well in order to maintain the system's integrity.

WASL test results provide limited diagnostics - mainly in the form of strand data that is too general and comes only once each year. Three approaches would help teachers target their efforts:

- Developing classroom-based-assessments together with anchor papers (samples of proficient and non-passing work) that enable teachers to score and compare student responses to see what quality work looks like.
- Providing on-line WASL study guides, sample questions, or the actual test to create a standardized state-wide diagnostic system that would provide ongoing feedback.
- Allowing students to complete the math proficiency in small bite-sized segments to build the confidence of students, parents and teachers as they see progress toward full proficiency.

*To align diagnostic assessments* requires WASL math assessments to be well calibrated to the state standards and allow students to meet standards on separate portions of the math WASL as they demonstrate proficiency. Diagnostic tools must be linked to the test specifications to provide real-time and consistent feedback for teachers.

## **Intervention Plans**

Provide opportunity (funds for interventions) in return for accountability (plans to implement best practices).

Solving and resolving the crisis in mathematics' education will require a consistent ongoing investment in research, development and training to ensure that students learn mathematics successfully through a 12-year continuum of courses.

To improve student achievement, we need real-life examples of what works best in schools. What can we learn from the schools that have done well? Research shows that schools whose students outperform on the WASL, have strong principal leadership, spend at least 60 minutes per day on mathematics, have worked with teachers to align their curriculum, and meet with teachers weekly to discuss what is working and what needs to be changed (OSPI survey). Edmonds has found that when students have completed Advanced Algebra or Integrated Level Three approximately 85 percent pass the math portion of the WASL; however, most students do not complete this higher level of math until 11<sup>th</sup> grade – one year after the 10<sup>th</sup>-grade WASL. Data also show that students who continue to take math courses (beyond the two credit state graduation requirement) do better on college placement tests.

*Funding for interventions* must include both students and teachers. The PAS (Promoting Academic Success) funding for students who don't reach proficiency on the 10<sup>th</sup> grade WASL should be expanded to include students who don't reach proficiency on the WASL at 4<sup>th</sup> and 7<sup>th</sup> grades. Funding needs to be secured to develop and implement district and school math plans centered on research-based recommendations such as math coaching and professional development, adoption of recommended materials, math curriculum calendars, and regular use of diagnostic math assessments.

*Gathering and implementing best practice recommendations* is important to inform the public and educators regarding what successful mathematics programs look like. Recommendations might include:

- 1) Schedule 60 minutes per day for mathematics instruction.
- 2) Arrange for teachers to meet regularly to review student work together.
- 3) Provide opportunities for all students to take rigorous mathematics courses: pre-algebra by 8<sup>th</sup> grade; algebra/integrated math in 9<sup>th</sup> grade.
- 4) Ensure that all students not on grade level receive immediate intervention.
- 5) Increase graduation requirements to include three credits of "high school" math.
- 6) Schedule time for district and building staff to develop curriculum calendars showing when and where each of the critical standards will be taught.

## **Pipeline**

Create a pipeline that provides support and incentives for students preparing for math and science careers.

To compete in a global economy we need an increasing number of math and science students in the educational pipeline. Mathematics represents rigor and, for many, discomfort. Taking more math courses in high school may lower a student's GPA. Scholarships are often based on student need rather than their career choices. Admissions seats to our universities are limited including in math and science. Math and science teachers earn the same teaching salary even though their skills could command far more in other math or science career fields.

*Incentives* could be offered at the college level that would:

- Better prepare all teachers – elementary and secondary – to teach mathematics.
- Increase the number of seats in higher education math, science and engineering classes.
- Offer tuition scholarships or tuition forgiveness to qualified students interested in pursuing math, science and engineering degrees; including those who are preparing to teach in those areas.

## **Conclusion**

We agree that short-term fixes are needed to support students now required to pass the WASL in order to graduate. However, short-term solutions must be linked to viable long term solutions that will overhaul our mathematics system state-wide.

The focus of this paper is to look at the mid-to-long term – how we can best create a state-wide system that helps all students become proficient in mathematics. In the best scenario, it will take three to five years for adults to create a system where teaching, textbooks and testing are aligned and taught consistently. To improve the mathematical success of students we need ongoing support for standards, materials and assessments; high quality, ongoing professional development; and quality research and committed resources.

In 1958, Congress passed the National Defense Education Act in response to a national crisis spawned by the Soviet launch of Sputnik. Today's response needs to be no less vigorous. Mathematics is important work. Mathematics is essential work for the state of Washington and for the future success of our students.

## **Appendix A – Short-Term Transition Solution**

Stay the course while providing further learning alternatives to students.

Although the focus of this document is mid-to-long term system-wide solutions, we recognize the need for a short-term transition plan that:

- a) Holds a high standard of accountability for students, schools and state; and
- b) Creates fairness and opportunity to learn for students who are not yet successful in our current system.

We recommend that for the next four years students be able to meet standards by:

- a) Passage of the WASL; or
- b) Passage of one of the current WASL alternatives; or
- c) Continued progress toward the state standards as demonstrated by enrolling in and passing a required math course in their senior year.

Without a transition plan, the present requirement will act as a gatekeeper, denying future opportunities to many students through no fault of their own. Therefore we believe that a short term transition plan is needed while we create and fund a math system that works for all students.

## Appendix B – Resources

Listed below are web-based mathematics resources.

Eisenhower Mathematics and Science Regional Consortium and Clearing House:

<http://www.ed.gov/help/site/expsearch/enc.html>

Jerry Johnson, Professor, Western Washington University

WASA Keynote; Fall, 2006

Leadership Information: Teaching and Learning: Mathematics – Vol 5, No. 4, Fall 2006

Published by School Information Research Service (WASA)

<http://www.wasa-oly.org/sirs.htm>

“Math Wars” or “Mathematically Sane”

Provides references to both sides of the computation vs. understanding

Mathematics Education Collaborative: <http://mec-math.org/default.asp>

Helps educators support improved math instruction for all students

National Council of Teachers of Mathematics: <http://www.nctm.org/focalpoints/>

Curriculum Focal Points

OSPI review of mathematics curriculum:

<http://www.k12.wa.us/CurriculumInstruct/K12InstructionalMaterialsReview>.

Reaching for Common Ground in K-12 Mathematics Education

<http://www.maa.org/common-ground/cg-report2005.html>

Ball, Ferrini-Mundy, Kilpatrick, Milgram, Schmid, Schaar

Transition Mathematics Project (TMP): <http://www.transitionmathproject.org/>

Public, private partnership to align Washington math standards K-16

Trends in International Mathematics and Science Study (TIMSS):

<http://nces.ed.gov/timss/>

International effort to benchmark and assess student learning in math and science

Washington Learns is conducting a top to bottom, 18-month review of Washington’s entire education system, its structure and funding:

<http://www.washingtonlearns.wa.gov/>

What Mathematical Knowledge is Needed for Teaching Mathematics?:

<http://www-personal.umich.edu/~dball/Presentations/BallMathSummitFeb03.pdf>

Deborah Loewenberg Ball, University of Michigan

## Appendix A—Math Teaching and Learning Proposal (WASA’s Rewrite)

1. Stay the course while providing further learning alternatives to students.
  
2. While we have proposed mid- to long-term, system-wide strategies in this paper, we also propose a short-term transition plan that:
  - a) Holds a high standard of accountability for students, schools and the state.
  
  - b) Creates fairness and opportunity to learn for students who are not yet successful in our current system.
  
3. We recommend that for the next four years a student can meet the math graduation requirement by:
  - a) Reaching proficiency on the 10<sup>th</sup> grade math WASL.  
  
Or
  
  - b) Achieving a score set by the SBE on the math portion of the PSAT, SAT or ACT.  
  
Or
  
  - c) Meeting the criteria approved by the SBE for grade point average comparison.  
  
Or
  
  - d) Meeting the math collection of evidence criteria when approved by the SBE.  
  
Or
  
  - e) Enrolling in and passing a math course certified by the district to cover state math standards in a student’s junior or senior year.

This transition plan will hold a student accountable but will not deny him/her a high school diploma while the system is reformed as proposed in this paper. **The state must provide the resources necessary to implement all phases of the transition.**