



Support for Race to the Top Grant Applications

As an independently-researched and proven professional development program, **Intel Math** supports U.S. states' comprehensive plans for effective, systemic professional development, addressing the America's Recovery and Reinvestment Act (ARRA) reform priority #2 - *Recruiting, developing, retaining, and rewarding effective teachers and principals.*

Intel Math supports the following Race to the Top selection criteria¹:

A. State Success Factors:

Criteria (A)(1) 30 pts - Building strong statewide capacity to implement, scale up and sustain proposed plans

Intel Math has been implemented in four states - AZ, CA, MA and NJ, with MA implementing a statewide model; collaborative opportunities exist with those states and others. Intel Math's National Training Agency, the Institute for Mathematics and Education at the University of Arizona, is well positioned to support states with implementation.

B. Standards and Assessments:

Criteria (B)(3) 20 pts - Supporting the transition to enhanced standards and high-quality assessments

Intel Math's focus on number and operations, rational numbers, linear equations, and functions address internationally benchmarked proposed common core K-12 math standards. Teacher understanding of rigorous math enhances student learning.

C. Data Systems and Support Instruction:

Criteria (C)(3) 18 pts - Using data to improve instruction

Through pre and post assessments, nightly homework, and analyzing student work, Intel Math teachers receive the feedback data they need to improve their instruction.

D. Great Teachers and Leaders:

Criteria (D)(5) 20pts - Providing effective support to teachers and principals

Once teachers get more grounded in the mathematics, they spend time analyzing the same mathematics in student work. Intel Math offers an aligned Mathematics Learning Community curriculum for teachers to sustain collaboration to improve their overall effectiveness of instruction.

E. Turning Around Struggling Schools:

Criteria - (E)(2)ii 35 pts - Turning around the lowest achieving schools

The most recent NAEP math scores highlight an achievement disparity between Hispanics and African Americans and the other sub-groups. Intel Math offers a solution to address this disparity by helping teachers better understand mathematics, differentiated instruction in mathematics, and student understanding of mathematics.

¹ located on the U.S. DOE website at: www.ed.gov/programs/racetothetop/index.html

Intel Math Research and Evaluation

According to the 2008 National Math Panel Report,
"Research on the relationship between teachers' mathematical knowledge and students' achievement confirms the importance of teachers' content knowledge."

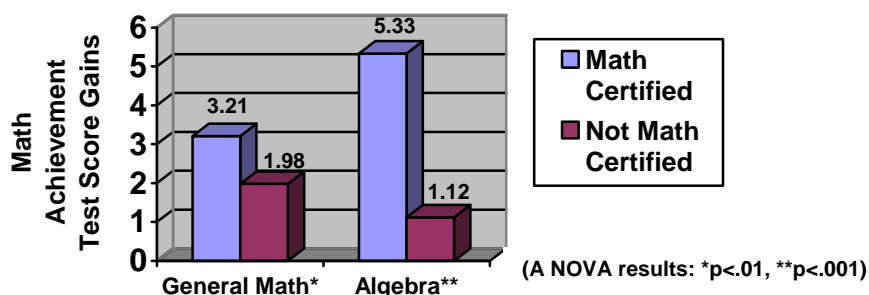
Page xxi of the final report found at <http://www.ed.gov/about/bdscomm/list/mathpanel/reports.html>

Research Based

Teaching mathematics effectively requires specialized training: deep conceptual understanding of math, broad understanding of how students make sense of math and knowledge of how to merge that content and student understanding into effective instruction. While Intel Math focuses primarily on teachers developing a deep understanding of mathematics, it also emphasizes transference to the classroom by the modeling of exemplary instructional practices. Classroom transference is also a focal point examining student work - identifying the mathematical big ideas and next steps. Finally, the course has a sustainable component - a mathematics learning community curriculum that reflects the content of the Intel Math course but through the lens of examining student work. Within this professional learning community, teachers are afforded time to use their knowledge of how students make sense of mathematics into more effective instruction.

Demonstrating research-quality effectiveness of the Intel Math program requires multiple assessment tools, similar to effective student assessment strategies. First, Intel Math was developed directly from Dr. Ken Gross' Vermont Mathematics Initiative (VMI), a three year master's degree program for teachers. A longitudinal six year study found that students, in schools with concentrated numbers of VMI teachers, achieved at three times the rate of their control group peers.² Many of these teachers had three years of math content courses but some only had eighty hours of intervention.

Effects on Student Achievement of Teacher Certification in Mathematics



Another way to explore effects on student learning is to examine teacher certification impacts. A research study by Hawk, Coble and Swanson found that students of teachers who are certified in mathematics, or who have completed many math content courses, perform significantly better than students of teachers who are not certified in math.³

² Vermont Math Initiative Program Evaluation, Harris and Meyers, May 2005

³ Certification: It does matter; P. Hawk, C. Coble, M. Swanson; Journal of Teacher Education, 36 (3), May-June 1985; pp. 13-15.

Intel Math Research and Evaluation

Course Results

The Intel Math program itself utilizes multiple assessment tools to gauge program impact. First, teachers complete a pre and post inventory of mathematical content knowledge. Compiled by WestEd, the results from 2008 yielded significant improvement: “on average, teachers’ scores rose 16 percentage points from pre- to post-test.”⁴ Within that improvement, teachers made the greatest gains on conceptual items vs. computational items.

Intel Math Course Survey Table of Mean Scores on Conceptual & Computational Items⁵

Nature	Pre-test Mean	Post-test Mean	Percentage Gain
Conceptual	41.0%	62.5%	21.5%
Computational	67.5%	81.0%	13.5%

Intel Math teachers also complete a pre and post assessment called the *Learning Mathematics for Teaching (LMT) survey for Number Concepts and Operations*⁶ developed at the University of Michigan. The LMT assessment of teachers’ mathematics content knowledge and knowledge for teaching provides a good benchmark for teachers’ ability to apply the course content in the context of their work with students. The below item illustrates testing of mathematical knowledge that is specialized to teaching math:

In 2008, Intel Math teacher graduates showed **statistically significant gains** on this LMT assessment at the $p < 0.005$ level. The effect size (mean gain) of .63 standard deviations is medium to large and is “commendable given that it is extremely rare to find a large effect size unless the group is very large and/or the participants’ initial scores are quite low.”⁷

Evaluation Quotes⁸

- “I provided students with a variety of ways to utilize fractions and I really understand the theme of part to whole.”
- “I found it extremely difficult, having been out of college for 30 years. However, it helped me see that I can think and learn in ways that are different from others.”
- “(IM) really made me question what I know, and if I really understand what I have been teaching all these years.”
- “I am now more deliberate in connecting new math concepts to my student’s prior knowledge and in emphasizing the inter-relatedness of different math strands.”
- “I have become more confident in my own learning... I recognize now what relevance the lessons I (teach) have for the kids in their future mathematical thinking.”

“We know that the quality of math and science teachers is the most influential single factor in determining whether a student will succeed or fail in these subjects.”

President Barack Obama (National Academy of Sciences speech, April 27, 2009, www.nationalacademies.org)

⁴ *Year Two Evaluation of Intel Mathematics—Professional Development Course & Teacher Learning*, Cathy Carroll and Susan Mundry, West Ed, June 30, 2009; page 9.

⁵ *Ibid*, page 12.

⁶ *Knowing Mathematics for Teaching, Who Knows Mathematics Well Enough to Teach Third Grade, and How Can We Decide?*, Deborah Loewenberg Ball, Heather C. Hill, and Hyman Bass, American Educator, Fall 2005, page 43.

⁷ *Ibid*, page 7.

⁸ *Year Two Evaluation of Intel Mathematics* -, Cathy Carroll and Susan Mundry, West Ed, June 30, 2009; pages 24-33.

Intel Math Design and Partnerships

Course Design

In addition to developing this LMT model, Heather Hill and Deborah Ball, have identified professional development factors which contribute to teacher growth in teaching mathematics. Some of these are: a focus on math content; co-facilitation by a math educator and a mathematician; duration of training (80-120 hrs); and ability for teachers to engage in problem solving – analyzing solutions and strategies, exploring representations and connections, and proving and communicating thinking.⁹ These factors are strongly incorporated in the design and implementation of Intel Math.

Underperforming Schools

A focus of Intel Math has been on under performing schools and districts, especially ones with high percentages of Hispanic and African American students. Intel Math graduates from the neediest districts have more measureable gains than their peers at higher performing schools. “Teachers with the least experience are educating the most disadvantaged students in the highest poverty, most challenging schools.¹⁰” US Secretary of Education Arne Duncan has stated schools must have equitable distribution of highly effective teachers for all students, particularly in high-poverty and/or high-minority schools¹¹.

Over National Assessment of Educational Progress (NAEP) testing history, the percentage of White 4th grade students decreased from 75 to 56 percent while the percentage of Hispanic students increased from 6 to 21 percent. We are rapidly becoming a more diverse nation. At the same time, the Hispanic-White achievement gap has remained relatively steady at a 21 point difference and the Black-White gap has steadied around 26 points. The gaps are even greater in 8th grade at 26 points and 32 points, respectively.¹² Implementing Intel Math for the teachers of these students in needy schools could help address this civil rights issue.¹³

Partnerships

Many well respected organizations have joined forces with Intel Math to make this program available to as many US K-8 teachers as possible. Some of our partners include:

- Achieve** – supports interactions with states, especially with current Achieve work
- American Mathematical Society (AMS)** – supports instructor recruitment and program marketing
- Arizona Department of Education** - implements the program within Arizona
- Institute of Mathematics and Education (IM&E)** – University of AZ, National Training Agency, Program Manager
- Intel Corporation and Foundation** – program founder and supporter
- Massachusetts Department of Elementary and Secondary Education** – implements program across MA
- Mathematical Association of America (MAA)** – manages instructor training and supports instructor recruitment
- New Jersey Department of Education** – implemented the program at Montclair State College
- UMASS Medical School** – developer of Mathematics Learning Community component
- Silicon Valley Leadership Group** – business organization funded implementation in Bay Area, CA

More Information

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⁹ *Learning Mathematics for Teaching: Results from California's Mathematics Professional Development Institutes*, Heather C. Hill and Deborah Loewenberg Ball, Journal for Research in Mathematics Education, 2004, Vol. 35, No.5, pgs 330-351.

¹⁰ *In Urban Classrooms, the Least Experienced Teach the Neediest Kids*, MaryEllen McGuire, The US News, June 12, 2009.

¹¹ *Race to the Top Application for Initial Funding*, page 37.

¹² Mathematics 2009, National Assessment of Educational Progress at Grades 4 and 8; US Department of Education; page 10 and 25.

¹³ *Radical Equations: Civil Rights from Mississippi to the Algebra Project*, Robert Moses, Beacon Press, ISBN – 0807031275