



Intel Math is a professional learning program for K-8 teachers in mathematics content. Comprised of eighty hours, the course is co-facilitated by two instructors—a mathematician and a mathematics educator—and focuses on deepening teacher participants’ understanding of the mathematics in the K-8 curriculum. The course is grounded in a problem-solving approach to uncovering mathematics content and leverages multiple solution methods to help teachers explore the richness, depth, and interconnectedness of the mathematics they teach. While the main focus of the course is deepening teachers’ math knowledge, there are also opportunities for teacher participants to apply this knowledge of K-8 mathematics to pedagogy and consider implications for their own teaching practice. The national implementation of Intel Math is managed by the University of Arizona.

BENEFITS FOR TEACHERS AND THEIR STUDENTS

Results from independent evaluation indicate that Intel Math “provides teachers with opportunities to deepen their content understanding and to consider pedagogical issues related to their roles as mathematics teachers” (WestEd 2009 Evaluation Report). In particular, teachers who completed

Deepening teachers’ content knowledge is a priority for districts since research suggests that students are disadvantaged, and actually learn less, when their teachers do not understand the content ... Progress in rectifying this situation stands to be a major contribution of Intel Mathematics.

--WestEd, 2009

the course have demonstrated growth in both their computational skills and their conceptual understanding of mathematics. Teacher participants commented on varied ways of applying knowledge gained from the course to their classrooms, indicated an increased focus on communication and reasoning, and reported multiple benefits to their students. Lasting benefits mentioned by teachers include “mathematics knowledge and strategies, access to resources, increased confidence in mathematics learning, changes

in approach to teaching mathematics, an appreciation for the importance of making connections across mathematics topics, and understanding student thinking and learning styles”.

COURSE CURRICULUM

The course is organized into eight units, each of which is comprised of four to seven sessions. Unit One begins the course with Problem Solving, and Units Two through Four explore integer

arithmetic with the four operations (Addition and Subtraction, Multiplication, and Division, respectively). The course then leverages this strengthened foundation to provide teachers an opportunity to explore the operations with fractions (Unit Five) and rational numbers (Unit Six). The course builds to linear relations in Unit Seven and wraps up with Functions in Unit Eight.

Each Intel Math teacher participant receives the two-volume *Teacher Manual*, in which mathematics content is explored through varied activities and problem sets. Additionally, teacher participants receive an *Answer Manual*, which gives multiple solutions to each problem set, and a *Reference Manual*, which expands on the content and themes of Intel Math by offering supplemental readings.

Teachers who participate in the Intel Math course increase their content knowledge in mathematics. Teachers increased their ability to solve mathematics problems and show growth in all content areas tested.

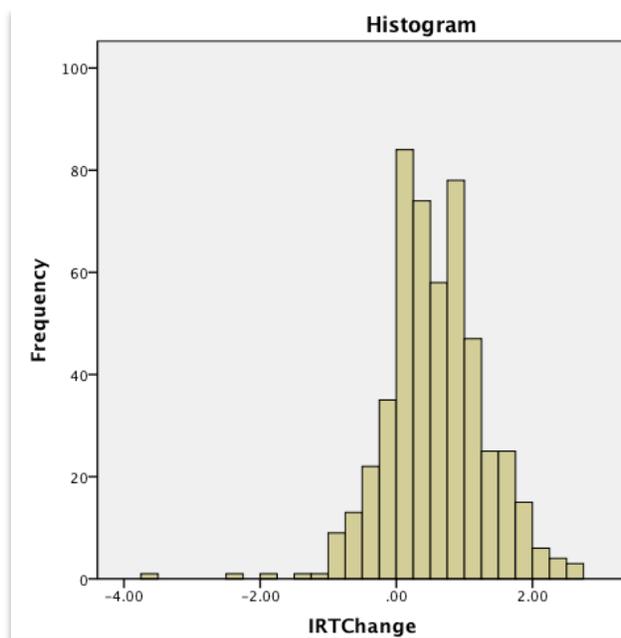
--WestEd, 2015

Instructors receive all the materials that the teacher participants receive, and an additional *Instructor Manual*—a session-by-session companion to the *Teacher Manual*. The *Instructor Manual* also includes a course introduction that details aspects essential for a successful implementation.

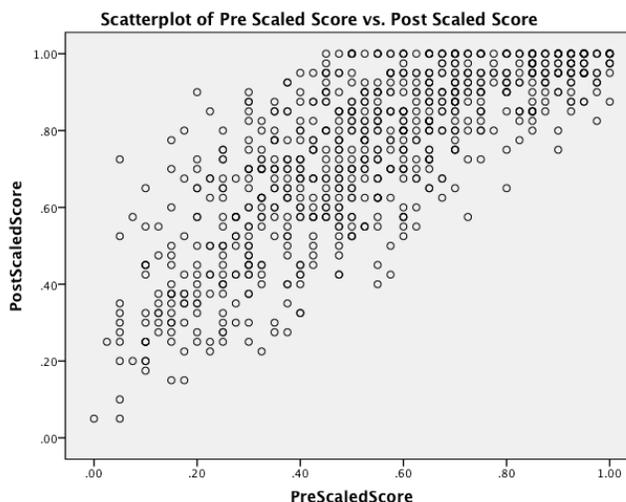
INDEPENDENT EVALUATION

Each year, the University of Arizona partners with WestEd to conduct independent evaluation of the national implementation of Intel Math. Evaluation instruments have included a Teacher Attitude Survey, the Mathematical Knowledge for Teaching instrument (MKT), and an Intel Math Content Survey (IMC), developed by WestEd and reflective of the mathematics content of the Intel Math course. Through the nine years of evaluation, the program has consistently shown significant teacher gains in mathematical knowledge, as shown on both the MKT and IMC instruments. The following are a sample of the typical results from various evaluation reports by WestEd.

In their 2011 Evaluation Report, WestEd stated that with regard to the MKT instrument, “the majority of teachers increased their scaled scores from pre- to post-test, with most teachers gaining between 0 and 1.00 points on their scaled score.” Shown at right is Graph 6 from the 2011 Evaluation Report: “[MKT] Frequency of Pre- to Post-test Changes,” with Mean = 0.56, Std. Dev. = 0.725, and N = 503.



In the 2014 WestEd Evaluation Report, teacher participants' IMC pre- and post-test scores are compared. WestEd reports that "there was a wide distribution of scores on the pre-test and on the post-test, and the majority of teachers showed a gain in scores. Graph 1 also shows that many teachers scored 100% on the post-test." Graph 1, titled "IMC Teacher Pre-test and Post-test Scores," is given at left. This graph is a helpful visualization, demonstrating that the vast majority of teacher participants not only improve their scores from pre- to post-test, but that there is a ceiling effect and that there may be more growth than can be demonstrated on the IMC tool. Table 1, "IMC Summary Table of One Sample T-Test:," from the 2014 Evaluation Report is given below and corresponds to this graph.



Location	Mean Gain	Std. Deviation	T	Significance
Total (N=824)	.1979	.15589	36.447	.000*

An asterisk (*) indicates the finding is significant at the $p < 0.05$ level.

In the 2010 Evaluation Report, WestEd reported the following selected quotes from Teacher Participants, as collected by the Attitude Survey instrument. Quotes are grouped thematically into "Improved Content Knowledge," "Improved Pedagogy," and "Perspectives on the Program."

Improved Content Knowledge

- "I feel more comfortable with my understanding of math and also in how I teach it to kids."
- "It helped me renew my knowledge of mathematics. While I have learned all this at one point, one tends to forget but it is important to keep it all fresh for a better and deeper knowledge."
- "I have always loved doing math, but have not had the opportunity to take a course for a couple years now. The course brought to light a lot of different ways to solve problems. I really enjoyed the course and learned a lot of new techniques."

Improved Pedagogy

- "I am far and away a better math teacher than I could possibly have been otherwise."

- “I can teach students on their level instead of teaching to the middle of the class.”
- “My students have been able to learn mathematics in new ways and they are actually more excited about math.”
- “This has helped my students because I now look at errors very differently. I look for what they did right first and plan from there.”
- “I am able to ask better questions so that they can use prior knowledge to get to the next step without me telling them.”

Perspectives on the Program

- “[Intel Math] helped me to present the math curriculum content with a deeper understanding of the math learning experience/struggle that my students go through.”
- “It helps me see the big picture, as to what do my students need in the future, what do they need to know to succeed ... It also helps me see the bigger math picture. Math skills often are so fragmented on each grade level that it is often difficult to see what each one of them is leading up to and in what way it is a building block for future mathematics. This course helped clear this up.”

For full text versions of any of the evaluation reports excerpted here, please contact Aubrey Neihaus (aneihaus@math.arizona.edu).

IMPLEMENTATION MODEL

Intel Math is comprised of eighty hours of in-person professional learning. The eighty hours can be divided many ways to accommodate local needs, provided that key requirements are maintained. These requirements reflect best practice and ensure that each cohort is implemented with fidelity and has outcomes consistent with those described above. The course must begin with five or more consecutive days. The remaining days may or may not be consecutive, but the beginning of the course is crucial for setting community, norms, and establishing a space where teacher participants feel comfortable taking mathematical risks. The eighty hours should be completed within 12 months, preferably less, with both instructors present for the full eighty hours.

There are many ways to implement Intel Math to accommodate local priorities and needs. The Intel Math Project Manager, Aubrey Neihaus, is a resource to you as you plan implementation, and is happy to offer suggestions based on past implementations.

PROGRAM COST

The cost of the Intel Math Program varies, depending on the number of teachers trained at each site, the localized precedents for incentives and stipends, and the scale to which the program is

implemented. The following is a guideline for the breakdown of the cost of various elements of the Intel Math program in the first year of implementation:

Instructor Training for a team of two instructors to be trained

Registration	4,000
Instructor Travel to Training	3,000
Instructor Stipends	3,000
Printed Materials for Instructors	300

Course Costs

Instructor Stipends	20,000
Printing and Shipment of Intel Math Materials	4,000
Supplies	1,000
National Training Agency Support and Services	4,250

Total **39,550**

This guideline is based on one course of 30 teacher participants, and includes the start-up cost of training new instructors for the site. This estimated \$10,300 budgeted for Instructor Training would not be necessary beyond Year One, lowering year-to-year costs to \$29,250.

Instructor stipends will vary by site and local precedents. Additional costs, such as teacher compensation, travel for instructors during the course, may also need to be factored in, based on implementation.

NEXT STEPS

If you are interested in bringing Intel Math to in your state or school district, we encourage you to:

- **Contact us!** Aubrey Neihaus is the National Project Manager for Intel Math and is happy to help you set up your course so that it reflects the best practices that have proven effective. You can email Aubrey at aneihaus@math.arizona.edu, or call at (520) 403 - 5128. We are eager to offer our help and guidance as you consider your site's implementation and strategy.

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