Math Solutions®

FOUNDED BY MARILYN BURNS

Professional Development Courses
Research Basis

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Overview of the Guiding Principles of Professional Development Provided by Math Solutions

As a thriving organization responsive to a changing world, Math Solutions is dedicated to improving children's learning of mathematics by providing the highest quality professional development services, products and resources to educators.

Research confirms that teachers are the single most important factor in raising student achievement (U.S. Department of Education 2007). Furthermore, when it comes to improving students' math skills and overall achievement, teacher professional development has more of an impact than new textbooks or technology (Johns Hopkins 2008). Professional development that improves student achievement focuses on teachers' knowledge of the subject matter and how students understand and learn it (Holland 2005).

Math Solutions professional development courses and services improve teachers' instruction to impact students' learning and increase achievement. Our relevant, interactive learning experiences for teachers:

- Strengthen mathematics **content knowledge**
- Build understanding of **how students learn** mathematics
- Increase the use of **effective instructional practices** that address how students understand and learn mathematics

Additionally, research shows that in order for professional development to be effective it must provide relevant, sustainable, and continuous learning opportunities for teachers (State Educational Technology Directors Association 2008).

Math Solutions has given us the framework and the tools to change the way we teach math. Our Math Coaches and Teacher Leaders have provided a multi-layered effect that encourages the momentum of change in the pedagogy of math instruction.

—Pat Tilson
Assistant Principal
Tadmore Elementary School, Georgia

The National Staff Development Council found that efforts to improve student achievement can succeed only by building the capacity of teachers to improve their instructional practice and the capacity of school systems to promote teacher learning (Chung Wei, Darling-Hammond, et al. 2009).

Math Solutions partners with schools and districts across the country to build their capacity to achieve sustained results for both educators and students. Our approach includes:

- Collaborative planning with school and district leaders to delineate support needed for classroom implementation
- Expert school-based technical assistance
- Job-embedded professional learning experiences for teachers and administrators to meet their specific goals and needs
- Course formats and content designed to address specific curriculum, student populations, and special needs
- Integrated services and resources that provide on-going support and learning opportunities for teachers, coaches, administrators and district leaders

Alignment of Math Solutions Courses with Research Findings on Aspects of Effective Professional Development

Teacher Content Knowledge

Research Findings

The National Council of Teachers of Mathematics (NCTM) publication *Principles and Standards for School Mathematics* (2000) states, "Students learn mathematics through the experiences that teachers provide. Thus, students' understanding of mathematics, their ability to use it to solve problems, and their confidence in, and disposition toward, mathematics are all shaped by the teaching they encounter in

school. To be effective, teachers must know and understand deeply the mathematics they are teaching and be able to draw on that knowledge with flexibility in their teaching tasks."

The Report of the National Mathematics Advisory Panel (2008) confirms that "teachers' knowledge of mathematics is positively related to student achievement. Teachers must know in detail the mathematical content they are responsible for teaching and its connections to other important mathematics, both prior to and beyond the level they are assigned to teach."

Math Solutions Application

> *You can't teach well what you don't understand.*
>
> —Marilyn Burns
> Founder, Math Solutions

Knowing that teachers' math content knowledge is critical to effective instruction, every Math Solutions professional development course and resource targets content knowledge and the development of teachers' mathematical understanding. Upon gathering extensive information from school and district leaders, Math Solutions designs professional development experiences to address specific content needs and instructional issues related to teaching that content.

A variety of factors influence the identification of content to target—student achievement data indicating poor performance, teachers' assessments of their own content needs, content for upcoming instruction, and content in adopted instructional materials. Math Solutions focuses professional development on specific implementation of content and pedagogy related to district-identified needs. Frequently, the content areas where teachers need support mirror areas that the National Math Panel or NCTM Focal Points identify as essential learning for students. Fluency with whole numbers and fractions are areas of focus for many of our professional development courses, as is helping teachers learn how to support students in developing a robust sense of number.

How Students Learn Mathematics

Research Findings

In its 2005 report "How Students Learn Mathematics in the Classroom," the National Research Council identifies three principles of learning important for teachers to understand and incorporate into their instruction:

- **Engagement** of **prior understandings** and misunderstandings
- The essential roles of foundational **factual knowledge** and **conceptual** frameworks in learning for **understanding**
- The role of understanding and **self-monitoring** of thinking processes

These ideas are also reflected in *Principles and Standards Report for School Mathematics* (National Council of Teachers of Mathematics 2000):

- Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge
- Conceptual understanding plays an important role in the learning of complex subjects such as mathematics
- Effective learners recognize the importance of reflecting on their thinking and learning from their mistakes

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All Math Solutions courses are designed to deepen educators' understanding of how students learn mathematics. Simulations, mathematical investigations and discussions, opportunities for written reflection, and analysis of learning experiences support participants in identifying how they learn and how others around them learn. Classroom application of new skills, strategies, and insights supports teachers' translation of this understanding into their classroom instruction.

- **Engaging Prior Understanding**

  Embedded in Math Solutions courses are opportunities for teachers to experience the power of asking

questions and posing tasks that reveal student knowledge along with conceptual understanding and misconceptions. Opportunities include mathematical investigations for teachers, observation of student lessons, student interviews, and the study of student work.

- **The Role of Factual Knowledge and Conceptual Understanding**

  Math Solutions courses include specially designed sessions that engage teacher preconceptions of mathematical ideas for the purpose of modeling what is meant by teaching and learning for understanding. These sessions frequently create disequilibrium and provide an ideal context for teachers to engage in experiences and conversations that enable them to make sense of mathematics that they once learned by rote. These experiences illuminate the need to learn factual information and concepts with understanding in order to apply them to new situations. With this background, participants are equipped to consider the "why" and "how" of creating learning experiences that go beyond teaching math as simply a body of memorized facts and procedures.

- **The Importance of Reflection and Self-Monitoring**

  At the heart of all Math Solutions sessions is the goal of helping teachers build their students' capacities to think, reason, and communicate mathematically. This is achieved through participants' engagement in problem-solving situations during which they represent and communicate their mathematical ideas in diverse ways. The tasks provide opportunities for participants to reflect on their understanding of concepts through journal writing and to refine their conceptions as they communicate with partners and in groups. This firsthand experience in learning that requires reflection and self-monitoring models instructional practices to use with students in the classroom.

Proven Effective Instructional Strategies

Research Findings

The National Staff Development Council has nine standards for professional development. The Quality Teaching standard states: "Staff development that improves the learning of all students deepens educators' content knowledge, provides them with research-based instructional strategies to assist students in meeting rigorous academic standards, and prepares them to use various types of classroom assessments appropriately" (2001).

In describing this standard, NSDC notes, "Because it is natural that teachers will teach as they themselves are taught, it is imperative that the instructional methods used with educators be congruent to the greatest extent possible with those they are expected to use in their classroom."

NCTM has identified the following aspects of instruction that provide direction in selecting and using instructional approaches and strategies that enhance opportunities for students to learn mathematics with understanding (2000).

- **Classroom Environment**
  Effective teaching conveys a belief that each student can and is expected to understand mathematics and that each will be supported in his or her efforts to accomplish this goal.

- **Classroom Communication**
  Communication is an essential part of mathematics and mathematics education. It is a way of sharing ideas and clarifying understanding. Through communication, ideas become objects of reflection, refinement, discussion, and amendment.

- **Mathematical Tasks**
  Students should have frequent opportunities to formulate, grapple with, and solve complex problems that require a significant amount of effort, and should then be encouraged to reflect on their thinking in order to solidify and extend what they know.

- **Assessment**
  Assessment should support the learning of important mathematics and furnish useful information to both teachers and students; it should focus on students' understanding as well as their procedural skills.

Math Solutions Application

Many teachers have not had the opportunity to learn math in ways that are consistent with what we now know about how people learn. It is imperative, then, that teachers' learning be engaged and facilitated by the same research-based instructional strategies that they are expected to use in their classrooms with students. Experience with the strategies from a learner's perspective, combined with reflection on the impact of the strategies on instruction and student learning, are key to teachers' professional learning opportunities. Described below is the general approach Math Solutions takes to NCTM's instructional guidelines that support learning for understanding. Included are the specific instructional strategies incorporated in Math Solutions courses and resources.

- **Classroom Environment and Communication**
  Instructors model setting expectations for a classroom environment that supports learning, oftentimes inviting participants to develop norms that enhance opportunities for all to learn. All are encouraged and expected to contribute to the learning process.

- **Mathematical Tasks and Communication**
  Immersion in problem-solving tasks sets the stage for participants to consider the characteristics of worthwhile mathematical tasks. They recognize the importance of working on problems that require more than recall of facts and procedures. As they share their thinking, reasoning, and strategies with partners, in small groups, and in whole groups, they experience how every learner in the class is expected to grapple with mathematical ideas and processes and to communicate his/her thinking orally and in writing.

- **Assessment and Communication**
  Participants make connections between their problem-solving experiences and their classroom practice. Instructors guide them to identify critical aspects of their experiences and to consider how they can use the same strategies with their students. Considering the questions that the instructor poses during the tasks leads to discussion of ongoing assessment that informs both the teacher and the student and forms the basis for next steps in instruction. Often, participants look at student work and view student interviews as further means for considering how they can use formative assessment in their instruction.

> *All {of the types of teaching modeled} fit my goals for education—they were active, supportive, collaborative, risk-free, and challenging.*
>
> —Principal
> Westerville, Ohio

- **Specific Instructional Strategies**
  Math Solutions courses provide teachers with opportunities to experience, identify, and analyze effective instructional approaches and strategies that they can then transfer and use in their classroom math instruction. These strategies have long been foundational in Math Solutions courses and resources. While these strategies are effective across all curriculum areas (Marzano Research Laboratory, ongoing), teachers benefit from learning how these strategies apply specifically to math instruction. These instructional strategies include:
    - advance organizers
    - building vocabulary
    - cooperative learning
    - cues and questions
    - feedback
    - generating and testing hypotheses
    - identifying similarities/differences
    - interactive games
    - nonlinguistic representations such as models and manipulatives
    - practice
    - student discussion
    - summarizing

References

- National Council of Teachers of Mathematics. 2000. *Principles and Standards for School Mathematics 2000.*
- National Staff Development Council. 2001. "Quality Teaching." (http://www.nsdc.org/standards/quality.cfm)
- Holland, Holly. 2005. "Teaching Teachers: Professional Development to Improve Student Achievement." American Educational Research Association's *Research Points 3,* no.1, pp. 1–2. (http://aera.net/uploadedFiles/Journals_and_Publications/Research_Points/RPSummer05.pdf)
- National Research Council. 2005. *How Students Learn: Mathematics in the Classroom.* Washington, DC: National Academies Press. (http://books.nap.edu/openbook.php?record_id=11101&page=R2)
- U.S. Department of Education. 2007. *Teacher-to-Teacher Initiative.* (http://www.ed.gov/teachers/how/tools/initiative/index.html)
- Johns Hopkins. 2008. "News Release: Professional Development Key to Improving Math Achievement." December 4, 2008. (http://www.jhu.edu/news/home08/dec08/math_achieve.html)
- National Mathematics Advisory Panel. 2008. *Foundations for Success: The Final Report of the National Mathematics Advisory Panel,* p. 37. Washington, DC: U.S. Department of Education. (http://www.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf)
- State Educational Technology Directors Association. 2008. "Empowering Teachers: A Professional and Collaborative Approach." (http://www.setda.org/c/document_library/get_file?folderId=270&name=DLFE-265.pdf)
- Chung Wei, Ruth, Linda Darling-Hammond, Althea Andree, Nikole Richardson, and Stelios Orphanos. 2009. *Professional Learning in the Learning Profession: A Status Report on Teacher Development in the United States and Abroad,* p. 7. Dallas: National Staff Development Council. (http://www.nsdc.org/news/NSDCstudytechnicalreport2009.pdf)
- Marzano Research Laboratory. Ongoing. Meta-Analysis Research. (http://www.marzanoresearch.com/research/researched_strategies.aspx)