The Mathematical Thinking for Instruction (MTI) course offers participants an opportunity to extend their content knowledge of mathematics, deepen their understanding of student thinking, and develop a research-based instructional approach for teaching mathematics.

"Geometry is grasping space...that space in which the child lives, breathes, and moves. The space that the child must learn to know, explore, conquer in order to live, breathe, and move better in it." - Hans Freudenthal

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Encourage Multiple Strategies and Representation

Many adults remember practicing math computation over many years in school. The belief at the time was that to compute accurately, students needed to have a clear sequence of steps to follow, and that if followed correctly, would always produce a correct answer. When students struggled to find the correct answer to a computation problem, teachers and parents often responded by simply increasing the number of problems the student had to solve or by decreasing the number of digits in the problem. These two supposed solutions were meant to either provide more practice in following the steps or to lessen the difficulty in following the steps.

The issue with this type of instruction is that it does not address the underlying issue that the student does not understand why the steps are being applied confused between when and how to apply the various procedures they have learned. This difficulty increases throughout middle school and high school as the number of memorized processes increases greatly as the type of numbers being computed changes.

In a classroom where the ideas from the MTI course are being implemented, there is evidence that students can draw upon knowledge of multiple models to solve problems and that they understand when and where to best apply the models based upon the situation and numbers involved in the problem. For example, if given the problem 2003 - 1997 students could visualize a number line (or a timeline) in their head and see that the distance between the numbers is 6 rather than go through the laborious process of setting up the numbers in vertical columns and subtracting them in the traditional manner. Try it! It isn’t fun or efficient. This understanding of whole number subtraction using a number line model can then be used again in subtraction of decimals, fractions, and even algebraic equations. An understanding of multiple strategies and representations allows students to be flexible in the procedure they apply to a situation and they choose the procedure that is most appropriate based on the numbers.

The type of instruction that embodies the five critical features for building mathematical understanding are a significant departure from what many of us experienced in school and from how the majority of teachers are used to instructing mathematics. In the MTI course and through our follow-up support, we provide teachers with strategies for implementing the features of the framework and work with them as they put them into practice in their classrooms.
The Initiative for Developing Mathematical Thinking at Boise State University (IDMT) is dedicated to assisting teachers, parents, and children in learning how to think mathematically. Our approach is based on current research about how children develop a deep and well-connected understanding of mathematics. We study how students develop mathematical ideas over time and help parents and teachers build learning environments to best promote this development. Through this work we have created the Mathematical Thinking for Instruction (MTI) course.

The state required MTI course is focused on building students’ mathematical understanding through a research-based framework. The framework is comprised of five critical features: (1) taking students' ideas seriously, (2) pressing students conceptually, (3) encouraging multiple strategies and representations, (4) addressing misconceptions, and (5) understanding the relational structure of mathematics. Mathematics instruction based upon this framework provides a foundational understanding of mathematic topics that is often absent in the traditional teacher-centered instruction of the past.

On MTI Course Evaluations accumulated through summer 2010, participants rated their ability in the following categories before and after taking the MTI course.

<table>
<thead>
<tr>
<th>Ability to do very well…</th>
<th>Before Course</th>
<th>After Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teach classes for students with diverse abilities</td>
<td>18 %</td>
<td>47.7 %</td>
</tr>
<tr>
<td>Provide a challenging curriculum to all students you teach</td>
<td>13.8 %</td>
<td>54.8 %</td>
</tr>
<tr>
<td>Use a variety of assessment strategies</td>
<td>8.5 %</td>
<td>43.2 %</td>
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What Teachers Are Saying

The following is an excerpt of a letter from a 4th grade teacher trying to implement the MTI ideas into her math classroom.

“This is the problem: You are helping your younger brother/sister make a pumpkin costume. You are responsible for the orange part of the costume. It measures 30” x 15”. The fabric comes in 10” x 9” squares. How many squares will you need? extra: Each square costs $5.80. How much will the costume cost?

The reason for this letter is what this one girl came up with. Her ISAT score in math is Basic -8. Her percentages on the sub-areas of the ISAT math are all below 50%. Using a grouping strategy to show this problem, she was able to come up with the correct amount. I then asked her to write a number sentence to show this. She wrote 5 x $5.80. It is amazing to me that my “low” students are doing problems that are mixed numbers times a decimal/money. That is so far beyond what our book covers or what one would expect from an ISAT Basic -8 student! Can you imagine the horror of that problem with traditional algorithms?

So, I guess I’m a convert. :-) I’ve noticed two big things with my math guys: 1. They are never off task during math work. They work and work and work--little Energizer Bunnies. 2. They are now fearless. They just jump right in to whatever problem we have. It took a while to get there, though. Thanks!”
**On-line and Statewide Follow Up Opportunities**

Online link: [IEN Locations Map](#)

MTI Follow-up Course for Grades 4 – 9 (IEN, Feb 22 - May 10)
**Through:** Idaho Education Network (IEN)
**Dates and Times:** 5:00 - 7:30 PM, Tuesdays -- Feb 22, March 8 & 22, April 12 and 26, May 10
**Contact:** Michele Carney michelecarney@boisestate.edu
**Description:** This class is designed for teachers who have completed the MTI course and want to investigate and discuss mathematical topics related to instruction in grades 4-8. Activities include examining grade-level content, building learning progressions, examining student work, and sharing resources, practices, and ideas. Credit available through BSU.
**Comments:** Up to three additional IEN classroom locations can be included. If you are interested in setting this up, please contact Michele Carney and/or your Regional Math Specialist.

Coaching/Leadership Group - All Grades (IEN, Jan 26 - May 25)
**Through:** Idaho Education Network (IEN)
**Dates and Times:** 9:45 - 11:30 AM, Wednesdays Jan 26, March 2, May 25
**Contact:** Michele Carney michelecarney@boisestate.edu
**Description:** This group is designed for math coaches, district and school administrators, and teacher leaders, who want to effectively support teachers that are implementing techniques from the MTI course. Topics include (but are not limited to) RTI, assessment, the unit study model, and the Common Core standards.
**Comments:** Meetings will be offered through IEN. Up to three additional IEN classroom locations can be included. If you are interested in setting this up, please contact Michele Carney and/or your Regional Math Specialist.

MTI Math Content Webinars (IDLA, scheduling soon)
The following math topics will be scheduled as MTI webinars in the next few weeks. They will occur throughout spring 2011. Please return soon to see the actual dates and times. We will be adding additional webinars throughout the spring, so return often.
- Composing & Decomposing Numbers
- Fraction Concepts
- Ratios & Proportional Reasoning
- Expressions & Equations
- Math Assessment
- Common Core Standards Implementation

Visit the MTI Follow Up Website for more information on these opportunities and up to date details by region. [http://tinyurl.com/MTIfollowup](http://tinyurl.com/MTIfollowup)

**Summer MTI Registration**

The tentative schedule for summer 2011 registration: The course schedule will be posted on the State Department of Education MTI website on March 15th. Registration will begin at 8 a.m. (7 a.m. PST) on Monday, April 4th.

[www.sde.idaho.gov/site/math/mti.htm](http://www.sde.idaho.gov/site/math/mti.htm)

Please pass this information on to others in your district that need the MTI course or are interested in the follow up opportunities.

Thank you!