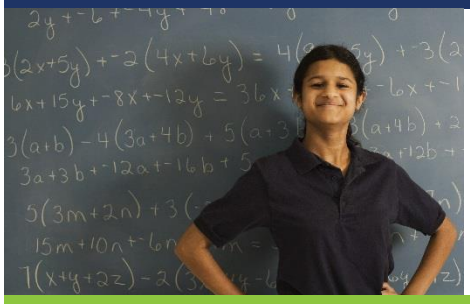


Developing Mathematical Thinkers:
Moving Students from Rote to Rigor

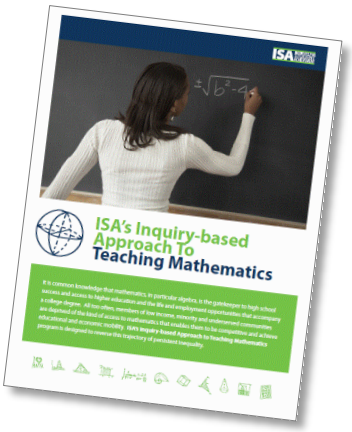
ISA Blog – by N. Gerry House, ISA President

ISA math coach Julie Arcement describes a typical scenario that she often observes in high school math classrooms during the early stages of her coaching:

> *The teacher is at the front of the class demonstrating how to solve a quadratic equation. He has placed the following equation on the board: $y=ax^2+bx+c$ and is modeling for the students how to solve the problem. The teacher begins the carefully planned lesson by walking his students through the steps used to solve the equation. On several occasions, the teacher asks students if they have questions and if they understand the steps that he is walking them through. One student asks a question to which the teacher responds. Some students are trying to make sense of the skill that the teacher is modeling but seem hesitant about responding to the teacher's question about what step comes next. One or two have their heads on the desk, and some are talking to classmates about unrelated topics. The teacher then calls on three students to come to the board and work similar exercises. One student is able to replicate the problem-solving steps with some prompting from the teacher. Students are then instructed to solve the quadratic equations on the worksheet that the teacher has passed out to them. A few students are able to work the exercises completely and correctly. Several students struggle but try to work through the exercises by following the steps that the teacher modeled as best they can. Some students try to begin to solve the problems, but then quickly give up and sit silently, talk to classmates, or bring out books for other classes.*

Arcement points out that the first step in helping students to develop into mathematical thinkers is to support teachers as they reflect on their own beliefs and practices about mathematics and how they teach it. She partners with teachers as they learn to shift their mathematics instruction to an inquiry-based approach that focuses on developing students who can:

ISA's math specialist, Julie Arcement



[Download our new e-book,](#) *ISA's Inquiry-based Approach to Teaching Mathematics*

- Construct new knowledge through investigations using interesting tasks and activities;
- Talk deeply about the meaning of mathematical concepts.
- See the connections and interrelationships between mathematical concepts.
- See the relationship between mathematical concepts and procedures.
- Speak about what a procedure means and why it makes sense.
- Grapple with all types of mathematical problems.
- See multiple strategies to solve all types of problems.
- Defend their process and answer with explanation, justification, and proof.
- Critique the reasoning of others and refine their own reasoning based on others' feedback.
- Reflect on their thinking and learning as a means of self-evaluation and growth as a learner.

ISA's math coaches are the key to helping teachers shift from an instructional approach that is often limited to student memorization of facts and procedures or knowledge of isolated skills. "The journey of growing as an educator has a different starting point for every teacher," says Arcement. "I always bear in mind my own journey of growth as a teacher as well as the great benefit I received from working with an ISA coach myself." The ISA process of coaching teachers to use an inquiry-based approach to math instruction ultimately results in the development of students who are proficient mathematical thinkers who can comprehend concepts, operations, patterns and relationships and can have the procedural fluency to carry out math procedures flexibly, accurately, efficiently, and appropriately.

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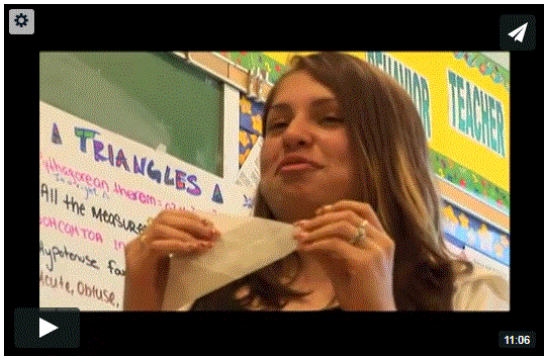

Click here to see a student-centered lesson using the inquiry-based approach to teaching mathematics. Reflect on the following questions as you watch the video: What do you notice about the questions that the teacher asks? How do they engender inquiry on the part of students? What do you notice about the teacher's silences? What learning do you notice occurs with students as a result of this process?