Two principals explain why they turned from conventional math instruction to an approach that focuses on understanding and applying math concepts.
As educators, we react quickly to the student who moans that he cannot read as well as his peers. But what about the student who says “I’m no good at math?” Even though research tells us math teaching that focuses on rote memorization of facts and processes, supplemented by heavy doses of “drill and kill” homework, doesn’t provide students with understanding of mathematical concepts, many of us continue to follow this “tried-and-true” method of instruction. But while it may be comfortable to stick with traditional teaching methods, it is a form of educational neglect that inevitably leads to a mathematical dead end.

**IN BRIEF**

Two principals tell why they decided to make major changes in math instruction in their schools. They describe how inquiry math benefits students at all ability levels by letting them arrive at problem solutions through group discussions and provide a typical word problem as an example of how inquiry math works.
Change is never easy, but it is necessary if we are to ensure mathematical success for all students. Speaking as two experienced principals, we have discovered that changing to concept-based math instruction works for our students, as reflected by our state-mandated assessment scores. The process we have chosen is inquiry math.

What Is Inquiry Math?

We all know there is only one right answer for a math problem, but there is obviously more than one way to obtain that right answer. Inquiry math is different from traditional math in that students work with partners and whole-group instruction to construct mathematical explanations that make sense to them. Students are presented with opportunities to verbally explain their thinking processes to the teacher and class, and it is this exchange of ideas that provides the foundation for true understanding of mathematical concepts.

For example, with traditional math instruction, the teacher presents a mathematical concept, reviews the procedures required to find the solution, and then has students practice these procedures with additional problems. This method tends to work in the short term, but students who cannot remember the procedures, or do not understand why they are using them, will inevitably forget them and have difficulty moving on to higher levels of mathematical thinking.

In contrast, inquiry math focuses on conceptual development. In teaching with inquiry math, the teacher sets up a problem on a chalkboard or overhead projector, making sure that everyone understands it. The students are then paired or grouped according to their ability level. They work together to come up with a solution by thinking out the problem, questioning and correcting one another. Finally, the teacher leads a whole-class discussion in which students relate their various strategies for solving the problem.

The dialog at the heart of the inquiry math process allows students to solidify their thinking and allows the teacher to discover and correct mistakes in their strategies. The discussions help struggling learners glean more sophisticated ways to solve problems, while gifted students are encouraged to think at a higher level. Here is an example of an inquiry math problem: There are three candy bars to split among four children. If they are split evenly, how much will each child’s portion be?

In pairs or groups, the students will first attempt to establish a common denominator. Lower-ability students may focus on actually drawing the candy bars and separating them into equal pieces—running into difficulty when dividing the last candy bar. Higher-ability students may use more advanced strategies. In either case, students will eventually discover that the solution requires dividing each of the candy bars by the common denominator of 4, with each child receiving three-fourths. In the solution process, students learn why a common denominator is needed and why it is useful.

Why Two Principals Changed

Chapko: When I became principal of Eisenhower Elementary School eight years ago, I was surprised to discover that students in this affluent suburban school were very deficient in their math computation and problem-solving skills, as evidenced by standardized test scores. At first, I naively figured that I could quickly remedy this situation by encouraging my teachers to follow the example of my own math education. I had a teacher who timed the class as we frantically wrote out math facts on the chalkboard, with the winner getting a coveted candy bar.

While my teachers were willing to try this approach, it quickly became evident that times had changed since my school days, and that a candy bar was not a quick fix for math deficiencies. Answers came slowly as we explored more effective ways of teaching math. We discussed various approaches and we read best-practice articles. We also received guidance from our district’s gifted and talented teachers and curriculum director, as well as a local university professor.

After eight years of working together, my teachers and I have concluded the following about K–6 math instruction:

- Society, career fields, and technological advances mandate that students possess math knowledge beyond basic computational skills.
- Students must master their math facts in order to be able to effectively move on to higher-level math skills, and any program that allows students to accomplish this is acceptable.
- Students learn math skills most effectively when they are taught as relevant lessons based on real-life situations.
- It is extremely beneficial for students when parents work in partnership with teachers to ensure student’s mathematical success.
- Math instruction should be a combination of teacher direction and student discovery, with all learning styles addressed.
- The math textbook needs to be accompanied by hands-on instruction and standards-based assessments.

For the past two years, our teachers have collaborated at scheduled inservice days with teachers at nearby MacArthur Elementary School, which uses inquiry math instruction. Our teachers have witnessed the positive effects of this approach on the MacArthur students, and this led them to the decision to request a waiver (continued on page 33)
from the traditional math text used by the district to an inquiry-based program developed by the University of Chicago. We felt this program to be the best fit for our students and our school improvement goals.

**Buchko:** For the past several years, my teachers and I at MacArthur Elementary School have been on an instructional journey directed toward math success. With the help of Purdue University professors Erna Yackel, Michelle Stephan, and Diana Underwood, as well as our district’s gifted and talented teachers, we embraced the concept of inquiry math.

Although this new approach changed the way we taught math, it didn’t happen overnight. We began our journey with inquiry math seven years ago, when my four second-grade teachers trained with Dr. Yackel. Each summer since, more of our teachers have given up two weeks of their summer vacation to train in this method. Currently, 13 of my 20 teachers have been formally trained in inquiry math. Our success with inquiry math has caught on throughout the district and inquiry math workshops now extend to the entire K–6 teaching staff.

The inquiry-based process is one of sustained change versus a quick fix, but both of our staffs have embraced this fundamental shift in thinking, teaching, and learning. As principals, we are excited to see how our students’ inquiring minds are developing, and we applaud our teachers for their flexibility and willingness to help students learn.

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**WEB RESOURCES**

ENC Online provides a special section on inquiry and problem solving, including articles on classroom activities and guidance for teachers.

[www.enc.org/topics/inquiry/](http://www.enc.org/topics/inquiry/)

The National Staff Development Council presents “Introducing Math Teachers to Inquiry,” describing the development and results of a pilot program in the Rochester, New York, area.


Northern Kentucky University posts a paper prepared by Erna Yackel for the Ninth International Congress on Mathematical Education in 2000, “Creating a Mathematics Classroom Environment that Fosters the Development of Mathematical Argumentation.”

[www.nku.edu/~sheffield/eyackel.html](http://www.nku.edu/~sheffield/eyackel.html)

For program information and application: [http://explorerschools.nasa.gov](http://explorerschools.nasa.gov)

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Application Deadline: January 31, 2005