TAKE IT TO THE MAT

A NEWSLETTER ADDRESSING THE FINER POINTS OF MATHEMATICS INSTRUCTION

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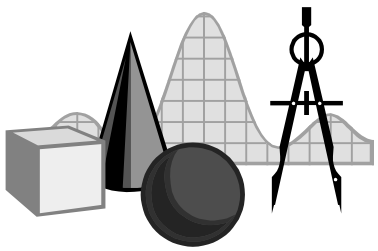

When we think of equation solving, our initial impression is of a unit in a first-year algebra course. Learning to solve equations begins long before that: the primary grades. This issue of *Take It to the MAT* will examine the foundations of equation solving in the elementary grades.

As early as first grade, students begin solving equations. These equations are commonly referred to as "missing addend" problems. There is no conceptual difference between the primary grades' ___ + 2 = 5 and the algebra class' $x + 2 = 5$. Later, in the intermediate grades, we continue to build algebraic reasoning through missing factor exercises, such as $3 \times \square = 27$, corresponding to $3x = 27$. It is not uncommon to see the use of variables in elementary texts and supplements, e.g. $n + 2 = 5$ and $3 \times n = 27$.

The heart of the matter is not that we are teaching equation solving, per se, but are building skills that will be necessary when students take more advanced mathematics. Algebra instructors build upon the concepts initially introduced in early grades. These methods connect the "*what* plus two equals five" of ___ + 2 = 5 and the fact that the answer is 5 – 2 = 3.

Another place this ties in is *fact families*. Students learn the relationships between three numbers, like 2, 3, and 5, by examining the "family" of addition and subtraction facts created by these three numbers. This is another place where we begin to build algebraic reasoning. If we ask the question, "What plus two equals five," we are also simultaneously asking, "What is five minus two?" The key is recalling the addition/subtraction fact family when 2 is an addend and the sum is 5. We can do likewise with multiplication/division—connect finding the missing factor in $3 \times n = 27$ with the fact family of 3, 9, and 27.

$2 + 3 = 5$
$3 + 2 = 5$
$5 - 2 = 3$
$5 - 3 = 2$
$3 \times 9 = 27$
$9 \times 3 = 27$
$27 \div 3 = 9$
$27 \div 9 = 3$

Fact families should not end with sums to 20 or 24, or with products to 100 or 144. No, students' relationships with fact families should continue past the "traditional" addition and multiplication tables. For example, every student by the intermediate grades should have mastered the families involving sums of 100. That is, the family of 35, 65, and 100; the family of 19, 81, and 100; the family of 42, 58, and 100, etc. This should further extend to products of 100, such as 5, 20, and 100 or 4, 25, and 100. By 5th grade, students should be able to handle 1000's, 10,000's, and beyond.

Should student's memorize these families? Yes and no. Certain things students should be able to do automatically. For instance, a 4th grade student should be able to fill 239 into the blank of ___ + 761 = 1000 without hesitation. But one would not expect the same students to "memorize" the addition/subtraction family of 127, 386, and 513 or the multiplication/division family of 9, 57, and 513. But, if the student were presented with the equations $n + 127 = 513$ and $9 \times n = 513$, the student had better be able to relate that n is 513 – 127 and 513 ÷ 9, respectively.

Success in algebra begins in the primary grades. Missing addend/factor exercises and memorizing fact families are two tools that help lay the foundation for algebraic reasoning and students' future achievements in algebra and higher level mathematics.