Building Student Confidence and RAISING TEST SCORES IN MATHEMATICS

BY NANCY McGRAW

Insanity: Doing the same thing over and over again and expecting a different result.
—Albert Einstein

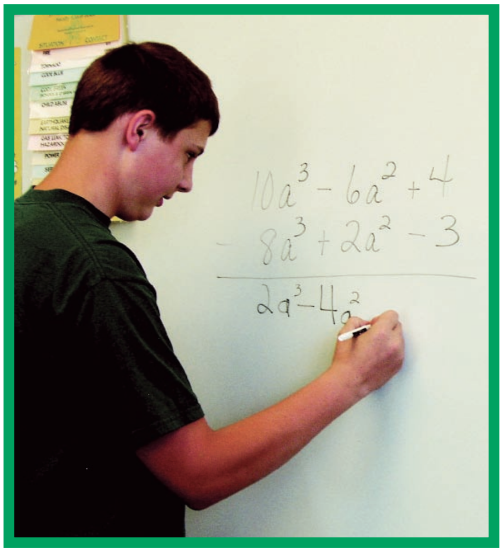
After I had taught for more than 20 years, Einstein's definition of insanity led me to finally try something different with my math students at Saint Paschal Baylon School. I was frustrated by the fact that, no matter how hurriedly I paced my lessons or how hard I pushed my students, I was never able to get to the end of the textbook by the end of the year. I felt that I needed to cover all the chapters so that my students would be exposed to the skills they were expected to master at that grade level. In June, I would tell myself, "Next year we have to move faster; I have got to push a little harder." I wanted the next year to be better, but it never was. Doing the same thing got me the same result.

There was a still greater frustration: Even when students showed mastery of a particular skill, such as calculating elapsed time or subtracting from zero, it seemed that later in the year they would forget what had been mastered. When we got to multi-digit multiplication, my fifth graders offered a blank stare, as if they had never heard of the concept before. I knew that was impossible; they had learned about multi-digit multiplication from their fourth-grade teacher. So I went over the concept again, until all of my students could pass a test with a good deal of accuracy. Then we moved on to a new skill.

When we returned to multi-digit multiplication several weeks later, I assumed everyone would know what to do. However, the students' work was inaccurate, and I had to take the time to go over the algorithm again. How could I get my students to remember what they learned from one year to the next when they couldn't even retain the skills from one week to the next?

Students Will Not Remember What We Expect Them to Forget

The greatest disappointment of all was that so many students were discouraged and had simply given up on math. In the primary grades where I had begun my career, children had very little resistance to learning about numbers. They were willing to take risks, believing they could learn anything; they had no reason to think otherwise. However, by the time they reached the middle grades and junior high, many children seemed suddenly apprehensive, especially about mathematics. Students had experienced failure upon failure and became convinced that they "just can't do math."



To my amazement, parents would even remark that they themselves had been poor math students and therefore their children couldn't be expected to excel in math—as if there were a "math gene" that was passed from generation to generation! What I realized was that attitudes about math ability could be passed from parent to child, and these attitudes were what I had to tackle first.

At the time, one of St. Paschal's futuring goals was to improve math instruction and increase math achievement at each grade level. Parents wanted higher standardized test scores, and they wanted their children to complete Algebra I by the end of eighth grade. Their expectations were justified, since the local public schools were able to provide eighth graders with Algebra I, including high school credit. Our eighth graders typically had to take Algebra I as high school freshmen.

I had taught most grade levels, and I noticed that each year the math curriculum began with the study of place value; then moved to simple addition; then subtraction, multiplication, and so on. Each year, the very same concepts were introduced again, as if they had never been covered before. In fact, while teaching fifth and sixth grades, I dissected the mathematics texts and found that the first ten of thirteen chapters were devoted to concepts which had already been taught in earlier grades! This was exasperating because the prime teaching time, September through late winter, was spent on review, while new concepts were not introduced until early spring, when students were getting tired and counting down the days until summer. I had to find a way to change this unproductive pattern.

Revolutionizing the Mathematics Curriculum

Reteaching math concepts each year was simply not the best use of class time. I decided to omit all the chapters that were a review of previously taught material. I wanted to dive into the exciting, new grade-level concepts right at the start of the school year. This was a radical move. I had the support of my administrator but still felt anxious as I stood in front of an assembly of parents at our curriculum night, explaining how I intended to skip the first ten chapters of the traditional mathematics text. I did my best to make clear both the rationale for this strategy and my "accountability plan" for the material in those first ten chapters. I had to convince parents that their children would be prepared for the new concepts I would be presenting and that my approach wouldn't make math more difficult for their children. The parents understood what I was getting at and showed their support by applauding my presentation. Since that day, I have never looked back.

I developed a system of daily mixed review for the students to complete as homework. The homework contained only material that the students had previously learned and examples of items with which they were very familiar. It was important to me that the students were able to complete the review sheets on their own and without frustration. My goals were to build confidence and reinforce everything they had ever learned in mathematics. Four nights a week, my fifth and sixth graders completed 20 review items. Each item on the page covered a different skill. For example, there might be a question about estimation, then a geometry problem, then multi-digit multiplication, and so on. During the first few minutes of class each day, we followed the same procedure: I displayed the answers to the previous night's homework on an overhead transparency, and the students checked their own work. They marked the items done incorrectly or any that they found difficult. Using dry erase boards (always a big motivator), the students and I would go over the items they had marked. We spent as much time as necessary practicing the skill, and I gave additional examples until I was pretty sure everyone understood each item. Then I assigned the next lesson, and we went on with the new math material for the day. On Fridays there was a weekly quiz covering a random selection of the homework problems from that week.

After going over the homework, we spent the rest of the class on new material. I had plenty of time for the development of the new concepts because I was introducing them much earlier in the year. There was no rushing, no forcing. We spent as much time as necessary practicing together in class. As homework, I assigned just three to five of the newly introduced items, and then I encouraged the students to begin completing these items in class under my direction.

For example, if the new concept was adding fractions with unlike denominators, the students would have to do only three to five problems about adding fractions with unlike denominators. It is pointless to assign a whole page of this type of problem when the students are just learning how to do it. They run the risk of doing the work incorrectly and then actually practicing the erroneous method! That method then has to be un-learned. Education researcher Robert Marzano says, "When homework has been assigned for the purpose of practice, it should be structured around content with which students have a high degree of familiarity…Practicing a skill with which a student is unfamiliar is not only inefficient, but might also serve to habituate errors or misconceptions" (Marzano, et. al., 2001).

The mixed review work, along with three to five examples of new material, was plenty of math homework. We concentrated on grade-level concepts during class, and I used many of the same tactics that other teachers use to motivate kids: games, contests, incentives, and so on. But I also took away the pressure by allowing students to learn math at their own pace. I often told them, "Just try. I want you to do only a few of these." I gave my students the freedom to decide when they felt comfortable enough to take a test on the new material. The students began to enjoy math because they experienced success. As students' self-confidence rose, math grades improved, standardized test scores increased, and we covered more mathematics that year than ever before. In fact, we finished all the chapters of the text early, and in the spring, I began doing sixth grade work with my fifth graders and pre-algebra with my sixth graders.

Expanding the Approach

The students' parents were so impressed with the spiraling review strategy that they asked me to create the program for seventh grade. I not only did that, but eventually created mixed review for everyone, kindergarten through eighth grade. With the cooperation of my colleagues, we implemented the program school-wide. Because fifth and sixth graders moved beyond grade level, the seventh- and eighth-grade teachers were able to cover the full Algebra I course. We achieved our futuring goal, and St. Paschal Baylon students now routinely test out of Algebra I in high school.

The strategy actually accelerated the entire school in mathematics. John Bednar, our principal, gave his strong support throughout the development of the daily review strategy; and he reports that scores for the Iowa Tests of Basic Skills not only increased right away, but have remained consistently high at 2.5 to 3.5 years above grade level for every class in the school. In 2003, one of my students suggested calling the program *Simple Solutions*. I began to publish the materials, and each year I offer the complete program, as a pilot (free of charge), to several second- and third-grade teachers, so that they can try it with their own students. It's the best way for teachers to see how powerful the approach really is.

Why is the strategy so successful? Teachers say that adding daily mixed review to the traditional math curriculum makes math less intimidating and that students are much more willing to complete the assignments every day. There are always many items on the page that are easy; the students can do the work by themselves and in a matter of minutes. Teachers like the built-in assessment component; the strategy can be used with all types of learners, and the routine is easy to implement. Furthermore, the idea of distributed practice just makes sense. Research shows that revisiting material often and studying bits of information over time increases retention. According to Daniel Willingham, a new skill will become automatic or long-lasting only in the presence of "sustained practice, beyond the point of mastery" (Willingham, 2004). Larry Ainsworth and Jan Christinson recommend focusing on "practice during the first part of every math lesson to help students sharpen their math skills over time" (Ainsworth & Christinson, 2004).

Today, the expectation of St. Paschal Baylon School is that every student will remember everything that has ever been learned in math. The school is known for its exceptional math program, and educators from other schools visit to observe teachers and students engaged in the daily math routine. St. Paschal Baylon's students are well prepared for high school math. Best of all, the students come out of elementary school with the confidence that they "can do math!" ▲

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