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Marilyn Burns: 10 Big Math Ideas

Everyone's favorite math guru shares the top 10 ways you can enhance your students' math learning, test scores, and skills

By Marilyn Burns | March 2005

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Several years ago, Michael, one of my third graders, wrote this in his journal: "I never used to look forward to math. All we did was add and subtract. Now I like it more. We work together in class, and we still learn math but in a better way." In a sense, Michael described the challenge we face as math teachers-to help students become flexible thinkers who are comfortable with all the content areas of mathematics and able to apply their learning to problem-solving situations. I have to admit-my early teaching resembled the math class Michael described, but over time I have found more engaging and effective approaches. Here are the ten "big ideas" I now embrace for helping children learn, understand, and enjoy math class.

1. Success comes from understanding. Set the following expectation for your students: Do only what makes sense to you. Too often, students see math as a collection of steps and tricks that they must learn. And this misconception leads to common recurring errors-when subtracting, students will subtract the smaller from the larger rather than regrouping; or when dividing, they'll omit a zero and wind up with an answer that is ten times too small. In these instances, students arrive at answers that make no sense, and they rarely know why.

Help students understand that they should always try to make sense of what they do in math. Always encourage them to explain the purpose for what they're doing, the logic of their procedures, and the reasonableness of their solutions.

2. Have students explain their reasoning. It's insufficient and shortsighted to rely on quick, right answers as indications of students' mathematical power. During math lessons, probe children's thinking when they respond. Ask: Why do you think that? Why does that make sense? Convince us. Prove it. Does anyone have a different way to think about the problem? Does anyone have another explanation?

When children are asked to explain their thinking, they are forced to organize their ideas. They have the opportunity to develop and extend their understanding. Teachers are accustomed to asking students to explain their thinking when their responses are incorrect. It's important, however, to ask children to explain their reasoning at all times.

3. Math class is a time for talk. Communication is essential for learning. Having students work quietly-and by themselves-limits their learning opportunities. Interaction helps children clarify their ideas, get feedback for their thinking, and hear other points of view. Students can learn from one another as well as from their teachers.

Make student talk a regular part of your lessons. Partner talk-sometimes called "turn and talk" or "think-pair-share"-encourages students to voice their ideas. Giving them a minute or so to talk with a neighbor also helps students get ready to contribute to a discussion. It's especially beneficial to students who are generally hesitant to share in front of the whole class.

4. Make writing a part of math learning. Communication in math class should include writing as well as talking. In his book *Writing to Learn* (Harper, 1993), William Zinsser states: "Writing is how we think our way into a subject and make it our own." When children write in math class, they have to revisit their thinking and reflect on their ideas. And student writing gives teachers a way to assess how their students are thinking and what they understand.

Writing in math class best extends from children's talking. When partner talk, small-group interaction, or a whole-class discussion precedes a writing assignment, students have a chance to formulate their ideas before they're expected to write. Vary writing assignments. At the end of a lesson, students can write in their math journals or logs about what they learned and what questions they have. Or ask them to write about a particular math idea-"what I know about multiplication so far," or "what happens to the sums and products when adding even and odd numbers." When solving a problem, encourage students to record how they reasoned. Writing prompts on the board can help students get started writing. For example: Today I learned ..., I am still not sure about ..., I think the answer is ..., I think this because....

5. Present math activities in contexts. Real-world contexts can give students access to otherwise abstract mathematical ideas. Contexts stimulate student interest and provides a purpose for learning. When connected to situations, mathematics comes alive. Contexts can draw on real-world examples. For example, ask students to figure out what you might have bought and how much it cost if, after paying for it, you received $0.35 change. Or ask children to figure out how much money each of four children would get if they shared $5.00 equally. Or ask a group of children to estimate and then figure out how many raisins each of them would get if they shared a snack-size box.

Contexts can also be created from imaginary situations, and children's books are ideal starting points for classroom math lessons. After reading Eric Carle's *Rooster's Off to See the World* (Simon & Schuster, 1991), for example, ask children if they can figure out how many animals went traveling. Or ask children to follow the calculations in Judith Viorst's *Alexander, Who Used to Be Rich Last Sunday* (Simon & Schuster, 1978), and figure out how Alexander spent his money. For a ready-to-use, literature-linked math lesson, see "A Step-by-Step Lesson with Marilyn Burns," above.

6. Support learning with manipulatives. Manipulative materials help make abstract mathematical ideas concrete. They give children the chance to grab onto mathematics ideas, turn them around, and view them in different ways. Manipulative materials can serve in several ways-to introduce concepts, to pose problems, and to use as tools to figure out solutions. It's important that manipulatives are not relegated to the early grades but are also available to older students.

For teachers just getting started using manipulatives, classroom staples should include at least 400 color tiles (1" square tiles in four colors), three to six sets of pattern blocks (six different shapes which typically include green triangles, yellow hexagons, blue and tan parallelograms, orange squares, and red trapezoids), 500-1000 interlocking cubes (usually in 10 colors, about 3/4"), and a supply of measuring tools.

7. Let your students push the curriculum. Avoid having the curriculum push the children. Choose depth over breadth and avoid having your math program be a mile wide and an inch deep. As David Hawkins said in *The Having of Wonderful Ideas*, by Eleanor Duckworth (Teachers College Press, 1996), "You don't want to cover a subject; you want to uncover it." There are many pressures on teachers, and the school year passes very quickly. But students' understanding is key and doesn't always happen according to a set schedule. Stay with topics that interest children, explore them more deeply, and take the time for side investigations that can extend lessons in different directions.

8. The best activities meet the needs of all students. Keep an eye out for instructional activities that are accessible to students with different levels of interest and experience. A wonderful quality of good children's books is that they delight adults as well. Of course, adults appreciate books for different reasons than children do, but enjoyment and learning can occur simultaneously at all levels. The same holds true for math. Look for activities that allow for students to seek their own level and that also lend themselves to extensions.

For example, challenge children to find the sum of three consecutive numbers, such as 4 + 5 + 6. Ask them to do at least five different problems and see if they can discover how the sum relates to the addends. (The sum is always the middle number tripled.) Allowing the children to select their own numbers to add is a way for students to choose problems that are appropriate for them. Even those students who don't discover the relationship will benefit from the addition practice. Invite more able students to write about why they think the sum is always three times the middle number, or to investigate the sums of four consecutive numbers.

9. Confusion is part of the process. Remember that confusion and partial understanding are natural to the learning process. Don't expect all children to learn everything at the same time, and don't expect all children to get the same message from every lesson. Although we want all students to be successful, it's hard to reach every student with every lesson. Learning should be viewed as a long-range goal, not as a lesson objective. It's important that children do not feel deficient, hopeless, or excluded from learning

mathematics. The classroom culture should reinforce the belief that errors are opportunities for learning and should support children taking risks without fear of failure or embarrassment.

10. Encourage different ways of thinking. There's no one way to think about any mathematical problem. After children respond to a question (and, of course, have explained their thinking!), ask: Does anyone have a different idea? Keep asking until all children who volunteer have offered their ideas. By encouraging participation, you'll not only learn more about individual children's thinking, but you'll also send the message that there's more than one way to look at any problem or situation. That's when the potential for delight occurs.

About the Author

Marilyn Burns is the creator of Math Solutions, in-service workshops offered nationwide, and the author of numerous books and articles. She is author of the book *50 Problem-Solving Lessons, Grades 1-6*, distributed by Cuisenaire.