MATH TRAILBLAZERS

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An elementary school curriculum for grades K–5, developed by Teaching Integrated Mathematics and Science (TIMS).

A fundamental principle of *Math Trailblazers* is that mathematics is best learned through active solving of real problems. Lessons are grounded in everyday situations, so abstractions build on experience. Students' skills, procedures, and concepts emerge and develop as they solve complex problems. The curriculum introduces challenging content at every grade level, including computation, measurement, data collection, statistics, geometry, ratio, probability, graphing, simple algebra, estimation, mental arithmetic, and patterns and relationships. Each grade level has 16–20 units; units range from one to three weeks long.

A central tenet of *Math Trailblazers* is that real problems are naturally interdisciplinary. Accordingly, the curriculum integrates mathematics with many disciplines, especially science and language arts.

Scientific investigations embedded in many units use the TIMS Laboratory Method, an organized method of investigation appropriate for elementary school children to use. Students explore a situation by drawing a picture, gathering and organizing data, graphing the data, and analyzing their results. The science content in *Math Trailblazers* is intended to supplement, rather than replace, a school's existing science curriculum.

Math Trailblazers also makes strong connections to language arts. As part of every lesson, students discuss and write about mathematics. Many lessons use trade books to launch or extend mathematical investigations. The curriculum itself contains original stories, called *Adventure Books*, that show applications of concepts being studied or episodes from the history of mathematics and science.

Many of the assessment activities in *Math Trailblazers* are incorporated into daily lessons; others are included in formal assessment units. Assessments include a mix of short, medium-length, and extended activities. Beginning in third grade, *Math Trailblazers* provides a scoring rubric for assessing students' work. An adaptation of this rubric allows students to assess their own work using the same criteria.

Components of the *Math Trailblazers* curriculum vary across grade levels. For grades 1 and 2, student materials are consumable, and consist of a *Student Guide* and a *Discovery Assignment Book* (containing student activity and homework pages) and an *Adventure Book*. For grades 3–5, *Student Guides* are hardcover, non-consumable texts and *Adventure Books* are spiral-bound, non-consumable texts; the *Discovery Assignment Book* for grades 3–5 is still consumable. Kindergarten student materials consist of reproducible pages contained in the teacher materials; these pages are also bound in a consumable *Kindergarten Activity Book*.

For every grade level, *Math Trailblazers* includes a *Teacher Implementation Guide* that provides background information and support for teachers on the pedagogy and content of the program. Teacher materials for grades 1–5 consist of Unit Resource Guide Files, which contain teacher support materials organized for each unit of the curriculum. Teacher materials for kindergarten also include a *Teacher Resource Book*.

Math Trailblazers requires the use of manipulatives. Calculator use is also integrated into the program, and is required for some activities.

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PHILIP WAGREICH & CATHERINE KELSO ▸ DEVELOPERS

Philip Wagreich is Director of the Institute for Mathematics and Science Education and Professor of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago. He received his Ph.D. in Mathematics from Columbia University in 1967. Since 1973 he has been on the faculty at UIC. He has published 15 research articles on algebraic geometry and seven articles on mathematics education, and is one of the principal authors of the TIMS Elementary Mathematics Curriculum (*Math Trailblazers*).

Professor Wagreich was Director of the TIMS (Teaching Integrated Mathematics and Science) Elementary Mathematics Curriculum Project, a seven-year, $5 million NSF-funded curriculum development project, and Co-Director of the Mathematicians and Education Reform (MER) Forum. In 1997, he was appointed to the NCTM Standards 2000 Writing Group, which revised the NCTM *Curriculum and Evaluation Standards*. He has been principal investigator on numerous NSF grants for precollege curriculum development, teacher professional development, and teacher preparation.

Philip Wagreich

Guiding principles

The big idea of *Math Trailblazers* is doing mathematics in a meaningful way. We tried to create a curriculum in which children were doing mathematics in a context that made sense to them, that was meaningful to children. One way to engage and excite children is to do a lot of our meaningful activities in the context of science. In *Math Trailblazers*, children do a lot of experiments, using what we call the TIMS (Teaching Integrated Mathematics and Science) Laboratory Method. In every experiment, we expect basically four ingredients. Children draw some kind of a picture or diagram that identifies the variables and would explain to another person what the experiment was about. The second part is always a data table; data is collected and organized in some way. The third thing is that the data is almost always graphed, so there's a visual representation of the data. In these experiments, generally, we're hoping that there will be a pattern in the data that can be expressed in some mathematical way.

The last step, which we call the questions, is using that data to answer questions about the physical situation. A prototypical experiment that we do is the bouncing ball experiment, where the students take a ball—like a tennis ball—and drop it from three different heights, at 40 centimeters, 80 centimeters, and 120 centimeters. For each one of those heights, they see how high it bounces. Then the question is, is there a relationship between the drop height and the bounce height? If you graph the data, you see a very nice pattern; those data points lie close to a straight line. You can then use that straight line to make predictions. What if you drop it from 200 centimeters? Or, if it bounced up to 100 centimeters, what height would you have dropped it from? In these experiments, students collect data, look for a pattern, then use those patterns to make predictions.

In the lower grades, these predictions may be done in a very concrete way, just drawing the graph and using the graph to make those predictions. As you get into the upper grades, a lot of these relationships are proportional, so you can ask questions like, "If you double the bounce height, what happens to the drop height?" The ultimate goal is for them to have a strong foundation, by the time they get to the middle grades, that allows them to learn proportional reasoning, to understand fractions and ratios, and to really understand what a function is.

Science isn't the only context in which we do mathematics. Sometimes it's a meaningful context out of everyday life. Sometimes the meaningful context will be just a context that is purely mathematical. It may involve a fantasy world, where animals grow according to certain rules. Children can be engaged by situations like that just as easily as they can be engaged by everyday life situations. Combining all kinds of situations, including doing a lot of science, is a good way of grabbing the kids' attention. Once we get that motivation, then we can help kids build their reasoning and higher-order skills.

Math Trailblazers also integrates mathematics and science with language arts. Part of our curriculum is something we call the *Adventure Book*, stories in which mathematics is used in a real-world context, but one that we cannot create for children in the classroom. One example is a story about a scientist and his two children going out to a cave and trying to figure out how many bats there are in the cave—

there are thousands and thousands of bats. We also have a classroom activity that we do along with this story. Of course, we can't have bats in the classroom, but we can have a big pot of beans. The question is: "How many beans are there in the pot?" So in the classroom we do what's called the "capture/recapture" method. You sample a bunch of beans (or bats) and tag them. With bats you put a little tag on their wing, or spray paint them on their wing. With beans, we just paint the beans. Then you mix the tagged ones back into the population.

The next day, you collect another sample of bats, and you see what fraction of those bats have tags on them. Using that data and proportional reasoning, you can figure out how many bats there are in all. So, on the one hand, we have this mathematical activity about beans; on the other hand, we have this story in cartoon form, which gives the real connection out there in the real world. Of course, it's "real" in quotes, because it's a fictional story. We have a wide variety of stories, and we try to have a sense of humor, so some of the stories are whimsical.

Language arts comes into the curriculum in another way. When children do problems, an important component of problem-solving is not just getting the right answer, but communicating that answer in writing and verbally. Children's written expression, and also the way they represent their mathematical ideas, are very important in the curriculum.

Balancing conceptual and procedural learning

The idea of balancing conceptual learning with procedural learning has always been very important in *Math Trailblazers*. There are certain basic facts that everybody needs to know: you need to know your multiplication facts; you need to learn how to graph. But if you teach these skills detached from any other thinking, in an isolated way, it's harder for kids to learn them because the skills don't have any meaning for them. Even the procedural aspects of learning mathematics can be made easier if you're teaching them in a way that has connected them with mathematical meaning.

The conceptual work is a foundation for everything else. In *Math Trailblazers*, we build the conceptual foundations of addition and subtraction before we have the kids become fluent with the addition facts, because what we see in classrooms and read in the research indicates that it's more effective in the long run to do so. You can teach 1st graders—if you spend enough time on it—to memorize all their addition and all their subtraction facts without meaning, and a lot of them will learn it. The question is, is it worth the investment of time? By the end of 4th grade, we expect all of our students to be fluent in all of the addition, subtraction, multiplication, and division facts. Our research, in a large study of eight schools, indicates that by the end of 4th grade—whether the students are using a traditional curriculum or *Math Trailblazers*—virtually all of them do know their facts.

There are a range of different things we do to support skill development specifically. We have "Daily Practice and Problems," which take five minutes at the beginning of class. There may be one or two quick arithmetic problems: "What's 8 + 7?" Or with older kids, "What's 8 x 7?" There might be a second problem that's a little less routine, involving some mental math or an estimate, something like: "You have 89, 87, and 95. What's the median of those three numbers? What's the mean? How would you estimate the average of those numbers?" It's quick practice, distributed over every lesson.

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We also have daily homework problems, of two kinds. One kind of homework is strongly related to in-class activities. Students may be doing a unit on their family, and so they may go home and collect some data. "What's the height of the people in your family?" The other kind of homework problems are really review and more routine practice. We don't feel that it's necessary to give the students 100 one-digit addition problems to practice—but they do need practice. So again, we provide a small number of distributed practice problems.

Skills also get practice in the context of solving more complex problems. One example of a skill would be making a point graph. We may have one or two exercises in our Daily Practice and Problems that ask kids to plot particular points. But I think most of the practice of that skill is integrated into the activities they do in class. We do a lot of graphing in order to solve problems, so they get a lot of practice of that skill. We also do a lot of problem-solving activities that require kids, for example, to multiply numbers. It's not a lot of decontextualized multiplication problems, but it's using multiplication to solve a more complex problem.

I can't tell you the number of people I run into who say, "Gee, the kids today just don't know their math facts." There's absolutely no evidence that kids are any worse at their math facts and at arithmetic than they ever were before. There is, however, good evidence that our students can't solve a two-step problem. That's the crux of the issue. The largest part of our curriculum is devoted to solving those more complex problems.

Mathematics of *Math Trailblazers*

We worked very hard to get a balanced curriculum. In the new version of NCTM's *Principles and Standards for School Mathematics*, there are five content standards across K–12: number, algebra, measurement, data, and geometry. That is the mathematics of *Math Trailblazers*. Those strands are like five threads that are interwoven throughout the curriculum, developing alongside one another, and connected to each other. We don't really see them as discrete topics. In almost any lesson, you'll see different content strands tied together. For example, any time you do a science experiment, you're collecting data, you're graphing. You're measuring, so measurement is very strong. In 3rd, 4th, and 5th grades, the ideas of proportional reasoning are always in the background.

One of the organizing ideas behind our curriculum is the concept of a variable. By the upper grades, we're actually quite explicit about this; we talk about variables. We focus on the variables that are fundamental in both mathematics and science, basic ideas in science that are also important ideas in math: length, area, volume, mass, and time.

In a traditional math curriculum, measurement tends to be pretty formal. The most horrifying examples I've seen in textbooks are those in which they show two objects and say, "Which one is heavier?" Of course, just by seeing the size, you can't really tell which one is heavier. By doing the integrated activities, the labs, it's much easier for us to do measurement.

Of course, at the root of everything is number. If you don't understand number, then it's hard for you, for example, to understand measurement. We find that in doing measurement activities, children learn about number. It's a two-way street. Our approach is not, "Well, we'll teach the kids about number, and once they understand number, then we can teach them about measurement, because measurement is based on number." We find it works the other way, too: by doing vari-

ous measurement activities, which are very engaging for the students, they're building their number ideas. A good example of this is when we're measuring mass. We use a two-pan balance. If you want to find out the mass of an object—or its weight—you put the object in one pan, and then on the other pan you have these standard masses, which are ones and fives, tens and hundreds. Basically, you're using the place value system. If you want to find the mass of something, you have to build it up using tens and ones and fives. You're also developing number sense, promoting facility in breaking down and combining numbers.

Technology

In *Math Trailblazers*, we assume that the students have access to calculators. We don't really think of the calculator as any different than the pencil. We don't have lessons on how to use a pencil, and we don't have lessons on how to use a calculator—we have lessons on mathematics. Sometimes the calculator is an appropriate tool, and sometimes it isn't. There are lessons where we say, "Okay, today we're not going to use a calculator." We find that, most often, unless it's gargantuan numbers, the kids will do computations by hand.

We try to communicate to students the idea that there are certain things you can do in your head, there are certain things you can do with pencil and paper, and there are certain things that you might want to use a calculator for. You can figure out when to use which one. Prohibiting calculators doesn't makes any sense; there's no evidence that prohibiting them helps kids learn arithmetic any faster.

Computers are a different story. As we were writing the curriculum, we couldn't assume that a school would have any particular piece of software. Can you write a unit that says you've got to use this piece of software, when the school might not have the computers? It's not like the calculator, where, more or less, all scientific calculators are the same. We, ourselves, did not develop any software for *Math Trailblazers*, so the computer is more of a supplement to the curriculum.

Curriculum as a tool for professional development

One thing that sets all the National Science Foundation-funded curricula apart from almost all other curricula is that one of the purposes of the curriculum is to be a professional development tool. We all recognize that most elementary school teachers do not have a strong math background. I am a university professor, and I have to admit that universities don't always do the best job possible in educating future teachers. A major component of *Math Trailblazers* is the Unit Resource Guide File—the box with a strap around it that has 20 units or so at each grade—that are really background material for the teachers.

We also have something called the *Teacher Implementation Guide*. The second half of that book is really a mathematical reference for teachers. There are about 14 of something we call TIMS Tutors, which discuss key mathematical concepts in the curriculum. For example, there are TIMS Tutors on functions, estimation, accuracy and error, each of the variables addressed by the program. There's a TIMS Tutor on arithmetic, which is very important, because it spells out our philosophy about learning arithmetic. In general, most teachers haven't been teaching much measurement, so if you give them the knowledge, and some good activities about measurement, then generally they will adopt those and implement them. It's not as if they've been teaching measurement a different way for a long time. The same is true of geometry, and foundations for algebra. It's really in arithmetic that we

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encounter the most resistance. There has been a traditional way of teaching arithmetic, and a traditional way of teaching the basic facts. In fact, arithmetic may have been all that some people were teaching. Now we're saying—I think all the NSF-funded projects are saying—"Gee, you really should be doing it a different way," and that can make people pretty uncomfortable.

The curriculum is written to encourage a different style of teaching. For example, many problems have multiple solutions. In our textbook, you might see a problem posed, with an accompanying vignette for the teacher, and there are little thought bubbles, where one student is saying, "Well, I solved it this way," and another student is saying, "Well, I did it this way." They may be using mental math, they may be using a calculator—they're using quite a few different tools. We try to point out for teachers how it will work in the classroom, and what they need to pay attention to.

Professional development

School districts have to understand that implementing a program like this is not merely buying another textbook. When you're adopting a reform curriculum, you're talking about a new way of thinking about mathematics, which involves some new subject matter—that teachers may be unfamiliar with—and new ways of teaching the subject matter that is familiar. We're talking about really a whole philosophical change in the way you're teaching mathematics.

School districts need to realize that this is a complex task, and provide the resources to do the professional development that's needed. The professional development that teachers need does not happen in the traditional one-day workshop on the new program. There are several components to it. There should be time devoted to workshops given by people who are expert at using the curriculum. What's equally important is time during the year for the teachers to get together maybe weekly or monthly to discuss their problems, in grade-level groups and larger groups, as an ongoing support. Our guess is that it takes three years to really get good at teaching the curriculum. The first year is the hardest, certainly. A lot of teachers tell us, "It wasn't until January that it clicked—then suddenly I saw what this was all about." The second year is always much better.

We have a listserv of people using the program that has worked very nicely. Practitioners who are using the curriculum answer questions for one another, and that's very useful, since they have a wide range of experiences. For example, an early message on the listserv was from a teacher in Washington State who wanted advice on teaching a split 2nd/3rd grade class. Now, we didn't develop the curriculum originally for teaching split-level classes, so we had limited knowledge of how that would work. When that message was posted on the listserv, a teacher in Arizona replied and said, "I did that last year, and here's what we did."

Data on the impact of *Math Trailblazers*

We've just finished writing a chapter that synthesizes all the data we've collected on the impact of *Math Trailblazers* to date—it's going to be published with chapters on the other NSF-funded curricula in a book Sharon Senk and Denisse Thompson at Michigan State are editing.[1] We've worked with a variety of schools, inner-city and suburban schools, and we find that test scores on traditional stan-

[1] Senk, S. L. & Thompson, D. R., Eds. (in preparation). *Standards-based mathematics curricula: What are they? Do they work?* Mahwah, NJ: Lawrence Erlbaum.

dardized tests are increasing as a result of using *Math Trailblazers*. Of course, our curriculum really isn't designed in order to get better performance on multiple-choice tests, but that is happening. We have eight schools in Chicago where test scores went up. The school we've worked with the longest, the Boone School in Chicago, has had test scores go up quite dramatically, even over the same time period when their socioeconomic status has gone down. It's quite remarkable.

We are also in the process of gathering data on more complex measurements of students' performance. We do have a lot of positive anecdotal data, but it is very difficult to do a controlled experiment with curriculum implementation. Many of the districts that have adopted our materials changed their assessment practices at the same time, so it is very hard to compare results. We're continuing to collect and analyze that data.

Catherine Kelso

Implementation strategies

One of the things we strongly recommend is that school districts don't implement the entire K–5 curriculum at once. There are alternative ways to implement the curriculum that are more gradual and thoughtful. For example, in Waltham, Massachusetts, they had preparation in the years before they adopted the curriculum so that teachers understood the standards-based mathematics before they got into it; they knew that Trailblazers matched where the district was going as well as where the state was going in terms of evaluation. When they began implementing the materials, they didn't try to do it all at once. They did it over time: the first year, every teacher did just a couple of units, and then the next year they were doing all of it. They had a thoughtful plan for training and implementation that was gradual.

Another model that has worked well is the one used in North Thurston School District in Washington state, where they had what they called a "year of inquiry" before they selected the curriculum. During that year of inquiry, they looked at programs and made the decision to go with *Math Trailblazers*. The next year one teacher per grade level per school used the curriculum. Everybody came on board the following year. They have Teachers on Special Assignment who support teachers in schools. It was also important that their school administration said, "This is what we're doing. Go with it. We support you. Teach this,"—and they didn't say, "Prep for the Washington state test." The message they put out was, teaching this program will prepare kids for the Washington test.

It also works to implement a few grade levels at a time, gradually. You might begin with K–2, then implement grades 3–5. This model lets you provide some readiness preparation for the non-implementing grades, doing workshops or having teachers try a unit in their classrooms. When K–2 teachers begin teaching the curriculum, they get good training all year long, focused on their grade levels. During that time, the grades 3–5 teachers are getting prepared, doing some readiness work so they understand what the program is about. The following year, the grades 3–5 teachers get intensive training all year long.

Catherine Kelso co-directs the TIMS Project at University of Illinois at Chicago and the *Math Trailblazers* Implementation Center. She is a senior author of *Math Trailblazers*, a staff developer, and a former teacher.

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Looking across grades

We think it is incredibly important for teachers to know about the curriculum materials across the grades. *Math Trailblazers* has strands that build from year to year—for example, students study area every year, they study volume every year—and we need to convince people that it's worthwhile to do those pieces that they may not perceive as important, because next year's program depends on them. For example, one teacher may decide not to do a unit on area, not realizing that a later unit that uses an area model for multiplication depends on it.

Teachers can be very focused on what they have to do day-by-day. We think they need to see the big picture, but we know in workshops that teachers generally feel it is most important to open the materials and understand what is in there. So we do spend a lot of time in completely grade-level groupings. It's hard sometimes to convince teachers that the time we spend looking at the strands across grade levels is also worthwhile.

Grouping

Our recommendation is that people use heterogeneous classrooms. It is an equity issue for us—mathematics is for everybody. Our notion is that there are many different ways in the curriculum for kids to get at the subject matter. Classic examples are the labs, where kids are working with either the real objects, data tables, graphs, number sentences, or very abstract kinds of ideas; they may also be pushing it further and saying, "What's the next question to explore?" Kids of all levels can operate within the labs, within those different representations, and learn something from it. Also, the curriculum spirals, so that a child who may not get a concept in one context may get it in the next context.

Parents

Be pro-active with parents. Don't wait until complaints hit. People have done a lot of things to involve parents, from math nights to big math carnivals, where the kids teach the activities to the parents. There are letters in the program that go home to parents. In one district, the coordinator ran a six-week course for parents and taught them mathematics, essentially. It depends on what will work with your audience. Teachers need to communicate with parents, making sure that the parents see the math facts practice and that the arithmetic they value is visible. ■

KATHY BEACH ▸ TEACHER, GRADE 3

Kathy Beach is a 3rd-grade teacher at Horizons Elementary School in Lacey, Washington. She has been teaching for seven years, in grades 1–5; before that, she worked outside of education, in restaurant management and other positions. Lacey is in the Olympia area, and is part of the North Thurston School District, a sizable and largely middle-class district. The district includes Fort Lewis and McCord Air Force base and serves many military families. Kathy has used the *Math Trailblazers* curriculum for three years, and in addition to her own classroom work, also provides training and support for other teachers using the program.

Why *Math Trailblazers*?

Our school is a relatively new school—this is our sixth year. When it opened, there were a lot of different curricula being used at our school that teachers had chosen. Nobody really found anything that they loved. We picked units from different programs to cover all the bases.

After a pilot process two years ago, the math leadership team in the district decided that *Math Trailblazers* was the program they wanted. One reason *Trailblazers* was chosen was that it met all of the *Standards* that NCTM had set forth in terms of what needed to be taught to kids. It also aligned with our essential learning goals—our Essential Academic Learning Requirements—so that was in its favor. It was conceptually-oriented. It was a program where students could be actively involved. It stressed thinking, reasoning, applying what they learned. Our new state assessment test is not a bubble test; it's "Explain your thinking;" "Draw a picture." It's not enough to just do an algorithm on that test. So *Trailblazers* was consistent with that. It gave kids a lot of really good use of manipulatives, and balanced their use. I've used some programs where you use a lot of Cuisenaire rods, but then you never use anything else. *Trailblazers* includes a lot of things.

It also tied in really well with our science program, which was another positive. When you do a TIMS lab, as they call it, you're really using the scientific process. It's very similar. That helps kids see that it's important across the board—that you don't just do something in one subject that has no importance in another subject.

Instructional approach

My students work in cooperative groups quite a bit. Besides *Math Trailblazers*, we also do *FOSS Science*, which also does a lot of group work. I encourage talking between the students because I believe they listen to each other probably as much, if not more, than they listen to their teacher. It helps them to clarify their thinking and to learn from each other. It's a pretty active classroom.

In 3rd grade, there is also an expectation that they start to become more independent in their learning. As far as my personal approach, we do a lot of working in teams but I also insist that they begin to learn how to work independently. A lot of our math we'll do together. If it's new concepts especially, I'll model what it should look like. We talk about the expectations. We do a lot with rubrics so they know what the expectations are, you know, and to clarify how we would grade it, what we're looking for. For assessments and that kind of thing, then it's individual.

One of the major strengths that I see when children are working with the program is that it really does help them to develop concepts. *Trailblazers* works on a concrete level with manipulatives to build concepts before students ever start writing it down on paper, so that when they are presented with an algorithm, they have not only a mental understanding, but they've had a tactile understanding.

Subtraction with borrowing always causes kids a lot of confusion. I was amazed last year after I taught *Trailblazers* at the retention and the true understanding. When they started borrowing and showing it on paper, they really knew what it meant. And further into the year, when a subtraction problem would come up, they

still understood how to do it. The knowledge was really there. It wasn't just something they learned for a test.

The program has a spiral approach to the mathematics. If you're doing addition and subtraction and you have some children who, even with the concrete tactile sense and the conceptual base, still don't quite get it, you have some assurance you'll come back to it. Those students may be more developmentally ready in two months or so, and be able to get it then. That's actually hard for some teachers because they are used to teaching to mastery, and they don't want to let things go and move on because they're afraid that they'll never get another chance.

I personally think that the spiral is really great because I know when you only touch something one time during the year, not only do you have guilt, but the kids have such guilt that they failed. With *Trailblazers*, they don't feel that way. We say, "Don't worry about it, we'll do it again. You'll get it."

Mathematics

Kids really develop strong number sense. They understand how to use numbers to their benefit, how to break apart numbers. It's just amazing sometimes when they do problems and they tell me how they figured it out. I never would have thought of their approach in a million years because I don't have their number sense. The program does a really good job with addition and subtraction.

It also does a really good job on area, I think. Kids are dealing with irregular area and how to figure it out—it's not just multiplication of the lengths of the sides. They do go on to see how the formula would make it easier if you were dealing with regular shapes, but they learn how to do it on an irregular object first. I think they understand better what area is, because of this approach—area's not just a multiplication problem.

My 3rd graders can look at data and put it into a data table and then graph it. They learned about volume—I don't think I touched on volume until I was in high school. I think the program is pretty good with measurement. Kids like to measure things, and the program builds on that; it builds on their interests.

Last year at each school, there was usually one teacher at a grade level who would implement the program first. At one school, pretty much the entire 3rd grade implemented all at once. They didn't like the program, and I think they did it to prove that it was bad. They did not want to change from what they'd been doing. At every math club meeting we had, they were negative: they didn't like this, they didn't like that, kids weren't learning their math facts, on and on.

After the first semester in their school, they always give a big math facts test. They totally expected that when they gave this test, it would prove that children were not learning math facts, because they had not been focusing on memorizing them. They gave the math facts test and they found that their students did just as well as they ever had. In addition, their attitude about math was far better than it had ever been. So those teachers grudgingly became believers.

At another school, they have a math facts olympiad that they do it in every grade. It's a giant timed test. All the *Math Trailblazers* teachers thought, "We're not going to do very well. We haven't worked on it." In the grades 1 through 6, four of the six grades were won by the *Trailblazers* classroom. I think that won over a lot of people.

Assessment

I like the quality of the assessments. Some teachers I know don't think that there are enough assessments. But we've tried to go through and look at every unit and say, "Okay, this is the only thing maybe in this unit that is labeled 'Assessment,' but we've found that this homework makes a really good assessment for this concept." Or, "This class activity is really good for an assessment." So we've tried to find other things that are embedded in the program that help the teachers assess their students. If you just used the assessments that they put forth as assessments, there was a general consensus from the teachers that maybe that wasn't enough. So we did go back and look at things. And the people that had piloted and implemented the first year had all found those as we went along. So we tried to pass them along so it made it easier for the rest of the teachers.

The math facts acquisition is on a different timetable in *Trailblazers* probably than it has been in other programs that just did a lot of memorization. *Math Trailblazers* basically believes that by 2nd grade, kids should be very familiar and have facility with their addition facts through 18; and that by 3rd grade, they should have facility with addition and subtraction and have an understanding of multiplication, but probably don't have their facts committed to memory. That's a slower timetable than we've had before, and that's hard for a lot of teachers to deal with. But also in the past, 3rd graders probably weren't dealing with irregular area or volume, drawing 3-D, figuring out how to build a city, and those kinds of things.

Meeting needs of all learners

The reading level in the materials is high. That's problematic. In my classroom this year, I have a girl who's a good little mathematician. She does a good job with numbers. But trying to read the text, or read the directions, or read the problem, causes her a great deal of stress. She would not be successful if she had to do it on her own, because she couldn't read it. I solve that by reading a lot of the daily problems aloud so the kids can hear me read them. Then with some kids, I'll go over to them individually and make sure they understand it, or they'll come to me and say, "Will you read that again?"

I don't have any kids that go out of my classroom for math; they're all integrated in my program. Generally what I find is, if I read to them, they can do the math. The manipulatives help for some kids, because they can have that concrete example in front of them, and then they can write down what they see. If they have trouble with writing, they dictate it to me and I can write it for them. Or they just try to get the basic words down.

In a lot of lessons, students are partnered or working in table groups, so one person can be the writer, and they can both share their thinking. I try to keep those groups mixed up so that they're working with different people, so I don't get one combination where you have one leader and the other person is just sitting there thinking the other person will solve it.

One thing I really like is that in the book they have given great thought to equity and gender bias. It shows boys and girls doing everything. Boys and girls being smart. Boys and girls thinking about things in different ways. You know, I felt some prejudice in math and science in high school because I was a girl. I know I still see it with my daughters to a degree. That's a very big issue for me and I've been very pleased that they handle it well.

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We are dealing with the concepts and not just how to do procedures. I spend a lot more time going around talking to individual students, making sure they're clear on things.

Units

I know that there are some units probably as we go along that people like more or less than others. There's one unit—Unit 8 in the 3rd grade—that we, as a district, sort of between us have decided not to do exactly the way it's presented. It deals a lot with mapping and coordinates, and a big part of our social studies curriculum does that also. They build a town and that kind of thing and it's very fun, but we also do those kinds of things in social studies. If you're going to do it in social studies, you might not want to do this particular *Trailblazers* lesson. Or you might want to do the *Trailblazers* lesson and not do it in social studies.

So there are some units that probably are not as strong as others or that aren't as critical. For example, I did not do the unit on tangrams last year. I think it's a really good unit, and it's great enrichment—but quite honestly, kids aren't tested on it and I needed to get to some other things. I needed to do volume and I needed to do some other topics more.

There's too much in the program to get through it all. There are 20 units in a year. See, my semester is ending soon. By all rights, I should be on Unit 10 and I'm not, I'm on Unit 7. So, it's obvious right now that I'm not going to get through the whole thing. I'm further along than I was last year, but that's still a frustration to some teachers. But, I don't know anybody who's ever gotten through an entire textbook in a year.

We've asked all teachers in their first year of teaching *Trailblazers* to be very pure in the program, to implement it correctly, and to make sure that we're giving the program a fair chance to see how it does. But then after that—a lot of teachers have favorite lessons, and they don't want to give them up. So if you can see a place where you can put it in, you might. It's part of your personality, and you know, we don't want to take that away.

Technology

We use calculators a lot. We teach them to use the calculator as a tool, not a crutch. There are some times when, if you are testing a certain kind of knowledge, then no, they can't use their calculators. But if you are trying to solve a bigger problem—like, for example, figuring out the area of their coats, which we measure in base-ten pieces and then add together all of the base-ten pieces—if they had to do that with paper and pencil, it would take them forever. Also, they probably don't have the facility with numbers that large yet, because it's early in the year. So being able to use a calculator is very motivating, and it gives them greater ease to figure the problem out.

Time

One challenge is how much time *Trailblazers* takes. It's not a program that you can do in 30 minutes a day. It's not like a traditional textbook, where you assign a page of problems and they sit down, do it on their own and 30 minutes later, it's done, you can correct it very quickly and you're done with math. I spend over an hour every day on math.

It's so full of information. We are dealing with the concepts and not just how to do procedures. I spend a lot more time going around talking to individual students, making sure they're clear on things. When I grade work, I really have to read it carefully and see, if they're not doing it correctly, what their mistakes are, and what the mistakes in their thinking are, trying to figure that out. Then I go back and talk to them and try to help them clarify that. That takes a lot of time.

Teacher preparation

The program is challenging because there's so much information for the teacher. It's not a textbook where you can just go to your book and say, "Oh, yeah, I have to do math now. Oh, I'll do this page." No way. Before I start a unit, I always take the teacher guide home, read through the whole thing, and make sure I understand it. There's a wonderful book, called the *Teacher Implementation Guide*, that goes through mathematical concepts, the philosophy of the program, how to teach different things, so that, for example, if you are not very clear about volume, you can get a little mathematical education right there.

You really do have to do that, because the program is dealing with concepts that, if you've taught 3rd grade for a long time, you haven't taught before. It does take a lot of time, not just to teach the lesson, but also for teacher preparation. After the first year, it's not as much; you pretty much make your overheads, and your materials are set, so it's not that kind of preparation. It's more mental preparation, I think—making sure that you are mentally prepared to explain what you're teaching.

The program provides support for teachers on learning the mathematics. I haven't had any problem teaching it, and I was not a math major. I haven't had any problems teaching the lessons as long as I've done my work ahead of time. For example, on the day that we start doing point graphs and start talking about extrapolation and interpolation, if I have not gone back over that and clarified in my own mind what they mean and why we're doing it, then I'll be in trouble. But if I have prepared, it's okay. The resources for teachers are there in the program. The materials also give you journal prompts, homework ideas, and literature connections so you can extend the lessons. The materials have really worked for me.

Teacher support

I have nothing but praise for our district in this implementation. Our curriculum director committed not only to finding the best program that we could, but also to spending the money to train the teachers. As I said, about a third of the teachers implemented last year, our first year of the adoption. We had trainers at every grade level who had been part of the process of selection. They went to Chicago and worked with the authors so that they understood the program. The authors came to our district and still come to our district to do training.

We have 12 elementary schools in the district; last year we started implementing *Math Trailblazers* with about one-third of all the teachers in the district. Each year we're adding more teachers. We had three full days of training on the program in the summer before school started. We got our materials before school started, and it was key to have them so that we could work with them in the summer before we started. After school started, we continued to meet about once a month in what we call math clubs, after school from 4:00 to 6:00 p.m. That's paid time so there's a double motivation for teachers to come. We talk about the next units we're going to be using, problems that maybe we've had, strengths. We look at student work and kind of compare and see how all of our students are doing across the district.

This year, because we have a group of one-third of the teachers who've already done it for a year, we also have a math club for "veterans." It meets about four times a year, and we can talk about loftier math things, or still talk about the day-to-day nitty-gritty. If there's one unit that causes you a lot of trouble for whatever reason, you can talk about that and find out what other teachers are doing. I think that has just been worth every penny of the hundreds of thousands of dollars it's probably cost. It's allowed teachers the time to talk to each other and to learn about

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what they're doing and to really understand the program they're teaching. And so often that doesn't occur.

A neighboring school district adopted *Trailblazers* this year. I did some training for the 3rd-grade teachers. They had one day of training—one day!—and that was it. At specific schools, the principal has found building money to pay to have someone come and help them out. But as a district, they haven't committed any more money to training their teachers. They also adopted *FOSS* at the same time, so their teachers are really feeling under the gun. I think that support for teachers was one thing that our district did that was really, really a great help and showed how firmly they support the program.

Parents

This kind of math, no matter what program you choose, is difficult for the parents because it looks so different from what they're used to. We did quite a bit of parent education. My particular group wrote a grant proposal, and we won some money to do family math nights. We did three family math nights last year, and tried to educate our parents about what the new conceptual math looked like, what the state testing looked like, why it was a good fit and what their kids would be doing. We also talked about how they could help at home. Even though they might not understand some of the work their kids were doing, there were still a lot of things they could do to help the program.

The math nights have helped a lot. I took one of my math nights and just addressed *Trailblazers*. I actually took them through the steps of how they teach addition and subtraction, using all the base-ten blocks and the manipulatives and how it flowed into the algorithm. After that, I did not have another negative letter. There are still a lot of parents who are worried that, at the end of 3rd grade, kids haven't memorized all of their multiplication facts. The focus of the math night that I just had was on games that parents and children could play at home to work on math facts, just using decks of cards and things. These are things they can work on with their kids that are fun and easy to do. I don't want to spend a half hour in class memorizing multiplication. We have far greater things, bigger things to think about.

Another thing that helps with parents is the fact that my door's always open. You don't have to make an appointment to come to my room. You get what you get if you walk in—but I don't have anything to hide and I'm more than happy to help parents if they don't understand it. I think that that's pretty much true throughout our school. And I think that that is also the message that has come from the administration. Parents need to know that if they have concerns, they can call the teacher, or they can call the principal.

I think that as parents see what their students are doing throughout the year, they become believers. The students become so much more resourceful and proficient at problem-solving and exploring different ways to find the answer. And I know parents are so amazed—just like I was—at how kids can see numbers of things and use that number sense to really create wonderful answers.

One of the things that I've learned is what homeworks are good homeworks to send home and what homeworks we really need to do in class because of parent frustration. Last year, not yet knowing this, I sent a homework home and got back such venomous mail: "What is this? Why are you asking my 3rd grader to do this? If you ever send another magic square home, I am pulling my child out of the school. I can't do this, and neither can he." So now I'm just making better choices on what to send home. ■

DIANE VANSTON ▸ TEACHER, GRADE 3

Diane Vanston is a 3rd-grade teacher in Northville, Michigan, a small suburban district with five elementary schools. In her 23-year teaching career, she has taught 1st through 5th grades, and has also taught in multi-age settings. Diane has been teaching *Math Trailblazers* for two years with her 3rd-grade class; Northville has adopted *Math Trailblazers* for use in all of its elementary schools.

Why *Math Trailblazers*?

When we looked at the benchmarks for mathematics that had been established in Northville, *Trailblazers* met most of them. As a district, we have goals for our students by the end of the 12th grade, and one of those goals is that we want them to be communicators of information and problem-solvers. So, along the way, the curriculum needs to develop those skills in our students so that when they graduate in 12th grade, they'll be prepared. We want students to know the content, the basics, but we also want a lot more problem-solving and strategy and analyzing problems in mathematics. Problem-solving is a big part of the *Trailblazers* program.

Trailblazers does a lot of data collection and analysis and interpretation of data in the context of real-life situations, which I think is a strength. When we're teaching multiplication, and the program sets it in the context of running a lemonade stand, which a lot of kids have tried to do at some point on a hot summer day, the kids can relate to that and they can start seeing why you would want to learn the content. Those kinds of problems, I think, make it more realistic for them and bring some purpose to what they're learning. One of the things we were looking for in a curriculum was the use of applications. I think *Trailblazers* does a very good job of teaching kids content, and then having them apply it, and that takes them to a higher level beyond the computation.

Trailblazers' correlation with science is a real plus. In my 3rd-grade classroom, in our science investigations, they have to draw pictures of what's happening and write conclusions—just like in the math investigations. *Trailblazers* meshes the science and math nicely. We're looking at a new science curriculum now and I know that we've revised some things that we've asked for in our science investigations to match the TIMS method. That whole concept of drawing conclusions is something that I think we look at in my classroom a lot, across different areas. When a math curriculum can help you pull that together in reading and in math and science, that's a nice form of integration for your ultimate end benchmarks.

Meeting the needs of all kids

We're looking for instructional approaches that meet the needs of all kids. We use different methods of instruction to do that. During the course of the day, we're doing hands-on experiments, we're doing some lecture, we're doing a lot of drawing and acting out. We're trying singing and jingles. The kids work in small groups, and they work in large groups. There are large group discussions and small group discussions. Personally, as a teacher I feel that, in order to meet the needs of all kids, you have to have all forms of instruction. I feel that's a necessity in good teaching.

Children have needs at all ends of the educational continuum. There are students who do things quite easily; there are children who need lots of repetition and lots of hands-on activities. There are students who need a little bit of both. Within any classroom, within any program, I think there's a continuum of educational needs that we need to meet. As educators, we need to do whatever it takes in the delivery of instruction to meet those needs.

I think teachers can use the resources that are provided in *Trailblazers* to meet the different needs students have. I don't think *Trailblazers* was written to be regi-

Trailblazers does a lot of data collection and analysis and interpretation of data in the context of real-life situations, which I think is a strength.

mented, for there to be only one way to teach it. My perception is that *Trailblazers* offers the professional who's using it a lot of resources, and the professional needs to determine how they can use those resources to meet the needs of the different learners. One of the pluses of the program is that there are so many DPPs (Daily Practice and Problems) and DHPs (Daily Homework Problems) and a lot of information.[1] As a professional, you have to pick and choose.

Sometimes with new texts, teachers feel they have to do it all. With *Trailblazers*, they can't do it all, because there's just so much there. I see that as a plus; I look at the material from *Trailblazers* and say, "Thank you for letting me, as a professional, make some choices." Too often texts tell you, "Do this for your weak students and this for your challenging students and this for your medium students." *Trailblazers* says, "Here's a lot of material—challenging things and things that are a little more basic. Choose what you need for your students." I think that gives teachers the recognition that they're professionals in what they do. There's a lot of resources there, and you use the ones that work for you, and adapt the ones that don't, because they're giving you the base to work from. And I think it's an excellent base in terms of problem-solving and presentation of concepts in a realistic format.

Spiraling

One highlight of the program is the DPPs, the Daily Practice and Problems. Those problems constantly bring back concepts that students are reviewing and spiraling through again and getting better at. Maybe they didn't get it the first couple of times, and the problems bring it back. If they've learned it, the DPP may bring it back to the forefront, to make students remember and analyze and apply those strategies. The concept of bringing back a little piece every so often is a unique part of the program that I personally have found to transfer well into other areas of my teaching. I sometimes add a science review onto my math DPP, if I'm just going to collect it. "Tell me again how force relates to energy or work relates to energy?" Or I ask them to make an application. I think that whole concept of doing that is a very positive educational plus.

In the first year, I think we struggled with the DPPs. I don't think it's a fault of the program. We would do the DPPs and we'd spend a whole lot of time doing those problems, when they should have been quick and short. But because our students hadn't had two years of DPPs and the previous content, we spent a lot more time on that portion of the program. Teachers were saying, "I'm teaching math all the time—this DPP that should have taken 10 minutes took 40 minutes and I still have to teach my hour of math and get to social studies and science and..." I think that might come with the first year of any program.

Mathematics

All of the graphing and the collecting of data, comparing and analyzing the data, is probably *Trailblazers*' strength. Number sense is another strength. The DPPs really reinforce the number sense, asking, "What's 10 more? A hundred more? A hundred less?" I think most of the topics within—you know, addition, regrouping, subtraction—are strong. And I think its use of fractions is good.

[1] Daily Practice and Problems are short exercises to provide review and practice of math skills, concepts, and facts. They can be used in class or as homework. More information about Daily Homework Problems is included in the Wagreich/Kelso interview in this publication.

Mathematical vocabulary is interspersed well in *Trailblazers* so that students really understand some of those key terms that we have often in the past tried to get across to them in a memorization format. Now, they're using the terms a lot more, on a regular ongoing basis. Even if they're not using them within their lesson, they get them through their DPP. I think that's a real plus.

Kids are better problem-solvers

Our kids are better problem-solvers now. Because *Trailblazers* uses a problem-solving approach, one of the things that you teach students is that you have to keep on trying. You've attempted to use the data in one way that may not have gotten you the answer. You continue to try other ways, and you work with other people who can give you feedback and ideas. Students learn that sometimes problems have to be solved a couple of times before you get the right answer. In the more traditional math units that we'd taught previously, it was pretty much, "Do what I tell you to do, follow the directions," and get it right or wrong. There was a lot of rote memorization. There was one way to do it, and you had to learn the right way, and everybody had to do it that way. One thing that *Trailblazers* does for children is tell them that it's solving the problem that's important, not how you do it. I find that every year more and more students understand that there's not just one way to solve a problem.

You know, just the other day, as we were working on division and multiplication, I gave my students the problem: "I have 22 oranges that I need to get to Mrs. Wolf's class and only 3 oranges fit in a bag. How many bags do I need to get these oranges there?" Some students drew pictures to solve the problem. Some students did the computation. They solved it in a lot of different ways. As I walked around the room, what I felt the best about was that there was such a variety. The students were really thinking. I knew that they were starting to be real thinkers, because it wasn't like they had to wait to learn the one right way to solve it, and if they didn't get that, then they were lost. It was their work, and they could go to the board and explain it. They were proud of being able to say, "I can do it a different way. I have the same answer, but I've done it a different way." I think students gain a lot of confidence when they can solve problems.

We used to do problem-solving as a supplement to our previous program. We had books on problem-solving that would go through different strategies to solve problems, like draw a picture, or create a chart, or work backwards. We would teach every one of those strategies separately. We taught the strategies and then had students practice them working in booklets. Now, we're teaching the strategies without saying, "Today I'm going to teach you this strategy." They're learning that they have a need to learn the strategy, and I think that builds their confidence and their sense of who they are mathematically.

Supplementing

Trailblazers meets the Northville benchmarks beautifully in most areas, but is weak in a few, so we do supplement. The things we supplemented the most in the first year were things like time, clock, and elapsed time problems. *Trailblazers* addressed these areas in the DPPs, but the topics did not get the amount of exposure we felt they needed. We just supplement either with materials that teachers make up based on the needs of their students, or some materials from our old text.

Because* Trailblazers *uses a problem-solving approach, one of the things that you teach students is that you have to keep on trying.

In the first year, we were seeing more gaps. As with any new program, when you start a new program and you don't phase it in, students haven't experienced the whole program. My 3rd graders last year hadn't had the *Trailblazers* program in kindergarten or grades 1 and 2. I think there's always a lot more work in the first year when that happens, no matter what the program is.

As good as the program is at making children problem-solve and apply, sometimes the program doesn't take every step necessary to get our students to the application phase. I think that sometimes in *Trailblazers*, they start at step one and they may skip two and go to step three—and they just kind of expect students to make that jump. Because we have a continuum of kids, some students are able to make that jump, and some students can't. Those are the areas we decided to supplement.

We've also made some different assessments. When I look at an assessment and don't think it's going to assess what I want it to assess, then I make a different assessment. Sometimes, the program's assessments were at a higher-level application than what I wanted. At times, before I assessed that higher application, I wanted to assess just what they knew at a basic concept level. I know the theory is that you can't get to that application unless you have the basic concepts, but I think some of the children that fail in the application really do get most of the concept. I think that kind of teacher adaptation is necessary, regardless of the curriculum program, when you take responsibility for the continuum of students that you teach.

Materials for teachers

One of the things that I appreciate in the materials are the URGs, the *Unit Resource Guides*. The first year we taught the program, we studied those. We did the unit almost word for word as it was written, to make sure we got it right. What I appreciated most the first year I was doing it was the examples that they gave: examples of what had happened in other classrooms, examples of student work that were really helpful. The other thing that I really liked within the text were the rubrics that they give for knowing where you're going in a problem. Those things are really important; we do a lot with rubrics, and it really helped to have it be right in the math curriculum. Now the second year, the "At a Glance" part of the URG really helps me, as a reminder.[2]

Training teachers

The district did a very good job of training people. Some staff members went to Chicago to get training with the developers. They came back and gave us in-services. We went through our first unit before we even taught it; somebody took us through the whole unit to talk about what we should expect in it and answer any questions, and that was a real comfort. The district provided the manipulatives and everything we needed. So as far as resources go, we were able to go in fairly prepared and with a sense of confidence. Because of that, I think we had many more successes. And when you have successes, you feel good about what you're doing.

There were also monthly meetings for the different grade levels. At those meetings, we went through our units before we taught them. After we taught them, we met to talk about things that went right or wrong. People shared ideas that they had, materials they had used.

[2] "At a Glance" boxes are brief outlines of the activities of each lesson; they are provided in each unit's *Unit Resource Guides.*

We spent a year meeting with other people who were having the same concerns and problems, and getting help. If I had a concern or a problem, my co-worker might have had a solution to it.

Because of the possibility of sharing and getting help, the new curriculum didn't create the kind of anxiety that it might otherwise have. The district needs to be applauded in the way it introduced *Trailblazers* and supported it throughout. All the necessary materials were purchased; all our questions were answered. That allowed for a real comfort level for teachers. This year the support continues; we're still meeting after school. We don't meet as often—because we don't need to—but there's still that sense of, "We're having a problem; how can we solve it together?"

Parents

The parents think *Math Trailblazers* is a challenging text. I think that here in Northville, that's part of what they want. I think that it's looked upon as a very good choice of a text to meet our curriculum. I think parents see it as having less that is rote, and more emphasis on thinking, more problem-solving. They see how, if you can get students to problem-solve in mathematics, you can get them to problem-solve in other areas, in reading, science, and everything else. The community and the teachers on a whole are very supportive of it, and view it as an excellent choice by our math committee.

There are parents who were a little frustrated by the change, in that this approach is not how they were taught. There's some education of parents that needs to go along with this, and we've done that. We've held some parent meetings, which has been helpful. We brought parents in to actually do some of the data collection kinds of activities. We also give them examples of problems at our open house, and that's been helpful. With parents, anytime there's a big change, it is often hard for them to accept. But I think the district's done a wonderful job. The overall reaction to the *Trailblazers* is very positive. ■

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BARBARA MARTIN ▸ PRINCIPAL

Barbara Martin has been principal of the Holmes Elementary School in the Englewood area of Chicago for seven years. The Holmes school has 772 students in grades pre-K through 5; the student body is 100% African-American, and about 95% of the students live in poverty. Prior to becoming principal, Barbara taught at the Holmes School for 23 years as the mathematics coordinator, working with teachers and students in grades K–8. The Holmes School has been using *Math Trailblazers* for several years. They began piloting the program in one grade level and gradually added other grade levels each year. By 1998 the entire school was using the program.

Getting involved with *Math Trailblazers*

When I was a teacher and math coordinator, I found that math was taught very traditionally by most teachers. I had a math lab, and really the only time that children used manipulatives was when they came to the math lab. Then they went back to their classrooms and the way they did math was "Do page 25, problems 1 through 10."

When I became principal, we had recently embarked upon a new, somewhat nontraditional, reading program. Those first few years, I had to devote most of my time to getting this reading program off the ground. The program required new ways of teaching reading—shared reading, read-alouds, guided reading, and interactive writing—that called for a lot of staff development for teachers. We had a partnership with the Center for School Improvement at the University of Chicago, and people from the center were in the school, helping teachers. We started to get some recognition that we were doing some good things.

Then I started thinking about math—that it was time to get our math program going in a somewhat similar direction. I was approached by UIC, the University of Illinois here in Chicago. They were offering incentives to pilot this new math program. I attended the meeting for principals, and they explained the program. It had a problem-solving approach, which I thought was very good for little children, and for children who lived in the kind of environment that our Englewood community was experiencing. Kids needed to be able to solve problems, not only in math but in life. So I liked what I heard. It adhered to the *Standards*; it involved the use of manipulatives; it got away from the traditional textbook-way of teaching. It had the professional development component, and it had consultant services. I really didn't go looking any further, because it had all the elements that I thought we needed.

The program was very expensive. That kind of made me pause, because I had made a commitment to the reading program, which was very expensive also. We were bringing in literature, so that each classroom could have a library, and the use of trade books for reading instruction. But I committed us anyway.

It wasn't a hard sell for teachers, because I had been the math coordinator at this school for all these years, and they knew that when I became principal it wouldn't be long before I would start steering them toward something new in math. Also, it wasn't a hard sell because we had already gone through the new reading program, and teachers were beginning to notice the difference in children, and in their writing, because of the efforts that we had made in reading. We piggybacked right on that. We could do this same kind of thing in math, if we adhered to the national *Standards*; and, if we aligned ourselves with the UIC—as we did with the University of Chicago for reading—we would get the kind of support and staff development that we needed.

Role of the principal

Principals and other administrators need to understand their role in this kind of process. When you're starting something new, you've got to be willing to accept mistakes made by teachers. You have to create an atmosphere where it's okay to

do something new, it's okay to be innovative, it's okay to take a risk on teaching something new, even if you fall on your face. You just gather up yourself again and say, "Well, I won't do this next time. I'll do this and such." I think it's important for administrators to be supporters.

Trust is critical. Our reading program really helped with trust-building at our school. The whole idea was for us to become a demonstration school with the reading program; people would come to see us, people would be in our classrooms, and you couldn't just go and close your door anymore. It required that teachers observe each other. So while we were doing the training in the skills for teachers to teach the new reading program, there was also an element of professional community building, and that was based on trust and respect.

I saw my role as a keeper of the vision. We have this vision that our kids are going to achieve. When somebody's sort of sidetracked, or when a teacher is not doing what you expect, you bring them back to: "What's our vision? What did we say we wanted to do? How did we say we were going to go about it?" It's keeping focused: "We said that we're going to implement this program. We have invested our monies in it, and I need you to stay focused on the vision."

My first talk with the staff was, "I've been with you as a colleague, and I'm your principal now, and I'll just have to tell you from the get-go that you're probably going to see some change. I don't intend for it to be harmful or hurtful, but you're going to feel some agitation. And I think that's good." And we moved from there.

If you talk that talk, you've got to be a provider of resources. In other words, you've got to put the money there, and you've got to provide the time. For teachers who are involved after school, or going to the university for in-service, I try to pay them a stipend for their time. I try to provide the time for teachers in grade levels to get together—all grade levels have preps at the same time. I've paid for a consultant to come in once a month and work with new teachers on the math program.

Professional development

The key to all of this, I believe, has been the staff development. Once you can get teachers knowledgeable—knowing what they're doing—then you really don't have to worry about the kids. The kids are going to learn.

For *Trailblazers*, we were fortunate to have just completed a process with our reading program that was really good for professional development. It got teachers thinking about teaching and learning, and about learning and improving themselves. It was such a high-quality thing that it made the implementation of *Trailblazers* very easy.

For the math program, teachers met here for two hours once a week while they were implementing the program, to talk about how it was going. They went on Saturdays to the university for more professional development, and they went to two one-week summer programs, to get teachers started in their grade levels. New teachers also went. When I was hiring new teachers, I told them, "This is our math program. You're going to start with us in September, but I need for you to go this summer before school starts and get the training in *Math Trailblazers*."

Our math coordinator goes into teachers' classrooms to demonstrate lessons. I never did that as the math coordinator myself, but we've changed, based on what happened in reading. In reading, I have two literacy coordinators, one for primary, and one for intermediate grades. They are like demonstration teachers. They're in

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the classroom talking to teachers, meeting after school, before school, all that good stuff. It has worked really well. I wanted to duplicate that with math, so the math coordinator now provides that kind of support too.

What's challenging?

One thing that's challenging for teachers is getting the lessons duplicated. Teachers are saying that the program requires a lot of copying because there are activity sheets. The office has been helpful with that. I say to teachers, "Just give it to your grade-level chair. And if you need 300 copies of this, give us time in the office, give it to us in plenty of time to have it ready for you." That's what we do for lesson duplication.

Teachers also say to me that doing those lessons that involve a lot of manipulatives is challenging; sometimes they need somebody else there in the room. For the most difficult-to-manage classrooms, we've tried to have a tutor from the university sometimes, or maybe a parent in the room to just check in and keep kids on task with the manipulatives. But of course I can't do that for all the rooms.

There are materials we need to replace every year. The manipulatives are very expensive, and sometimes you have to replace them. Calculators also need to be replaced sometimes. The textbook that goes with the program is consumable for 1st and 2nd grade, so every year I have to have a budget to buy that, and to replace lost books.

Assessment

Our school is up for quality review this year. Quality review requires that teachers show three different types of assessments in mathematics from their classrooms. I think with any other math program, we wouldn't have been able to provide those different types of assessments. Some of them have been designed by teachers—my kindergarten teachers have written their own assessment with *Trailblazers*. Others are pulling assessments from the *Math Trailblazers*. The requirement is that you can have only one forced-choice-type assessment. One other must be a performance assessment, and certainly if you were using manipulatives and those kinds of things, you can do a performance assessment in *Math Trailblazers*. The other could be some kind of project, and that's easy to do with a program like *Math Trailblazers*.

Student reaction to *Math Trailblazers*

Students don't think they are really doing math when they do *Math Trailblazers*; they think they are playing. You don't get those ugly faces anymore when you say it's time to do math. When I talk with teachers about how students respond to the program, they never say that they don't like it. I used to hear that when people were just doing the pencil-and-paper-type math, kids were frustrated or had no idea what was going on, say, in long division. If, on the other hand, you can do division using manipulatives, separating and grouping objects, that reduces the frustration for those kids. So they have a more positive attitude about math. *Trailblazers* really calls for problem-solving. There's not just one way to solve a problem; there may be one best way, but I think that it's good to teach kids that their ideas are okay.

Wherever students go into in the middle grades, if they've had a sound foundation in the primary grades, they will be prepared. I think these kinds of concrete learning experiences are what primary kids and remedial kids need. I do have all levels of kids here: we have an accelerated program in each grade, and we also have special education. They are all using *Math Trailblazers*. For some of my children, our feeder schools are saying, "Please, please send us more like these."

Parents

We invite parents to an orientation where we talk about all our programs early on in the year. Our math coordinator speaks to the group about math lessons. *Math Trailblazers* has parent letters that go home all the time telling about what's going on in the math program. We do also have a math day, and on that math day, we invite parents to be in the room. The kids do math all day. In order to get the parents in the room, I offer them a little stipend. I only offer the stipend to the parents who can stay in the room all day—they're helping the teacher, because they're doing math all day, with *Trailblazers* and all the manipulatives. At the same time, they're also getting to see what kids do. There are other parents that visit math day and leave because they can't stay all day. We have a good turnout. ■