MATH*THEMATICS*

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A middle school curriculum for grades 6–8, developed by the STEM Project: Six Through Eight Mathematics

MATH*Thematics* is a complete three-year mathematics curriculum for students in grades 6 to 8. This program presents mathematics in relevant and meaningful contexts; each module focuses on a theme that extends throughout the module. The goals of this program are to help all students develop their abilities to reason logically, apply mathematical skills to real-life activities, communicate mathematically, and feel confident in using quantitative and spatial information to make decisions. Major mathematical strands of the program include: number concepts, measurement, probability, statistics, algebra, geometry, and discrete mathematics.

The instructional approach engages students in doing mathematics in a variety of settings. It encourages active learning, and students work both independently and in cooperative groups to investigate mathematics and solve real-life problems. Not all instruction, however, is through discovery learning; the program includes direct instruction in concepts and skills as well. The curriculum includes practice, review, and extension exercises that reinforce and extend learning.

Assessment is an integral part of the MATH*Thematics* materials. Each grade-level course begins by introducing students to assessment criteria that are used for assessing problem solving and mathematics communication on open-ended problems and projects throughout the modules. Other assessment tools include "checkpoint" questions that check students' understanding as they are exploring mathematics; reflection exercises that ask students to describe, summarize, and extend mathematical ideas; module assessments that ask students to reflect on a module as a whole; and portfolio projects that can be used to assess whether students can apply what they have learned.

MATH*Thematics* assumes that students have access to a scientific calculator. Graphing calculators can benefit students in the 8th grade modules, but are not required.

Each of the three grade levels of MATH*Thematics* includes eight modules; each module requires about four weeks of instruction. The modules are available as a consolidated text for each grade level. Accompanying each grade level is a Teacher's Resource Package, which includes an annotated *Teacher's Edition* (with warm-up activities, closure questions, and answers to all student text exercises and questions), a *Professional Development Handbook* (which outlines program philosophy, assessment, and scoring rubrics) and *Teacher's Resource Books* (which provide module-by-module teaching strategies, classroom management tips, and blackline masters).

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RICK BILLSTEIN ▸ DEVELOPER

Rick Billstein is a professor of mathematics at the University of Montana, where he has been for 31 years. His current research focuses include curriculum development and mathematics teacher education. Rick spends half of his time teaching courses for future teachers, and works the remainder of his time on the NSF-funded Show-Me Project, supporting the implementation of standards-based middle-grades mathematics curricula.

Rick has coauthored 19 books and published over 50 articles in journals like *American Mathematics Monthly*, *The Mathematics Teacher*, *Electronic Learning*, *Mathematics Education Leadership*, and *Mathematics Teaching in the Middle School*. In addition, he has contributed chapters in several publications such as NCTM's *Mathematics in the Middle*.

Rick typically does about 25 regional and national presentations per year. In 2000, he served as an organizer and presenter for the ICME-9 conference in Tokyo.

Development of MATH*Thematics*

We wanted to design a program that middle-school kids could relate to—that's why we chose a thematic focus. We wanted the mathematics to be taught in context, and we felt that it would be better if kids could see the uses of mathematics. So we looked at the mathematics that was traditionally taught at middle school, picked the big mathematical ideas that we thought were important, and tried to teach them within a context. At the same time, we wanted to create an integrated mathematics program. In a traditional program, there's a chapter on probability, a chapter on decimals, a chapter on fractions, and so on. A lot of times, the kids get turned off in a particular chapter, or don't get to an important section. In MATH*Thematics*, the mathematics is integrated so we're doing some probability, some statistics, some number concepts, and so on, all within a context. When students see the mathematics in a context, they remember it a lot better. We feel it's just a much better way to present the mathematics.

We use thematic modules throughout the whole program. The mathematics is introduced in terms of the particular theme, so instead of having a chapter on decimals, percents, or probability, our modules use themes such as health and wellness, search and rescue, and the mathematics of the mall. Each module is intended to be four to five weeks in length, and the kids will stay with that topic and that theme for that whole length of time. When we field tested the initial STEM materials, many of the themes got stretched to six or seven weeks, and we found that the students started to lose interest in the theme. Four to five weeks seems to be about the perfect amount of time to stay with a theme.

It took us six years to write the program. We involved over 250 teachers—and more than 3500 students in 25 states—and every one of those teachers gave us feedback. So the materials were rewritten and rewritten and rewritten over the course of the six years of development. The MATH*Thematics* materials are somewhat different from what we started out with in the original STEM field-test materials. As a result of our development process, we learned a lot, and now we've got the materials pretty much the way we want them. That's a big difference between MATH*Thematics* and a traditional program that's written in nine months to a year and not classroom-tested.

Mathematics

In our development process, we used the NCTM *Standards* as a guide, so we covered all the major mathematical strands that are in the NCTM *Standards* and added one more strand, discrete mathematics. We also have four unifying concepts—ideas that are so important that we want to stress them over and over again—which are modeling, multiple representations, proportional reasoning, and patterns and generalizations.

We introduce algebra concepts early in grade 6 and build on them. We give students a lot of hands-on materials, and try to help them move from the concrete to the abstract. By the time students finish all three years of MATH*Thematics*, they will have almost the equivalent of an Algebra I course. They won't have extensive work on the quadratic formula and factoring, which are probably not appropriate for 8th graders anyway.

One of the things we're finding is that parents want an Algebra I course for their students at 8th grade just because of the prestige associated with it. As I've traveled around the country, I've visited middle-school algebra classrooms where teachers are using an algebra book—but they never get through that algebra book, so students don't get to the quadratic formula and the factoring, anyway. Students are not getting the algebra course that they or their parents think they are, even though all the topics are in the textbook. In fact, students using MATH*Thematics* are probably getting more algebra topics than they would get by taking a traditional algebra course. If students took three years of MATH*Thematics* and then went into a traditional algebra course, they would probably be bored with the traditional course—with the way it's taught, and with the content. If they finished two years of our program, they would have, essentially, a strong prealgebra background, and would be able to complete any Algebra I book out there, if they were to go in that direction.

Assessment

I think one of the major strengths of our program is in the area of assessment. We've tackled assessment in so many different ways, including developing a multidimensional scoring rubric that's used for open-ended questions. There are a few articles that have been written about our approach to assessment, including one in the NCTM middle-school math journal[1], and they all mention the scoring rubric we use for open-ended questions.

Built into MATH*Thematics* about every four weeks are what we call Extended Explorations (E^2). In these explorations, the kids have about a week and a half to write up an open-ended problem. They turn them in, and the problems are scored with a generalized, multidimensional scoring rubric; there's one version for self-assessment and one for teacher assessment.

We really emphasize student self-assessment because we believe that if we're going to see changes in students, self-assessment has to be part of the program. Students at the middle school will respond and work hard if they know the rules. Where they get frustrated is when they don't know what's expected of them and what the rules are. One of the things we lay out immediately in this scoring rubric is what's expected of students and what's important to us. We know that what gets assessed gets attended to, so what shows up in the rubric and what we tell them is important is what students will attend to. When you look at our scoring rubric, you'll see problem-solving, you'll see communication, you'll see connections, you'll see presentation, you'll see language, and you'll see multiple representations. These are the things that we think are important, so they appear in the rubric; they're also the processes that the NCTM *Standards* say are important. If these elements don't show up in students' write-ups of their problems, then the scoring rubric picks that up.

It's just unbelievable the difference we've seen between what these kids can do at the beginning of the year and what they can do at the end of the year. When students are doing self-assessment and peer assessment, they can see what other kids are doing. They can see that, "Well, I really wasn't very clear on this. I didn't explain that. I could have done this a different way." It's something that hasn't been done at the middle-school level before.

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[1] Billstein, R. (1998). The STEM model. *Mathematics Teaching in the Middle School*, 3(4) , 282-286, 294-296.

Changes in teachers' practice

Typically, we try to get teachers away from the lecture mode, the traditional way to teach mathematics. With MATH*Thematics*, about 30% of our activities are cooperative learning-style activities, and then, as a teacher, you can add more to that, or subtract a little from it. In some cases, there are class discussions, and at other times, there are lectures. I think there's nothing wrong with lecture, where it's an appropriate way to convey the mathematics. I think the biggest change for teachers is that they won't always be the lecturer, the center of the stage in the classroom. The kids will do some group learning, and they'll be learning the mathematics on their own. The teacher will involve them in self-assessment. Teachers will be using a whole variety of different assessment strategies, rather than just a typical test that's included in the book. And so the whole assessment practice is going to change for a teacher. Other major changes include getting kids involved in doing projects and getting kids engaged in doing mathematics—mainly teaching in ways that are different from teaching a traditional program.

Another big change that we discuss with teachers is why there is no need to bring the kids up to complete mastery the first time through, because we'll come back and revisit topics over and over again. In MATH*Thematics*, the topics are reintroduced in a different context later on, so you don't have to run-off the drill sheets the first time through the materials.

Teacher professional development

What we try to do when we bring teachers in for training is walk them through the *Professional Development Handbook*, talking about the philosophy of the project, and the underlying concepts and instructional approach of the program. We spend some time talking about cooperative learning and communication in the math classroom. We talk a little bit about what technology is involved and how we use technology in the program.

The length and format of the staff development varies depending on the school. We typically work with the school to conduct a needs assessment. Whenever possible, we try to go in to talk to the teachers at the school and find out where they are. In some of the schools, you've got teachers who are secondary-certified and know a lot of the mathematics, so a lot of the work we do with them is going to be on the philosophy and pedagogy. Other schools have all elementary-certified teachers who need more work on the mathematics content, so we spend more time on probability, statistics, and so on. We try to customize the in-service based on the needs of the school. Ideally, I'd like to have a week in the summer to work with teachers in a given school before they start teaching the program, and then come back and do periodic visits every two months. But in some cases—in fact, in many cases—that just doesn't happen.

We also offer leadership workshops where we bring in master teachers who have been teaching the program for a year or more. We work with them on how to work with other teachers, and send them out to work with teachers as part of the in-service program. What we've found is that teachers will listen to other teachers, and not necessarily to developers. So we really are buying in to this lead teacher concept where teachers are teaching teachers. There still are publishing company consultants and developers as part of the team, but we want teachers to be an integral part of the professional development package when we go out to do in-service programs.

New topics for teachers

Statistics is probably the area of mathematics content where we see teachers are the weakest. Many middle-school teachers have never seen things like stem-and-leaf plots, or box-and-whisker plots, or lines of best fit. The teachers also feel uncomfortable with probability, so we teach them about geometric probability, and the difference between experimental and theoretical probability, for example. Because the teachers we work with are, for the most part, elementary-certified, many have never had probability or statistics in their background.

Because the TIMSS[2] scores show that middle-school students are weak in geometry and measurement, we spend time on these topics. So in terms of content areas, probability, statistics, and geometry and measurement are the big items. And then, of course, numeration and fractions always cause trouble, so we discuss different ways to get fraction concepts across.

We now have our own manipulatives kit that goes along with the MATH*Thematics* program. One of the things that we've had to do, especially with teachers who are secondary-certified, is show them how to use some of the hands-on materials. Many teachers have never seen graphing calculators, or haven't done much with computer software, either. While it is possible to use our program without using a lot of the technology, we want teachers to be aware of the technology and familiar enough with it.

Implementation strategies

In terms of implementation, we've seen just about everything you can imagine. What we typically see is a school system that has a seven to nine year textbook adoption cycle, where they have to spend all the money in one year or lose it. So districts will typically adopt 6th-, 7th-, and 8th-grade materials in one year, and then implement all three levels all at the same time. I would say the vast majority of schools do that. Everyone is scrambling when the district tries to implement three different grades at one time. Ideally, we would like districts to implement 6th grade the first year, 7th grade the second year, and 8th grade the third year. Then the students flow through the program and learn the assessment rubrics and the philosophy. And that way, the system can concentrate and work with teachers, one grade at a time. Ideally, that's what we'd like; but realistically, it doesn't happen.

Some schools using MATH*Thematics* start using the program at grade 5. Then, in other schools, just the 7th and 8th grades are using the program. In still other schools we have only grades 6 and 7 using it. A big factor is what the district wants to do with algebra, given the push for algebra in grade 8. So there's no one nice model, because many of the needs of schools are different.

Parents

During the field tests, when we had the black-and-white versions of the materials, there was some parent concern but there's not much anymore. The field-test materials were not as user-friendly as they should have been, and they all said on them "Field Test Version." Parents felt that their students were being experimented with, so they were very reluctant to get their kids involved in the program. Now that the materials are out and in hardbound form, we're not experiencing much negative parent feedback at all. They're feeling good about it. When we work with

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[2] Third International Mathematics and Science Study.

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teachers, we make sure to talk with them about how to communicate with parents right from the start. And we caution them that if they don't, then they're going to cause troubles for themselves.

In our *Professional Development Handbook* and in the teacher materials, there are a series of example letters that we sent home to parents during the field tests. Every four weeks, we have a *Mathematical Gazette* that goes home to the parents, explaining what the kids are going to be studying for the next four weeks and why they're studying it. It includes some ideas that parents can use at home, and some projects that can be done at home. Our approach is to try to get parents really involved and in the loop. One of the things that we've tried to do is to make the materials look a little more familiar to parents. For instance, the hardbound book we have now is a little bit more of what parents think a mathematics book should look like instead of the paperback books we had during the field test. We switched to putting the modules in the hardback book for a number of reasons, one of them being parent familiarity.

In some states there has been some backlash. Some parents think that these new NSF programs don't teach kids any basics, or any algorithms. That's not at all what we're about, because we do teach a lot of paper-and-pencil skills, basic facts, and computation. But if we get branded in that mode—of not teaching basics—it's very hard to get out of it, so we've got to get out and educate the parents about the program.

Mathematics for all students

One thing that NSF was very clear on when we received funding seven years ago was that this had to be mathematics for *all* students. For the students who need extra help, we've now included more practice and applications, both in the textbook and in the teacher materials. For the students who are more gifted, we've included what are called Extensions, which are more algebraic concepts. We've included projects in every module. So there are eight projects every year to challenge the students. Also, the Extended Explorations that the students work on every four weeks are very challenging.

We have written the materials so that teachers shouldn't have to go to any other sources. If you need practice and application, you've got those kinds of materials, either in the teacher materials or the student book, and you've also got challenging problems.

Impact data

When we were developing the program, we had an outside evaluator from Research Communications in Boston. They hired Jim Schultz, one of the writers of the NCTM *Standards*, to design a criterion-referenced test, and he developed one for each grade level, based on the NCTM *Standards*. The test was administered with control groups and the STEM groups. What they found was that the STEM students were not outscored at a significant level on any objective at all. STEM came up short on one objective, initially, but not at the significant level, and that objective was to find the area of a trapezoid. Since then, that material has been fixed in the commercial version of MATH*Thematics*. STEM students outscored the other group on four of the NCTM *Standards* and on problem-solving.

There's also a University of Missouri study where the researchers wanted to see the effects on students' computational skills when using a curriculum like MATH*Thematics*. The researchers went to schools in the St. Louis area and used a traditional test to find out if computational scores suffered, and the answer was absolutely "no." Computational scores did not suffer at all, even though they weren't emphasized in the STEM program. But when students were tested on problem-solving, communication, and so on, then the STEM students significantly outscored the traditional students. They found no gender differences in the scores of the STEM students, and the biggest gains were made by African-American students using STEM. That study has been written up and submitted to a research journal.

Another example is the town of Sitka, Alaska, where the STEM materials were field tested. Researchers from Western Michigan University wanted to see how students in middle school were being prepared for high school. Typically, the Sitka students were scoring very poorly on the national exams—as a matter of fact, they were at the 44th percentile. When they tested students after three years of the STEM field-test materials, they were scoring at the 89th percentile. The results have just been very, very pleasing. ■

LINDA TETLEY ▸ MATHEMATICS TEACHER, GRADE 6

Linda Tetley teaches 6th-grade mathematics at Thomas Jefferson Middle School in Jefferson City, Missouri. She has taught mathematics in grades 4–6 in Jefferson City since 1980, but has spent the most time with 6th grade. Her middle school has just over 1000 students, so there are between 300 and 325 students in each grade.

Situated about 30 miles south of the University of Missouri in Columbia, Jefferson City is a fairly conservative town. The largest employer in Jefferson City is the state government, so one or both parents from many families are employed by the state. Approximately 29% of students receive free or reduced lunch. About 85% of the city population is white, with the remaining population composed mostly of African-American families and a very small percentage of Hispanic and Asian families.

Getting started with MATH*Thematics*

In the early 1990s, our district built two new middle schools. In the process, we spent a lot of time talking about the philosophy of how to make these real middle schools and not just junior high schools—we wanted to be very student-centered and tuned in to how young adolescents learn. This meant moving 6th grade out of elementary school. The teachers who would become the middle-school math teachers really wanted to revamp our mathematics curriculum pretty extensively during this process. We had been using traditional textbooks from Addison-Wesley and D.C. Heath. But when we started working on our new curriculum, we were referred by Bob and Barbara Reys at the University of Missouri[1] to Rick Billstein at the University of Montana, who developed the STEM program. Our curriculum committee got to look at some of the early pilot versions of STEM.

The committee had looked at several textbooks, but when we learned that STEM was an NSF project, and that it fit with where we were wanting to go in math—away from strictly skills and more toward the ideas of the NCTM *Standards*—things just fell into the right place. Our 6th-grade classes began piloting MATH*Thematics* the first year it was available, 1993, and the 7th grade began piloting the new materials when they were ready the following year. Because in 1993 the 8th-grade materials weren't going to be ready for a couple of years, we purchased the *Gateways* textbook[2], which is also an integrated program with an emphasis on problem-solving.

Last year, in 1998, we wholeheartedly adopted the STEM program, so now it is being used in all of our 6th- and 7th-grade math classes. The 8th grade is now in their sixth year with the *Gateways* program. Algebra I is also offered at the 8th grade and for that we use McDougal Littell's *Explorations and Applications*.

During the process leading up to our adoption of MATH*Thematics*, we looked at textbooks from three different companies as well as two or three other NSF-funded standards-based programs, so we had about six options to choose from. After we narrowed down from our original group of six or so, we invited people to come and present from several of these curricula, and the full math staff was involved in those presentations. We worked a lot on developing a district curriculum framework, so we needed to see how the programs each plugged in to that. We studied the NCTM *Standards* documents quite a bit in writing our district document.

In the end, we made a unanimous decision to purchase MATH*Thematics*. The biggest thing that helped us realize we wanted to stay with MATH*Thematics* was trying to think of examples to put into our curriculum documents that showed problem-solving and communication. In MATH*Thematics*, we do problem-solving and communication and critical thinking and reasoning every single day. We saw a lot of features we liked in the other NSF projects. It may be that we favored MATH*Thematics* most because it was the one we knew best. One thing we liked about it was the hardbound textbook. That format is familiar to teachers, and the cost made more sense. We were worried about having to replace

[1] The Reys direct the Show-Me Center, a national center for dissemination of information about standards-based, comprehensive, middle-grades mathematics curriculum programs. For more information about the Show-Me Center, see page ii.

[2] *Gateways to Algebra and Geometry* is published by McDougal Littell.

soft-cover books every couple of years. We also had concerns about storing and distributing soft-cover books for every unit. In the end, we knew the STEM program and we were happy with it.

Strengths of MATH*Thematics*

There's a really big difference between MATH*Thematics* and a traditional textbook. For example, if you're doing probability in a traditional text, the book might have a picture of a spinner and ask, "What would be the probability of the spinner landing on the red section?" And that would be the end of the question. With MATH*Thematics*, we investigate it, the kids generate some data and graph it, or they discuss and pool data. Part of what I love about several topics—like the fractions and decimals and mixed numbers—in MATH*Thematics* is that there are so many application problems. The program does not set up phony applications. They give real problems that get kids involved in getting into the numbers. It's a very different approach.

I really love STEM because of its emphasis on problem-solving and thinking. The writing has been done very well in a way that interests and motivates middle-school children. When we learn about mean, median, and mode, the book talks about gymnastics teams and scoring, and so the kids will come to talk to me about their gymnastics team. These connections keep kids interested.

In middle school, we do a lot of work in groups. In fact, the textbook suggests that about a third of the material in 6th-grade MATH*Thematics* should be done in groups. A lot of times I'll just introduce what we're going to do and tell students how far to go or where the materials are and they just take off from there. In their groups, they decide how they want to divide the work or whether someone's going to read out loud. By working in groups or with partners, we get around most of the issues students might face in terms of reading and understanding what is expected of them.

The program is made up of modules, and each module has a theme, which is carried through the units. We are now able to integrate themes across different subject areas. Previously, math always had to be dragged along and forced to fit in with the themes set by other subject areas. Now, with modules like MATH*Thematics*' 7th grade *Search and Rescue*, math can start off the cross-curriculum work.

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Spiraling

MATH*Thematics* uses a spiral approach to teach concepts over time. When I taught from a traditional textbook, we'd do a chapter on fractions, so if you missed that, you could go back and just do those problems and you would be kind of caught up on fractions. Or if you didn't do it, you wouldn't know the difference because you wouldn't have any more fractions until next year. In MATH*Thematics*, if we work on some fraction concept early, like improper fractions, we come to it again and again and again and apply it later on. The spiraling helps the kids really get a concept into their heads.

One of the nice things about the spiraling in the program is that you don't miss any of the important math topics over the course of a school year. Most topics that we hope to touch on, we've touched on—probability, fractions, proportional reasoning, etc. So I never feel like we haven't gotten to a whole topic or chapter. And with the spiraling, the development of algebra is really strong. In 6th grade, it draws on

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a student's intuitive approach, and then calls for a more symbolic understanding in the progression through 7th and 8th grade. At 8th grade, the program covers a tremendous amount of algebra.

Kids who miss lots of school get really behind—no math program can solve that. But if they're only gone a day or two, I've found their group gets them caught up with no problem. If they're actually out sick, and they've missed two or three days of school, they come back and their team says, "Here's the data we got, here's how we found this out." There is a little section called "Spiral Review" which is great. It's very short and contains three or four problems on topics the program spirals back to, like adding fractions, or building mental math strategies, or making an estimate. These brief reviews really help kids brush up on and remember important information.

Skills practice

The teacher materials have neat sections called Study Guides, which come in handy when a student has missed the activity portion of a lesson. Study Guides are black-and-white pages that tell the student what needs to be understood. Those are particularly helpful when parents ask, "What can I do to give extra help to my child?" We just run off the Study Guides and send them home. We've had some good comments about them.

At the end of each section of a module there are Practice and Application problems as well as an extra skills page, and in the *Teacher's Resource Books* we have blackline masters for additional practice and application. Those are good to use for homework or quick quizzes. MATH*Thematics* has done a pretty good job of trying to keep a balance of arithmetic skills practice. With those additional exercises, I don't feel like I have to supplement the program.

Meeting a range of student needs

In 8th grade we have a small pullout section for Algebra I, but our classes are not tracked in 6th or 7th grade. I have kids of a whole range of abilities in my classroom. Students with learning disabilities and those who are gifted are all together in one room, and both groups are doing well. The lower-end kids do great with MATH*Thematics* because the investigations and the use of manipulatives—even at 6th and 7th grade—really help them. By the time they've learned some concepts using tiles and decimal blocks and pattern blocks and fractions through pattern blocks, everything makes a lot more sense to them. The conceptual ideas really do precede their mastery of the arithmetic.

When a kid has a learning disability, it doesn't mean he can't think and have some ideas. Sometimes those are the very kids who can do something with their hands. Today we did a unit about exponents called *Making Things*. We did a little origami exercise to kick it off. By the time I had finished handing out the directions, one boy who's sometimes in trouble had finished it. He was just as proud as he could be. Other kids were having some trouble, so I said, "Well, you're going to have to be the helper here and help people who can't do it as easily as you did." Kids have different strengths that they don't realize they have. This program allows those to come through, and the group work helps all the kids feel successful.

At first glance, you might look at the program and think, "Oh boy. There's not a lot of opportunity here for the really gifted kids to do work over and above the materials." However, there is actually so much rich material in MATH*Thematics*

that we can't get to all of it. The challenging problems, like the application problems, are just built into every lesson. Some of those are extremely challenging. We don't have any complaints from parents of gifted kids anymore, because their kids are being plenty challenged. At first, though, some gifted kids don't respond well to the program because they must think at a higher level and then explain or justify their processes—they can't get away with just doing a 3-digit multiplication problem to prove that they can do well.

MATH*Thematics* has assessments that are open-response problems—there's usually one per module. These are problems that can be taken in different directions and to different levels. A kid who's not so good in math will come up with a very different type of solution than a kid who can easily come up with an algebraic solution. So again, the students who want to be challenged can generalize and express something algebraically, and that will help you, the teacher, see that you've provided for them. The idea is math for all, and this program comes the closest I've seen to offering math for all in the classroom.

Articulation

Our K–1–2 grades use a very explorative, investigative-type program. They've used *Box It or Bag It Mathematics*[3] and now are using *Everyday Mathematics*, which seems to be a nice fit. However, the grades right before middle school, grades 3–4–5, use a text that is pretty traditional, so it makes the transition from 5th grade to 6th grade pretty difficult, as far as what the kids and parents are used to seeing in math. I'd like to see *Everyday Math* all the way through grade 5.

On the other hand, the transition from STEM in 7th grade to *Gateways* or Algebra I in 8th grade has been pretty good. And then our high school uses a variety of textbooks, but a lot of kids end up doing Algebra I and II and Geometry in McDougal Littell's *Explorations and Applications*. One thing we've been told by the high school math teachers is that they've seen a big difference in kids' willingness to write in class. Students expect to write and to justify their answers because "Why?" is a question that we ask a lot in middle school.

Changing teachers' practice

My experiences with MATH*Thematics* have been really good for my teaching. I've made major changes in my practice. When I used a regular textbook, a lot of the content was boring, so I had to find interesting things to add to it. I used to go to the state convention or a regional conference to find somebody doing some interesting activities that I could use. I looked at everything I could get my hands on that came through the NCTM journals or the middle-school journals. Now, I don't have to do that anymore. There's more to do in my MATH*Thematics* book than I will ever get around to doing. Instead of spending my time looking, I can use my time to think about what I'm going to do in the lessons. It keeps me on my toes.

I've learned a lot of math through using MATH*Thematics*. My bachelor's degree is in elementary education, so I didn't have a lot of math in that, but then my master's degree is in mathematics education. Even so, I've learned some new things through using STEM. As I've worked through the STEM materials, I've found that some topics were developed in ways I had never seen but that make more sense to me.

[3] A guide from the Math Learning Center to help teachers develop an activity-centered, language-enriched math curriculum for kindergartners.

When we met, we would bring examples of student work, stories of what had happened in class, and questions about why things didn't work.

I used to think that, as the teacher, I had all the answers because I had the answer book and knew where the lessons were going. But now I don't always know where the class is going to take the lesson, particularly if the kids are doing their own investigations. I might expect us to go in one direction, but the kids may ask a different question or see a different pattern. Or, they'll ask how to do something and it's not a piece I've thought about before. Now, I'm used to being in the role of co-investigator, but it's a very different role from the one I was used to as a teacher. It was hard to adjust to at first.

The idea of spiraling is hard for teachers to get used to because you really want to teach to mastery. The way I learned to teach, and the way I always taught, was that if we're working on multiplying decimals, we're not moving on until most of the class can multiply decimals. So it's nerve-wracking for some teachers to have faith with MATH*Thematics* that if they leave a concept right now they will be doing it some more in a couple of weeks. But if you try to teach everything to mastery, then you're not using the materials as they're meant to be used, and you can't accomplish what you're hoping to accomplish. You have to let go and just know that you're going to come back to it.

Teacher materials

The MATH*Thematics* materials were written largely by teachers and educators, so they've put a lot of tools into this to help teachers out. There are supplementary materials, like the *Teacher's Resource Books*. The teacher's textbook is just like the student book—except for the answers in red, there's nothing extra in there. But then we have the *Teacher's Resource Books* for each module, and those have some really good little hints and tips. By looking at the teacher materials, I can still anticipate where things are going to go. And then there are sections in the *Teacher's Resource Books* that talk about the mathematics, for example, and those have been really helpful. The books also have a common error section, or watch-out-for-this warnings that direct you.

The other piece we got when we had our meeting last summer about the new materials was the *Professional Development Handbook*. It's really a well-written piece. It focuses on topics like assessment, or dealing with parents, for example. It's also something that you can use to do a preview if a district is thinking about the program, or in an in-service with a district that has purchased the materials already.

Teacher support

Since we were one of the first pilot schools, our teachers had to really use one another as resources. We did a lot of meeting and talking. We met every two weeks or once a month, all the 6th-grade math teachers from both middle schools. We planned a timetable and set goals, and then we'd review them the next time we met. This was peer-run; nobody was in charge. When we met, we would bring examples of student work, stories of what had happened in class, and questions about why things didn't work. When we started talking about assessment and using a scoring rubric, we got together to score students' work and see how closely we could score each other's students. We talked about why we gave certain scores. None of us had ever used a rubric in math, so that really helped us gain some confidence.

Now when we hire new teachers, we say right up front, "This is our math program. How comfortable are you with this type of teaching and with the idea of the

teacher being off center stage?" The other middle-school department chair and I do a three-day summer in-service, and then the new teachers are appointed a mentor at their grade level. It takes a lot of checking in, a lot of pacing and a lot of questioning when you first start teaching MATH*Thematics*. Using this program is not something you can do without some in-service and support. Ideally, you would want to come back after a period of time and do some more work around the program with other teachers.

Parent education

We've developed a pretty big parent education process. One of the things not covered very well in our early training was what to expect when we started handing out these little black-and-white pilot versions of the STEM materials. That first year we educated parents only when we had to, doing phone calls to put out fires, but we realized that this wasn't a good strategy.

The second year, we started having math nights that we called "Math for Parents of 6th and 7th Graders." We had about four of those a year. We made little business cards with the date and time and a note that said "Welcome," and "Hope to see you." Math nights were only for parents; there weren't any kids there. The parents sat in groups at tables. We started out with a problem the kids had already done in class; the problem was usually pretty non-threatening, but also non-traditional. The parents worked on it, solved it, and talked it over. Then we discussed the solution as a group. By the next year, we found that parents were very interested in how the kids solved these problems, so we started getting kids' permission and making overheads of student work to show their different strategies for reaching the solution.

From there, we gave parents an overview of the program. We talked about what the program's approach is based on and what our goals were for students. We made it very clear that we had a curriculum and couldn't show them the whole thing that night, but we encouraged them to make appointments to see the curriculum guide or ask more questions. Then we talked about a specific topic. One night, we focused on assessment. Another night we focused on homework and how MATH*Thematics* homework was different from what they were used to seeing, that there weren't pages of arithmetic problems in isolation. We focused on topics that we thought would be different, like spiraling of skills or other things that looked different from the old textbooks.

At the end of the evening, we always had a question-and-answer period. That was when we were the most nervous, thinking someone would ask a question we couldn't answer. But we just answered truthfully from our experience, explaining that this is the way we'd seen particular things happen. We had really good turnout at the math nights, and we still do them, though now we only do about two to three per year.

Testing

The first two years we used MATH*Thematics*, people were kind of anxious. We don't have the same test now, but when we first started STEM, students had to take the Missouri Mastery and Achievement Test, which tested standard skills. It was very multiple-choice and very arithmetic-oriented. Once we started using MATH*Thematics*, we were really nervous because we didn't know how kids would do on a test like that after using STEM. But the first year we had big gains, and

…we found that parents were very interested in how the kids solved these problems, so we started getting kids' permission and making overheads of student work to show their different strategies for reaching the solution.

our scores climbed every year. That calmed a lot of fears because parents were all familiar with this test. It was very skills-oriented, and our scores showed that the kids were getting the skills.

In addition to that, they were getting problem-solving, which we hadn't done that well on in the past. Our scores for the sections on nonstandard problem-solving skyrocketed. Those sections used to just throw off the kids. Problem-solving was still difficult for them, but students started to show some real gains. Scores also went up in the areas we never used to get to very well, like geometry. You know, those were the sections at the end of the book and we just didn't have time to get to them. But now, because MATH*Thematics* is integrated, we get those concepts all through the year. So scores in those areas were really up. That helped us with the parents a whole lot. As of about two years ago, with the adoption of the commercial textbook, negative comments are at a very low number.

With a new program like this, we have to be concerned about alignment between the program and whatever state and local testing we have to do. The funny thing is that our state, like many states, is now going in a different direction with testing. We have a new test called the Missouri Assessment Program, and it only has one small multiple-choice section called the Terra Nova. The rest of it is all constructed response. At the end there's a performance assessment section. We didn't know anything about this test six years ago when we started looking at new curricula, but now our state test has moved in the direction that we're going. ■

BECKY SOWDERS ▸ MATHEMATICS TEACHER, GRADE 7

Choosing MATH*Thematics*

I met Dr. Rick Billstein, the developer of MATH*Thematics*, at a conference, where he told me about his idea to write a new math textbook. After listening to him, I said, "This sounds like the most exciting thing in the world. Don't expect to do anything without involving me." He called me a couple of months later and said, "Would you mind trying out with your kids what I've written so far?" I said, "I'd love to!" I was the first pilot teacher for STEM in the United States.

His idea was to have kids learning math because it made sense to learn it rather than because it was ordered in a particular sequence in a book. I really liked that idea. I believed very strongly in starting the kids with something concrete in their hands, but I also needed something to connect students to the abstract part of mathematics. I had tried a couple of other programs while they were being written—*Lane County Mathematics Project*, published by Dale Seymour in the 1980s, and the *Middle Grades Math Project*, which was a precursor to *Connected Math*. They were good but I felt they didn't do enough to connect the concrete with the abstract.

When Rick sent me the STEM materials, I took one look and saw that those connections were written into this program. That was one of the best features for me. I'm a right-brained math teacher. I hated teaching out of a traditional textbook, and would look through lots of other math books to get ideas for teaching. I'd try this and that, and make up my own ideas. After I got the MATH*Thematics* materials, I no longer had to find all those activities. With MATH*Thematics*, it gets really fun—here's a project, here's an activity, here's a game, let's do this. Then let's do another activity. But it's also the only program I've found that actually connects to the abstract so that kids actually learn math.

The first lesson that Rick sent me focused on skeletons and taught students about ratios. Students first looked at their skulls and the facial features of their skulls. We decided whether their faces were wide or narrow, based upon ratios. Then we looked at different skeleton data, like "Lucy" from prehistoric times. We found that you can tell what part of the world people come from based upon the ratios of the facial width and length measurements. I brought in a skull from the science department and the kids used it to do the measurements. The kids loved it.

Mathematics in MATH*Thematics*

In the published version of the 6th-grade materials, the ratios unit is still very strong. We look at body ratios. Using a piece of string and a meter stick, the students measure the circumference around the base of their thumb, their wrist, their neck, their waist, their head, their height, their reach, their tibia, their radius, and their foot. Then they have to start figuring out ratios. What is the ratio of your thumb to your wrist? Your waist to your neck? Your tibia to your height? We read that scientists say that a tibia is considered to be one-fifth of a person's height. We look at the tibia and ask ourselves, "If it's one foot long, how tall is the person? What age could this person possibly be?"

Another part that I really like in the 6th-grade book is where the kids are working with patchwork quilts. They learn decimals and fractions together, not as separate concepts. For the kids at 6th grade to understand that a decimal and a fraction are the same thing is to me an absolute marvel. Why haven't books ever done this before?

Becky Sowders teaches at Pacific Middle School, located in Vancouver, Washington, a suburb of Portland, Oregon. Becky has taught middle-school math for 15 years, and currently teaches 7th-grade general math and 7th-grade prealgebra, as well as dance and drill team. Prior to teaching at the middle-school level, Becky taught at the elementary level for 11 years.

The Evergreen School District has grown steadily for the last 30 years. When Becky started teaching in 1971, the district had five elementary schools, one junior high school, and one high school. As of 1999, there are 28 elementary schools, 7 junior high schools, 3 high schools and 2 alternative high schools.

Over time, the community has become less a farming community and more a technology-oriented community. Over 80% of the students have a computer at home. The district has a large Russian immigrant population as well as a fairly large Asian population; about 30% of students are enrolled in ESL.

In these lessons, students are given scenarios in which they predict outcomes and investigate problems while working in cooperative groups.

One section that works very concretely is a lesson about mixed numbers. In teaching the kids to understand how to add and subtract fractions, the program tells them about the Spanish dollar used in colonial America. This dollar was actually a wooden disk. It was divided up into eight pieces called "bits," so two bits equaled 25 cents and four bits equaled 50 cents. I have the students cut circles into eighths. Then they sell each other items like a loaf of bread for two bits and a pair of shoes for one dollar and three bits. At some point, students have all these eighths of circles. They then have to figure out how much money they actually have. They start writing it down and drawing pictures of the money, and showing their thinking. "Let's put a circle around this amount. You have 21 eighths. That's how many groups of eight?" It works beautifully.

The other lesson that I just love is learning to add positive and negative integers. When we get to it, we've already discussed the sizing and comparison of integers. In the activity, we talk about the different temperatures on a thermometer, and about altitudes and ocean depths. We identify a freezing point and lay the thermometer on its side to make a number line. Then we talk about coordinate graphing. After the students gain some understanding of positive and negative numbers, we play a game called Take a Hike, using three spinners to determine starting point, direction (positive or negative), and how many places to move on the number line. Four kids work together: one person does the spinning, a second person calls the numbers and directions, the third person actually "does" the hike up and down the number line, and the fourth person records the coordinates on paper. When the students get through with this game, they know how to add and subtract positive and negative numbers. Every year, I take my prealgebra kids out of the traditional book to do this lesson with them. It's a really strong piece of this whole program.

Problem-solving

In Books 1 (6th grade) and 2 (7th grade), the problem-solving lessons are absolutely the most important ones I've ever found. I think problem-solving skills make or break kids on our state test and on a lot of other state's tests where the questions are open-ended. In these lessons, students are given scenarios in which they predict outcomes and investigate problems while working in cooperative groups. The teacher materials tell you when it's appropriate to use cooperative groups and when to have kids work individually. Students write up their hypotheses for how and why they think something is going to happen. They have to use the proper mathematical vocabulary. They have to talk about and analyze the patterns that they see. For example, there's a lesson in the 6th-grade book that does an especially good job of addressing how to understand problems and how to make and carry out a plan. In it, the kids think about how and why they should use visual representation, and they learn to design charts appropriate for particular situations.

Impact on students

The students just love the activities. When I first did the body ratios unit, they told their parents, who called me to say, "My kid is so excited about what you're doing right now." The kids were excited about math! One year, I had a boy who had been absent 36 days of the first semester. Once I started using STEM, he didn't miss another day of school until finally he was absent one day and I wondered about him. His mother called me and said, "I am fighting him right now. He has an ear infection and he's running a 103 degree temperature but he is insisting on coming to school." I said, "Tell him to stay home and I'll let him come in after school and make it up one day."

Meeting different students' needs

I think the STEM program has been so successful for us because it addresses the needs of students with a wide range of learning styles. It's not that the lower-level students are not smart enough—they've just never had math presented to them in a manner that helped them understand it. For example, kinesthetic learners haven't been given a chance to play with manipulatives after the elementary grades. For those kids, getting up to "take the hike" on the number line really helps instill the image of the number line into their minds. When you can take concepts from their physical representations and move into writing them, the concepts take on more meaning.

Auditory learners are also able to do very well in MATH*Thematics* because they're able to spend time discussing ideas. They need to hear and be heard in order to process and remember concepts. For visual learners, there are beautiful pictures with lots of color. In the study guides and key-concept pages in the book, they see pictures showing that this is what you do, and this is how you do it.

I started using the 6th-grade material with the 7th- and 8th-grade LAP (Learning Assistance Program) math kids. This gave them the concepts a little bit slower. They needed more time with the concrete stuff before they got into the abstract. I had one student with Down's syndrome whose parents put him in my class specifically because they liked what we were doing and the "physical-ness" of how he could learn.

I have a lot of kids who have trouble reading, so I read a lot of the lesson to them. That helps the students with weaker reading skills understand what's going on. As far as writing assignments go, a lot of times I have kids discuss the problem in groups, so that together they can formulate and organize their thoughts. This helps students think about what they're going to write before they even pick up a pencil. I encourage ESL students to write in their native language first, if that makes them feel more comfortable, and then translate it to English.

As for the higher-end kids, I thought they were going to eat this up and tear through the book, but I was wrong. These students have always been able to memorize algorithms and be successful in math class. But now, they have to stop and learn how to think. At the beginning of the year, this was a slow process. Their learning curve was pretty steep. They've had to get used to writing explanations for their answers, drawing pictures, explaining their thinking process. After a while, they started digging in and now they're doing really well with it. I've heard this same story from other teachers.

Changes for teachers

One of the biggest challenges is learning that, even as the teacher, you don't always want to give the kids an answer. As teachers we are so used to telling instead of being facilitators. This program asks the teacher to be a facilitator. This is especially challenging for a substitute. Sometimes, I have the sub come in ahead of time. I give them the book and directions for them to read the lesson and work through what the kids will be doing.

Another challenge for teachers is correcting all of the projects. There's a lot of correcting to do. In each project, my kids have to turn in a report. They need to show me graphs, charts, tables, pictures, whatever it takes for them to answer the questions. And they have to tell me how this concept might apply to a real-life situa-

The materials help teachers figure out the most important questions to ask their students.

tion and what patterns they see that help them make generalizations about the concept. It's tough at first to get used to grading all of the different criteria. But after you've been doing it for a while, it gets easier and you can breeze through it.

Teacher materials

For me, the teacher materials are an incredibly important part of my curriculum. There are all these extra pages of work that the kids can do if they need to. The materials help teachers figure out the most important questions to ask their students. They include comments that prepare teachers for teaching the lesson: "Kids may answer this way, but what you want to do is direct their thinking in this way." It tells you when to use cooperative groups with kids, when to pull students together for a class discussion, and when to have them do work as individuals or in pairs. I use the suggestions in the teacher's manual to assign homework. I copy all the study guides for kids to take home and work on with their parents. There are explanations for how to score the E^2 (Extended Explorations) projects, which are major projects that the kids do approximately once a month. There is one set of E^2 projects in the student books, and an alternative set in the teacher's manuals.

I am a more abstract, random-type person, and this text allows me a little more freedom—and at the same time, keeps instruction organized enough for the kids to feel comfortable. On the other hand, I've worked with another teacher who loved the STEM program because it is so sequential and everything is laid out for her. She likes the fact that the connection between the abstract and the concrete is there. She likes that the activities are all set up and tell her exactly what to do and how to run them. She can look at a lesson ahead of time and figure out what she is going to do.

There are times when I have the kids do exactly what the book says. They literally walk through it. Other times, I decide that that is not the most effective way to go through a lesson and so I stray a bit to cover the needs of my students. I always prepare by reading the lesson and deciding what the questions are asking the students to do. Then, as I present the lesson, I do a lot of questioning. I don't just have them write down the answers to every single problem. I love STEM because it's so creative. It gives kids some chance to think for themselves, to create and build their own understandings, yet it does it in an organized and sequential manner that keeps me from straying too much. That other teacher and I both work well with the program; it really fits both of our personalities and teaching styles.

Professional development for teachers

For MATH*Thematics*, every teacher who's going to use the material needs to be inserviced. I offer in-services to teachers who are beginning to use STEM, and have seen both exciting and frustrating cases. In one location, I did two full days of inservicing, getting the teachers ready. I would have liked to spend one more day planning with them, but even so, I felt like they were ready to start. On the other hand, a neighboring school district only gave their teachers a two-hour in-service with me. The teachers were so frustrated. They kept saying, "What do I do?" Finally I told them to e-mail me with questions.

When I do in-services, I take teachers through the layout of the book. I run them through various lessons and some of the different activities. There are a couple of lessons that teachers need to run through to be prepared for what's going to happen when they get their kids working on them. It's crucial to go through those kinds of

lessons. Teachers need to see the problem-solving process to understand how important it is that the kids go through certain parts to pick up what they need to know. I like to have at least a two-day in-service so that I can give them an E^2 to do overnight. We also talk about assessment and how a lot of the assessment is built into things like teacher observations and journal writing. I show them some of the portfolios that my students put together. We talk about the scoring for the E^2 projects because that is the strongest assessment criteria scale that I have ever seen.

The districts that have done the best job of making this program work are the districts that pull the teachers together once a month to see where they are and to talk about future lessons: "What do you need to be able to teach this next one? Here are some directions. These are the materials you'll need." This helps teachers out a great deal because then they aren't trying to do it all by themselves and panicking the day they have to do it with their students. So a monthly meeting or at least a quarterly meeting is really helpful. The important thing is that teachers have a chance to go through the lesson and the mathematics in case they don't understand it. That's really important from a teacher's point of view, especially for elementary-trained teachers who may be uncomfortable with some of the math. After teaching the program for a couple of years, teachers are surprised by how much more math they know than they did before. That was my experience as well.

Technology

I really like the technology support. Texas Instruments worked with Rick and the STEM program to build a graphing calculator for middle school. I love the fact that that's incorporated into the book. The book walks kids through the steps to using the graphing calculator. My school doesn't have graphing calculators for the kids to borrow, so I don't require the kids to do the spreadsheet activities that are in the book, but they can turn them in for bonus points. The book also tells kids they can use a computer for particular activities. So when I get to the lessons with the computer pages, I simply take the kids into the computer lab and we'll do the lesson together. Technology is tied in very nicely with the program, and the kids love using it.

Testing

When I first tried the materials for the developer, I was teaching a LAP (Learning Assistance Program) in math, which is a Chapter I program. The class contained the kids whom everybody else had kind of written off. The state expected a one-point NCE gain[1] by the end of the year to show that I was teaching them something. I had another class with whom I did not use the STEM materials, and instead used basic computation problems for two to three days a week. And there was another teacher who taught straight computation to her LAP class five days a week. At the end of the year, when we tested the kids using the California Achievement Test (CAT), the students in the non-STEM teacher's LAP class had an NCE point gain of 0.75. My non-STEM class scored a 3.25 NCE gain. When I scored my LAP students who had used STEM, my mouth fell open: one class had a 9.8 NCE point gain, and the other class had a 13.2 NCE point gain.

After teaching the program for a couple of years, teachers are surprised by how much more math they know than they did before.

[1] Normal Curve Equivalency. In Washington, the NCE is set to slide with student growth, so students' scores should be one point higher at each grade level. In other words, a one-point NCE gain signifies one year's growth.

Parents

When I first started this, I had so many parents coming in angry, asking, "What are you doing? I want my kids learning how to do real math"—they meant traditional math. Five years ago, I had kids taken out of my room because I was using "that STEM stuff." Since then, things have changed a lot. One parent actually came up to me a couple of years ago and said, "My husband's an oceanographer. He would like a list of the kids that you have in the STEM program, so that when they come to him for a job in five or six years, he will know which kids he wants to hire." Of course I probably can't track them all, but that was really neat.

When parents come in for a math conference and they ask, "Why are you having my kids write all these answers out? Why can't they just write a one-word answer?" I tell them the book requires it and the state requires that they be able to communicate mathematical ideas. So now parents see this alignment with the state's Essential Academic Learning Goals and the state test, and they want to put their kids in the class. It's nice to not get flack anymore. ■

JUDY ANDERSON ▸ K–12 MATH TEACHER SPECIALIST

Selecting MATH*Thematics*

We have a systemic initiative grant from the National Science Foundation called *Creating a Community of Mathematics Learners*. It's a five year grant for grades 7 through 12, so we worked first with the middle grades for two and a half years and then with the high-school grades for two and a half years. The grant is $2.8 million for the six districts involved, who have partnered with the University of Washington.

The grant requires us to look at innovative curricula, and to work on improving teacher content knowledge and pedagogy. Several years ago, we found ourselves in a pinch. In grades K–6, we had two different programs—the Chicago *Everyday Math* series and a Houghton Mifflin mathematics textbook. Both of those sets of materials are fairly forward-looking. Our high schools use McDougal Littell *Integrated Mathematics*, so integrated is part of our culture here. But we didn't have a very new middle-school curriculum.

So the middle-school teachers looked at all of the NSF curricula for middle school, because that was required as part of the NSF grant. We were already into the grant a year before we looked at curriculum materials, and then we looked at and piloted curricula for a year. One of our obligations under the grant was to allow the middle-school teachers to purchase some classroom sets of materials. Each building had $1,000 to spend. So teachers looked at all the NSF curricula—*Connected Math*, *Math in Context*, MATH*Thematics*, and *MathScape*, and also at some traditional textbooks. All the major authors came out and talked to us, and we bought and piloted units from each of the programs we saw.

We had quite a large curriculum selection committee, with three teacher representatives from both middle schools, as well as four or five representatives from the 5th and 6th grades at several of our elementary schools. We had representatives from both of the high schools, and we had four parent representatives. The principals of the two middle schools were on the selection committee, too, and they were very involved.

The teachers went into the process thinking that there was no way we would adopt MATH*Thematics*. They had been using some of the field-test materials for a couple of years, and found them very difficult to follow. The materials and activities were not organized very well. So we looked very broadly at pieces of the different curricula. We looked a lot at the philosophies of each curriculum. We studied the research, best practices, the *Standards*, and our state's Essential Academic Learning Requirements. We met often and ironed out things, all the way down to what kinds of ancillaries we wanted as part of the curriculum. The parents on the committee were concerned about picking something that would enable them to be involved in their kids' education.

Finally, we went to districts around us that were using the different programs we were considering and observed in classrooms. I think we viewed classes for each of them, with several people from our committee going to each of the sites. When we had narrowed it down to three programs—MATH*Thematics*, *Connected Math*, and an Addison-Wesley book—we invited teachers with experience teaching those programs to come talk to us.

Judy Anderson is a K–12 math teacher specialist for the Shoreline School District in Washington state. The past three years she taught one or two high-school classes and worked part-time as the math specialist. This year, she is working full-time as the math specialist. Judy has spent 30 years in public education, teaching for 15 years at middle school and 15 years at high school.

In her role as math specialist, Judy provides in-services, works with individual teachers and building principals, and oversees the mathematics curriculum and budget. Judy also oversees the district's two NSF grants—a systemic initiative grant for grades 7–12 and a teacher leadership grant for grades K–6.

Shoreline is a suburb bordering the city of Seattle, with shorelines on both Puget Sound and Lake Washington. The community is largely middle- to upper-middle-class, with about 11,000 students in the school district. The district has a varied ESL population—about 35 different languages are represented.

Gradually, they're becoming more concerned about where the numbers come from and what they mean, instead of how to multiply them.

We adopted MATH*Thematics* last year. Our teachers were pleased with the format of the published version, which provided some continuity with our high school McDougal Littell books. Students really liked the program because the topics were interesting, and parents liked that the materials were challenging but provided adequate support for them to help their kids. Since our 6th grade is part of our elementary schools, we just use Book 2 of MATH*Thematics* for 7th grade and Book 3 for 8th grade. Kids who are ahead in math coming into 7th grade are placed in an accelerated program. We accelerate them a year, so they start in Book 3.

Mathematics for all students

As far as I know, the students have reacted very favorably to the new program. When I'm in the classrooms, I see a lot of activities that they just plain like doing. There are some very good activities early in the school year that really get kids hooked into the program. So there's a feeling from students of, "Oh, we like doing this. This is pretty good stuff."

We've put all our students in the program. MATH*Thematics* works well for the kind of kid who basically understands what's going on and who hasn't had time to commit all those algorithms to memory. The kids who struggled with math concepts still struggle. But the program will especially strengthen those kids who have been sitting on the sidelines saying, "I don't see any reason why I need to do this." As they get into a contextual situation, they can identify with the math a little bit more. They see that worrying about the computation is getting in their way of doing more interesting stuff. Gradually, they're becoming more concerned about where the numbers come from and what they mean, instead of how to multiply them. That helps us know they're on board with us and with the program.

For our special education and LAP[1] populations, we provide extra help. It's going okay. The LAP and special education teachers are learning lots of math.

A language challenge for students

In some cases with our ESL populations, the reading of the textbook has become an issue. Some of those students can do the computation easily if they don't have to see what words are around it, so we have to try to educate people that math is not just problem after problem, but that a problem has to come from a situation.

We're trying to figure out a better way of dealing with the reading issue. It's not specific to MATH*Thematics*, but is a problem with any textbook where you have math problems presented in word situations rather than in worksheet form. The MATH*Thematics* book uses a lot of graphics to supplement the reading. In other words, the explorations usually have a picture of the kids doing the activity, so the picture gives visual clues to supplement what the text says. But there is still reading that's necessary. And when students get to the word problems, there is reading involved. That is one thing that we would like our kids to be better at.

Reading in math is an issue not only for middle-school math but for all of math. Kids have been trained not to read math books. They expect to listen to the teacher and get the information, and only read things as a last resort. I think we've been doing kids a disservice. So we're trying to figure out ways to offer to our teachers some very specific help. Not many reading specialists are willing to tackle the problem, because it's mathematics. I've been looking for someone

[1] Learning Assisted Program.

to do an in-service about techniques you could use with kids to facilitate the reading of the textbook.

A change for teachers

Even with MATH*Thematics* being a different kind of curriculum that requires a lot of reading and writing, I think we're doing very well. Of course, I'm not saying we couldn't do better. I have two teachers who are in their 29th year of teaching, who have always had kids in rows, and they are struggling with these materials. But they're game. They're working at it. Right now, they take a lot of lessons and redesign them to fit a classroom with rows, so having kids work in groups is something they'll have to keep working at. At the same time, I really like what has happened with two of my older teachers. They've been teaching for 30 years at the middle school, and this is like a breath of fresh air for them. So those learning experiences for teachers are really valuable.

I also have some fairly new teachers who've adapted very well to MATH*Thematics*, too. They didn't come with a lot of preconceived ideas about what middle-school math should be, so they like the program and they're dealing very well with it.

Teacher training and support

I would advise new users of Math*Thematics* to get a lot of training before they actually adopt. That should include building an understanding of the philosophy behind the program, and building buy-in from teachers on what it is the district is trying to do. That's key, because this program is different from what we're used to, and teachers have to buy in to it philosophically to be successful with it. I think that buy-in comes from pre-training teachers on the curriculum. If teachers are not aware of what's going to happen to them, it'll throw them for a major loop.

Through the in-services we've done with the grant, teachers have gotten to network with teachers from the other five districts. Developing a network has been very valuable for our teachers. I pay them to meet, giving them the encouragement and the structure to make that happen, and they feel very positive about that.

As I said, under our NSF grant we're specifically working to improve teachers' content knowledge and pedagogy in conjunction with looking at curriculum. So for two years, all of our middle-school teachers had five days of in-service each school year, plus a week-long training during the summer. Plus, they had opportunities to do some elective workshops after school or on Saturdays, dealing with very specific topics like learning how to use the Geometer's Sketchpad[2] or the graphing calculator. Teachers feel it has been very positive for them in the classroom in a lot of ways because they've been challenged mathematically and pedagogically.

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Technology

Our district is pretty technologically advanced; we've passed a lot of bond issues for technology. We have classroom sets of calculators in all classrooms, grades 1–12. Starting at 7th grade, we have classroom sets of graphing calculators, so every math teacher has a set of 30 or 35. We also have quite a few computers in the district. But as far as using computers for math, we haven't found a lot of math software that we spend much time with. We do spreadsheets. We do the Geometer's Sketchpad and use some spatial geometry software fairly regularly with the kids.

[2] Geometer's Sketchpad is an interactive geometry software environment that allows students to manipulate geometric objects on the computer. It is published by Key Curriculum Press.

Parents

I am very pleased with how we worked with parents; we were proactive in our approach. We had several parent meetings. One, at the beginning of the year, was informational—I tried to give information about the philosophy of the program and share some research about ways our old texts weren't providing new and interesting material for students. We also had a parent night around the time of parent conferences, when kids had been using the program for a couple of months. We made sure to communicate that we were open to parents coming in to talk to me or to teachers if they had questions. So we weren't dealing reactively to things. I think that was key.

Of course, there are parents who have complaints about the program. Some parents don't feel that there is as much explanation as there should be, specifically with some of the algorithms. The parents can't remember how to do fractions, and have trouble helping their kids. But they still want their kids taught the way they were taught. I want to say to them, "You want me to teach your kid like you were taught, so when your kid has to help her kid, she can't help him either?"

In the back of the MATH*Thematics* book, there's a section called the Toolbox and I tell parents that they can look back there for help. It includes a lot of examples for ways to do different types of problems and operations. Those are things that MATH*Thematics* assumes kids know, going into each year. We also have a book in the classroom called *Math on Call* from Great Source, and a lot of the parents have bought it. It's been a really good source to fill in those computation gaps.

One of our district philosophies is that we'll provide kids with opportunities to learn, but if the kid refuses or doesn't take that opportunity for a certain length of time, then we have to move on. There's got to be some accountability for kids and parents. Of course the big issue is basic facts. We've started sending letters home saying that we've spent as much time in class on particular skills as we can afford. When a kid doesn't have those down, we recommend that the parent work with the child on a daily basis at home. If drill and practice is important to the parents, it's their responsibility. We send home suggestions and flash cards, and suggest software they can buy, so we do give them some support. But basically we try to tell parents that there are more important things that we should be teaching in class, rather than spending hour after hour drilling multiplication facts. ■