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Results. More than at any time in recent history, attention is being focused on the results our schools produce. Expectations have been raised. Student performance standards have been identified for virtually every subject. It is essential that we maintain these high standards and expectations.

Every adult who is able to manage personal finances, make informed purchase decisions, intelligently interpret the data and statistics encountered on a daily basis in the information age, and represent and solve problems involving quantities started to develop these numeracy skills in the earliest grades and hone those skills in middle school. We must look to schools where students are achieving the highest standards of mathematics learning and identify the practices that enable them to achieve those goals.

This report tells the stories of eight different schools. The common characteristic shared by all is results; all have implemented programs of instruction that have enabled them to raise the mathematical performance of their diverse student populations to exemplary levels. It is undoubtedly true that there is not one way for all children to learn mathematics, but it is essential that all children learn mathematics to meet the challenges of our ever-changing world. What's more, they can.

The schools that use the effective mathematics program that is described here share several other critically important common characteristics.

- All show improved student performance.
- All have implemented ongoing programs of professional development for their teachers.
- All monitor student progress during the school year to ensure effective instruction.
- All have demonstrated the importance of the program to instructional leaders in their schools or districts.
- All have created exciting climates within their schools to encourage learning.
- All demonstrate the importance of maintaining high expectations for all students, not just the brightest or most privileged.

The leaders of the schools described herein are eager to share what they have learned and to see their practices and experiences spread to other schools. Please feel free to contact the people identified in each article. We've provided telephone numbers, fax numbers, addresses, and e-mail addresses whenever possible to make communication as easy as possible.

Let's learn from those who have the results that show this effectiveness. Let's help teachers and supervisors use this information. Let's all work together to help our children become effective learners who will be prepared for and productive in the twenty-first century.



Dr. Thomas Houlihan
Executive Director
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Executive Director and Chief
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The National Council of Teachers of Mathematics produced a set of national standards in 1989 with the intent of improving mathematics education on a national level. Their most recent guide, *Principles and Standards for School Mathematics*, published in 2000, emphasizes the belief that all students can and should learn and understand important mathematical ideas. Clearly, one of the components in attaining excellence in mathematics learning is the development of high-quality curricula that allow students to think deeply about mathematics, require them to explain their ideas, and connect their understanding to other contexts both within and outside of mathematics.



Faye Nisonoff Ruopp



Cynthia J. Orrell

In the past, middle school mathematics programs were designed mostly as review of previously learned material. Fortunately, the National Forum to Accelerate Middle-Grades Reform has countered this notion by promoting academically rigorous, standards-based curricula, centered on the belief that early adolescence is a period of substantial development in students' reasoning capacity. In its own development, *Impact Mathematics* relied on the Forum's identification of three components of academically excellent curricula: academic rigor, equity, and developmental appropriateness. Our main goal was to offer a curriculum that respects the background and knowledge of middle school teachers, recognizes the competence and energy of middle school students, and addresses the need for intellectually challenging and inclusive materials.

With *Impact Mathematics*, we have combined the best of what is known in the research on "reform" curricula with the best of "traditional" curricula, incorporating more active involvement on the part of students in making sense of important mathematical ideas. We believe that conceptual understanding and basic skills are not opposing interests; they go hand in hand and support each other.

Impact Mathematics is both a comprehensive program, including the strands of number and operations, proportional reasoning, geometry, probability, and

data, as well as a program focused on the development of algebraic thinking. The publication of *Algebra for Everyone* by NCTM in 1990 put forth the view of algebra as the gateway course, a course that must be part of the background of all employees. Therefore, algebra must be taught on a broadened scale, where students come to it with an appropriate mathematical background and disposition. In our approach to algebraic thinking, we have relied on the research reported in the National Council of Teachers of Mathematics Algebra Working Group (1995), *Algebra in the K–12 curriculum: Dilemmas and possibilities*, pointing to the inaccessibility of the traditional algebra curriculum, generally taught as a stand-alone course in the 9th grade. In *Impact Mathematics*, student understanding of the algebra strand—interwoven with and related to the other mathematical strands—evolves over a three-year period, allowing such important ideas as patterns, functions, proportional reasoning, and algebraic structure and skills to develop and become familiar over time. The algebra strand is based on the highly successful Australian program, *Access to Algebra*, developed by Curriculum Corporation, which provided an algebra curriculum relevant to students' lives, more inclusive of the interests and experiences of middle school students. *Impact Mathematics* is unique, then, in its comprehensive, standards-based, developmental approach, while completing a full year of algebra by the end of the third course.

Finally, the authors of *Impact Mathematics* recognize that mathematics has developed as an extension and a codification of ways of thinking that are natural to us all. To that aim, *Impact Mathematics* is written to help students use and sharpen their own logical thinking, learn to be comfortable with the abstractions that give mathematics its power, develop their ideas and mathematical imagination, and acquire the skills that support their good thinking and the ability to express their ideas clearly to others. The descriptions in this report detail the progress made in a variety of school districts using *Impact Mathematics*, where the complementary goal is to improve the mathematical understanding of all students.

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Table of Contents



Bend-La Pine Public School District
Pilot Butte and Sky View Middle Schools
Bend, Oregon2

Butler Junior High School
Butler School District
Butler, Pennsylvania.....4

Glenn Westlake Middle School
Lombard School District 44
Lombard, Illinois6

Ithaca Middle School
Ithaca Public Schools
Ithaca, Michigan8

New York Mills Junior High School
New York Mills Public School District
New York Mills, Minnesota10



St. Joseph School
Waconia, Minnesota12

Sarah W. Gibbons Middle School
Westborough Public Schools
Westborough, Massachusetts14

Spotswood Memorial Middle School
Spotswood School District
Spotswood, New Jersey16

Other Comments on *Impact Mathematics*18

Appendix
Research Supporting Instruction in *Impact Mathematics*:
A Selected Annotated Bibliography21



Bend-La Pine Public School District, Bend, Oregon

Bend-La Pine Public School District is located in Deschutes County, in the City of Bend, where snow-capped peaks and alpine forests dominate the skyline on the west and the wide-open high desert sits to the east. The City of Bend is considered Oregon's fastest-growing high tech industry area. The school district serves 10,500 students in ten elementary schools, three middle schools, and three high schools. Thirty-three percent of the students attending Pilot Butte Middle School are eligible for Free/Reduced Price Meals, and 19% of Sky View Middle School students are eligible.



Aligning with Standards and Preparing for State Testing

In 2000, Bend-La Pine Public School District aligned its district math standards with the National Council of Teachers of Mathematics Standards, and then set out to find a mathematics program that would be compatible with their newly revised standards and help prepare students for the Oregon Mathematics Knowledge and Skills Test. A curricula action team reviewed several mathematics programs using 15 evaluative criteria drawn from the district standards. Susan Wesson, 8th grade teacher at Pilot Butte Middle School and curricula action team member, explains, "When we compared *Impact Mathematics* to the evaluative criteria, it met the criteria 100%. *Impact* is based on research, has strategies to reach all students, is standards-based, and teacher friendly."

Before implementing the program district-wide, however, Bend-La Pine wanted to pilot-test it. Susan Wesson and Joyce Conant, 8th grade teacher at Skyview Middle School, volunteered to pilot *Impact Mathematics* with their students starting in the 2001–2002 school year. Mrs. Wesson piloted with 150 students in 7th and 8th grade, and Ms. Conant piloted with 150 students in the 6th, 7th, and 8th grades.

The Teacher Experience

Since implementing *Impact*, Mrs. Wesson has received the honor of Oregon Regional Math Teacher. About her piloting experience she says, "*Impact* is a whole new way of thinking, planning, and delivering math, but it is absolutely easy to use. It is like going from the 'stone age' to modern technology, yet it is so teacher friendly that I can't believe it. With *Impact*, I am a facilitator."

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The Student Experience

Mrs. Wesson's students are also having a positive experience. As she explains, "It is awesome to walk around the classroom and listen to the students working together. The whole class just feels different. Students come back with their homework finished, which didn't always happen before, and they are so involved, putting forth 100% every day. I am so proud of my *Impact* students. They are achieving a higher thinking level, not just memorizing. They are understanding and applying the concepts of mathematics in a variety of situations." The District Superintendent visited Mrs. Wesson's classroom and observed the students piloting *Impact*. Mrs. Wesson says, "He was blown away by the answers kids were providing." Mrs. Wesson believes her students are now more comfortable with and interested in math. She adds, "Students that didn't like math, now say that it's their favorite class."

Ms. Conant echoes Mrs. Wesson's praise: "*Impact* provides more opportunities for students to create and solve. It makes students think and reason as they go along, instead of 'here's the rule, memorize it,' all while maintaining student interest and attention. I think students have a lot more fun with *Impact*, because they can personalize the problems. Before, a lot of students struggled with math, now they enjoy it. I think it's because of *Impact's* approach, where students are really involved, working and learning together. My students have come so far!"

Pulling the Grade

Mrs. Wesson and Ms. Conant have been closely watching the state test scores of their students who are using *Impact*. Mrs. Wesson notes, "In 2003, my 8th grade students' scores significantly increased from the previous year, with 100% of students using *Impact* 3 meeting or exceeding the state math standards, whereas before, 53% did not meet the standards." Ms. Conant explains, "For the Oregon Mathematics Knowledge and Skills Test, 8th grade students get three chances

to pass it. All of my students who had *Impact* for two years passed the test on their first try." Comparing her students to students taking traditional math, she found, "Only 80% passed the state test, and all of them had to take the test two, if not three times to do so."

Parents Are Positive

Both pilot-test teachers have received positive feedback from parents of students using *Impact*. Mrs. Wesson shares the experience of two mothers who are also high school teachers: "They can't believe what their middle school children are doing, and they are surprised at how little they have to help them." Ms. Conant says, "Parents have thanked me and even given me presents for challenging their children and providing a positive experience."

The Decision

Because the pilot-test results are so positive, Bend-La Pine Public School District has decided to implement *Impact Mathematics* district-wide, starting in the 2003–2004 school year. Shannon Roy, Pilot Butte Middle School Principal, says, "Though it's a paradigm shift for some (staff, students, and parents), *Impact Mathematics* brings us the results. Students are empowered to think and apply complex concepts in real-life situations." Mrs. Wesson adds, "Teachers are really turned on by what they have seen and heard about *Impact* and are looking forward to using it."

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Butler Junior High School, Butler, Pennsylvania

Butler, Pennsylvania, is a medium-sized suburb located approximately 35 miles north of Pittsburgh. Butler Junior High serves the 1350 students in 7th and 8th grade coming from all of Butler School District's eleven elementary schools. Twenty five percent of Butler Junior High's students qualify for Free/Reduced Price Meals.



Impact Mathematics was implemented in all of Butler Junior High's 7th grade classes in the 2001–2002 school year, and 8th grade classrooms were added in the 2002–2003 school year. As Mr. Kalac, Mathematics Department Chair, recalls, "The decision to use *Impact Mathematics* was a department-wide decision. In our elementary schools, *Everyday Mathematics* was implemented in the 1996–1997 school year, and we needed to make a change in our junior high to keep pace. We wanted something that was designed for the level of math and style of thinking that *Everyday* students were bringing to junior high. Also, our school is pushed a lot by gifted students and their parents who want them ready for algebra in 7th grade. We all knew the text we were using before wasn't enough. We wanted a repetitive, spiraling

design. We looked at other curricula, but we liked *Impact Mathematics* the best because we thought it would give students a strong basis for high school math. We've also used the Math Counseling Program of the Professional Society of Engineers and learned that our students were lacking in certain skills. We chose *Impact* to work on those skills."

Transitioning to *Impact Mathematics*

Seventh-grade teacher Donna Vogel remembers the transition into using *Impact Mathematics*: "I've been teaching traditionally for 32 years, and was anxious about changing. One of the other 7th grade teachers and I work closely together, and I've found that working as a team really helps. I think before, we kept thinking numbers, numbers, numbers, and *Impact Mathematics* has shown that math can apply to many different areas in life. Also, it's given us a more hands-on approach, which I'm learning to enjoy."

Amy Bodamer, 7th and 8th grade teacher, also remembers when *Impact Mathematics* was first chosen: "When we first saw it, I have to say I was nervous. At first, the textbooks seemed to be more 'fluff' than content, but we quickly realized that *Impact* emphasized even more algebraic skills than the traditional texts we'd been using. The major difference from the traditional texts we were using before is the de-emphasis on drill and more emphasis on learning concepts. There's a lot more reading and comprehension; it's not just one example and then 30 problems done exactly the same way."

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Mr. Kalac, Ms. Bodamer, and Ms. Vogel agree that in the transition from a traditional text to *Impact Mathematics*, training was extremely helpful.

Hopes Fulfilled

As Mr. Kalac, Ms. Bodamer and Ms. Vogel are discovering, *Impact Mathematics* was the right choice. Ms. Bodamer explains that her students have been thriving with *Impact Mathematics*: "When we reached the solving equations chapter in *Impact Course 3*, I was shocked at how well my students transitioned from using concrete techniques to solve equations, like backtracking and balance puzzles, to the more traditional, algebraic process of doing the same thing to both sides. It didn't even faze them; they just rolled right into the abstract equations. I think that *Impact* is providing a great foundation for high school mathematics by developing concepts through manipulatives and concrete situations."

She adds that even her lower-achieving students are growing with *Impact Mathematics*. "All my students—high-achieving and low-achieving—are much more likely to dive in and try it, no matter what the problem is. The concrete Manipulative Kit really helps the lower-achieving kids, so they don't give up so easily. They can have success before things start getting more abstract. With traditional texts, they were more likely to build up a wall and say 'I can't do this. This is too hard.'"

High Expectations

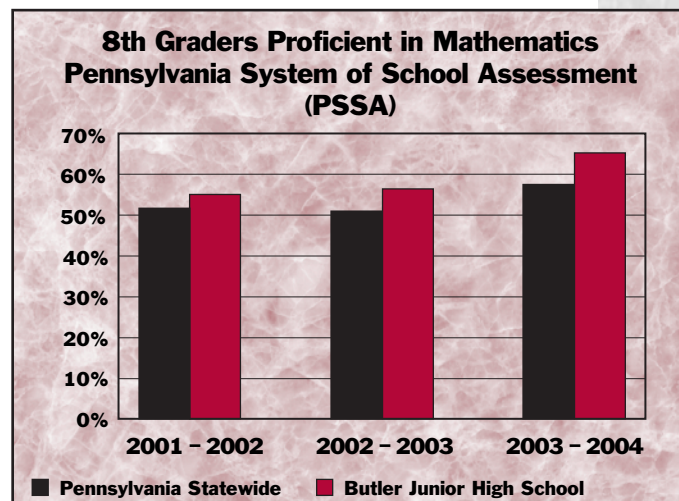
Ms. Vogel thinks that *Impact Mathematics* may better prepare them for the types of questions on the Pennsylvania System of School Assessment (PSSA) than did previous texts. She explains, "There are some open-ended questions on the PSSA, and the students are used to them now from *Impact Mathematics*. They're not afraid now to write out an answer and tell you what they're thinking. They're better able to answer and describe things more thoroughly than they were before."

Seeing Results

Student performance in mathematics on the PSSA at Butler Junior High School has steadily improved since the implementation of *Impact Mathematics*. At the end of the 2002–2003 school year, there was a slight increase in mathematics proficiency among 8th grade students with 2% more scoring proficient than the previous year. At the end of the 2003–2004 school year, an additional 9% of 8th grade Butler Junior High students scored proficient, pushing them well above state averages for proficiency. This impressive trend of growth and success is expected to continue as *Impact Mathematics* becomes embedded in the mathematics program at Butler Junior High School.

8th Graders Proficient in Mathematics
Pennsylvania System of School Assessment (PSSA)

Year	Butler Junior High School	Pennsylvania
2001–2002	55%	52%
2002–2003	57%	51%
2003–2004	66%	58%



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Glenn Westlake Middle School, Lombard, Illinois

Glenn Westlake Middle School is a large 6th, 7th, and 8th grade public school located in the suburb of Lombard, Illinois, about 40 minutes west of downtown Chicago. Glenn Westlake serves approximately 1150 total students, including 750 in Grades 7 and 8. Glenn Westlake's district, Lombard School District 44, has set a goal for every school in the district to increase the number of students who meet or exceed state standards as measured by the Illinois Standard Achievement Test (ISAT). Each school has been charged to use the Illinois State Board of Education's State Goals for Learning as the framework to define and assess student outcomes and evaluate improvement efforts. In response to this challenge, Glenn Westlake adopted *Impact Mathematics* for all 7th and 8th grade classrooms, beginning in the 2001–2002 school year.



Raising the Bar

According to 7th grade teacher Tom Surdam and 8th grade teacher Patty Bruzek, the mathematics faculty committee at Glenn Westlake Middle School knew in 2000 that it was time for a new curriculum. The committee was composed of six teachers, including two from each grade. As Ms. Bruzek explains, "We met to identify what we needed in math and to decide whether or not we should change curricula. We're a K–8 district, and we were using four different textbook series; it was just too splintered. Our scores on state testing weren't where we wanted them to be. We knew that we needed something new that was not as traditional."

Six elementary schools feed into Glenn Westlake, and all adopted *Everyday Mathematics* in 2000. Ms. Bruzek remembers that a representative for *Everyday Mathematics* came to the school to describe how *Everyday Mathematics* transitioned to *Impact Mathematics*, and the committee "thought it would work well." Mr. Surdam adds, "We'd seen a lot of research on best practices on how students learn. We needed to address certain topics, but we also wanted a consistency in learning style. The sequence of each chapter to the next in *Impact Mathematics* allows you to pick up where you left off, and the text flows very nicely from course to course."

"I was pretty nervous about making a change," admits Ms. Bruzek, "but we decided if we were going to make a change, we should make a change. We thought *Impact Mathematics* was a good solution to our search, to be partly traditional, but also to be trying something new." Mr. Surdam agreed with Ms. Bruzek's view of *Impact Mathematics*. "We looked at some open-ended curricula, but they were really too much. *Impact* is in the middle. It's part traditional and part open-ended, and there are no gaps in terms of covering state standards."

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Learning Together

Impact Mathematics has certainly fulfilled Ms. Bruzek and Mr. Surdam's hopes for a new and different style of teaching and learning. According to Ms. Bruzek, "In the past, it was all memorization. It all felt very disjointed, doing one thing over and over and then jumping to the next topic with no good connection. *Impact* has a definite course of action—one investigation leads to what comes next. It was exciting for the students and me to see it unfold from week to week. I like the progression. More important, kids learn the 'why' behind what they've just learned. They would have that 'a-ha!' moment. I've been teaching for 21 years and this really has made me a better teacher. It really makes me get more involved and active, and has opened my eyes to the real mathematics behind some of the topics we are teaching."

Lessons Learned

Both Ms. Bruzek and Mr. Surdam point to the importance of training and consultations with Glencoe/McGraw-Hill representatives to implement *Impact Mathematics*. Ms. Bruzek describes the consultations as "feeling like a new mom and getting to talk to other new moms and get their advice." Ms. Bruzek also notes that "the two other 8th grade teachers and I meet often and try to stay on the same page. We've found that working together as a team has really helped us, and we can bounce ideas off each other. Also, daily preparation is important. You can't just walk in cold; you have to be ready for each day."

Mr. Surdam and Ms. Bruzek also think it's important to introduce the curriculum to parents who may be wary of a new approach to mathematics. As Ms. Bruzek remembers, "We had a parent meeting the first year and suggested that parents talk the work through with their child and really look at their child's notes. Parents really love the discussions they have now with their kids, and how their kids can explain their reasoning."

Signs of Success

According to Mr. Surdam, "The higher level of math skills and concepts that we're teaching now in 7th grade were formerly taught at 8th grade. I'd say about 25% of what the 7th graders are learning now they used to get in the 8th grade. I appreciate the sequence and the spiraling effect, where the end of the chapter reinforces concepts in another way. The concrete examples make all of it more meaningful. Students who couldn't grasp a concept in the traditional style can understand with these concrete examples, and they can all explain concepts more clearly as the year goes on."

Ms. Bruzek states, "I think it's definitely improved their skills. They sit in their groups, and sometimes I wish I had a tape recorder! It's great to hear their math discussions and the questions they ask each other. Our students seem to be well-prepared for 9th grade. I've asked the group that just finished 9th grade after completing one year of *Impact* in 8th grade to tell me how they're doing. The kids who are taking regular algebra in 9th grade are at the top of their class. The ones who are taking geometry are doing pretty well too. With *Impact Mathematics*, the students are getting a strong foundation to build on."

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Ithaca Middle School, Ithaca, Michigan

Ithaca Middle School, in the agricultural community of Ithaca, Michigan (pop. 3098), is a small 7th and 8th grade school with a large vision. Situated one hour north of the state capital of Lansing and two hours northwest of Detroit, Ithaca Middle School is somewhat geographically isolated, but strongly maintains its connections to the latest educational methods and standards for the benefit of its 240 students. As explained by Math Department Chair for the middle and high schools, Mark Strong, Ithaca Middle School was selected by Western Michigan University in 2000 to participate in the Michigan Middle School Mathematics Reform Project (M³RP). Ithaca Middle School subsequently implemented *Impact Mathematics* in all 7th grade classrooms in the 2001–2002 school year, and added all 8th grade classrooms in the 2002–2003 school year.

Discovering *Impact Mathematics*



According to 8th grade teacher Sheila Casey, the M³RP trainings exposed her and Mark Strong to National Science Foundation (NSF) Exemplary texts, and the “reform,” non-traditional style of teaching mathematics such as those embodied in *Impact Mathematics*. Ms. Casey piloted different lessons from NSF Exemplary texts and from *Impact Mathematics* in her classroom in the 2000–2001 school year, and found that *Impact Mathematics* had all the characteristics their department had been seeking. As she explains, “We really wanted whatever we chose to fit well with 6th grade, where we’re using *Everyday Mathematics*.

And a lot of people in our community really want our kids to take algebra before 9th grade. We looked at other reform curricula, but they didn’t cover algebra as well as *Impact Mathematics*.”

Mr. Strong, who in addition to acting as Math Chair also teaches math in grades 9–12, agreed with Ms. Casey’s assessment: “The number one thing about *Impact Mathematics* is that it gets through Algebra I by the end of 8th grade. All of the integrated curricula cover algebra, but not in as much depth. We were seeking a program that covers algebra well and we found it. Another big difference is that there are more in-depth problems. Learning is cooperative, because the students work together. The teacher is facilitating, rather than directing or lecturing.”

Ms. Casey, who has taught both 7th and 8th grades at Ithaca Middle School, remembers her dissatisfaction with the previous curriculum. “This is my ninth year here, and for seven years, I was using a more traditional text at 7th grade. I just didn’t like their examples. It was hard to supplement, and it wasn’t conducive to group work. Our high school proficiency scores were good, but 7th grade math just wasn’t exciting and the kids weren’t dialoguing.”

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Making a Change

Mr. Strong, Ms. Casey, and the other math teachers evaluated the strengths and weaknesses of each curriculum under consideration and decided to implement *Impact Mathematics Course 2* in all 7th grade classrooms in the 2001–2002 school year, and use *Course 3* in all 8th grade classrooms in the 2002–2003 school year. According to Mr. Strong and Ms. Casey, *Impact Mathematics* is bringing their reform training to life in the classroom. As Ms. Casey explains, “We really like the group dynamics, the inquiry-based style, the more open-ended problems and the fact that there is more than one way to do a problem. We use it for general curriculum; all students are mixed and it works really well. At some point, every kid can feel smart.”

Mr. Strong also feels that the transition has been smooth: “Having the 7th graders starting with *Impact Mathematics Course 2* without having had *Course 1* wasn’t a problem, nor was moving from *Course 2* to 8th grade *Course 3* this past year.” To maintain consistency, 9th graders will begin the 2003–2004 school year as the first class using Glencoe/McGraw-Hill’s *Contemporary Mathematics in Context*, and a grade level will be added on each year as this group progresses.

Student Response

According to Ms. Casey, “The students feel proud that they are doing tough math. I feel we’re offering them valuable and relevant mathematics that can meet a wide range of abilities.” She believes that one of the keys to learning with *Impact Mathematics* is group work; “The groups can help pick up someone who’s lost. They’re hearing concepts in smaller groups. And it’s harder to tune out classmates than the teacher! It also encourages a variety of solution methods. There’s plenty of material for kids who need more practice or for kids who need to be challenged more. It helps that they learn by discovery and discussion. They look at graphs and tables and equations together, and one of those is going to make sense to them.”

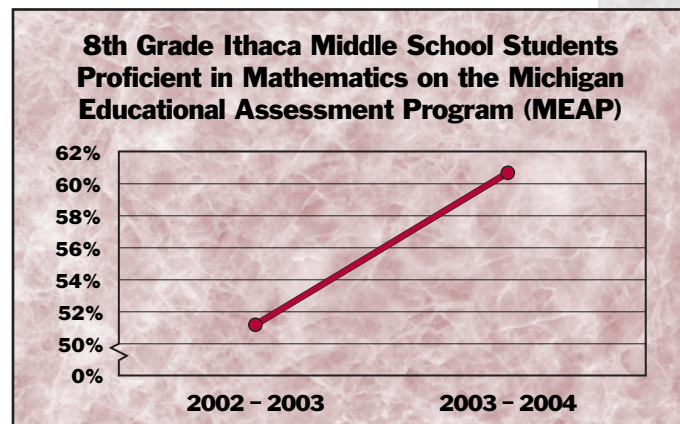
Ms. Casey attests that “our class is 55 minutes, and with *Impact Mathematics*, students don’t feel they were tortured for 55 minutes. This is the best compliment I can get—I’ve had students look at the clock and say ‘wow! This class went fast!’”

Seeing Results

After the first year of using *Impact Mathematics* at Ithaca Middle School during the 2002–2003 school year, 52% of 8th graders were proficient in Mathematics. After the 2003–2004 school year, the percentage of proficient students jumped up to 61%, demonstrating positive growth in students’ mathematic skills at Ithaca Middle School.

8th Graders Proficient in Mathematics Michigan Educational Assessment Program (MEAP)

Year	Ithaca Middle School
2002–2003	51.7%
2003–2004	61.1%



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New York Mills Junior/Senior High School, New York Mills, Minnesota

Originally a trading post for French and British fur traders, New York Mills, Minnesota, is in Otter Tail County, about 170 miles from Minneapolis. The K–12 New York Mills Public School District has 735 students, of which 360 attend the secondary school. Thirty-eight percent of the secondary students are eligible for Free/Reduced Price Meals.

State Math Standards Provide Motivation



The district adopted *Impact Mathematics* for the 7th and 8th grades in the 2000-2001 school year, after the successful introduction of *Everyday Mathematics* at Grades K–6 two years earlier. Tamara Uselman, K–12 Curriculum Coordinator and Principal of the secondary school,¹ heard about *Everyday Mathematics* from a neighboring school and encouraged the elementary teachers to look at it. She explained, "Although originally no one was interested, one early elementary grade was willing to use it as a pilot program, and their results were so positive that grades 4–6 adopted the series. At the same time, the high school was studying the Minnesota math standards and was searching for a series that fostered thought over direct skill review. We could see that the standards are embedded in the series."

As with most schools in the nation, New York Mills Junior/Senior High School had been using a traditional skills-based math textbook with "lower-level thinking." Ms. Uselman felt strongly that a program that would bridge the years between *Everyday Mathematics* and 9th grade Algebra was necessary. The selection criteria for a new program were that it (1) be standards based, and (2) include in-depth problem-solving as well as skills development. Her ultimate goal is to move students into more advanced math. "We now feel if we have Grades 6, 7, and 8 working in *Impact*, we can teach and assess the middle school algebra standards very well, and may be ready to accelerate students into geometry in 9th grade rather than waiting until they're in Grade 10."

Positive Teaching Experiences

Ms. Uselman admits that changing over to *Impact Mathematics* "was a big step, but now the junior high math teachers would NOT like to return to the old math texts." Harley Jabas, a 7th and 8th grade math teacher who has been using *Impact Mathematics* for three years, agrees with her assessment. "I've gotten used to it. The program is clearly set out, although it takes a while to figure out the 'personality' of the program,

¹Ms. Uselman is now Superintendent of Schools in a neighboring school district.

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its rhythm. The questions are involved, and you have to be ahead of the students. The program uses cooperative learning techniques, which you have to be comfortable with."

Results with Students

One of the outcomes that Mr. Jabas appreciates about *Impact Mathematics* is its effect on students' ability to think critically. Ms. Uselman reports that she "feels it prepares kids well in terms of the logic and deep thinking involved in math." Mr. Jabas himself comments, "The program promotes higher critical thinking skills, and is great preparation for high-stakes testing. There is circular learning and real-life situations in the book that students can relate to. Sixth and 7th graders can keep adding more and more pieces and do complex equations, and 8th graders are doing what other schools don't teach until 10th grade."

In comparison with the traditional math program, *Impact* takes some practice to master, but is ultimately rewarding for students. Mr. Jabas notes that students who have used *Everyday Mathematics* in the elementary grades are better prepared for *Impact Mathematics* in the 7th and 8th grades. "Using it across grades is great. This year's 7th graders have had the program since the 4th grade and pick up the information much faster."

Mr. Jabas also points out that with the memorization which is used in traditional math programs, "you sink if you don't know the information. Students who had difficulty learning (i.e., memorizing) traditional math are now using critical thinking processes and understand what they are doing. In traditional math, there are 30 questions to do for homework. *Impact* would have 5 problems that take as long to do as the 30 questions because they require a higher level of thinking. After some experience, the students get it. It's like trying to describe how a pizza tastes—until you eat it, you don't really know."

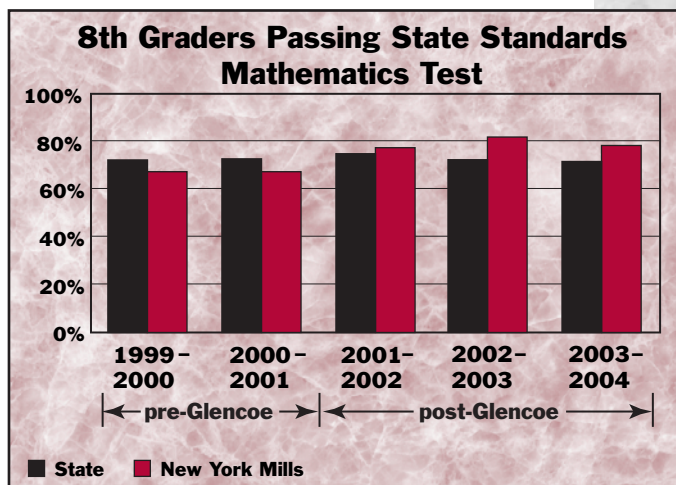
Test Scores Go Through the Roof

Not only do teachers and students enjoy using *Impact Mathematics*, but the district's primary reason for selecting it has already been realized. According to Mr. Jabas, test scores in the elementary grades that are using the precursor to *Impact Mathematics* have "gone through the roof" in math, and the school's passing percentage on the 8th grade state standards test increased by 15% the first three years *Impact Mathematics* was used.

8th Grade Students Passing State Standards Mathematics Test

Year	New York Mills	State
1999–2000	66.7%	71.8%
2000–2001	66.7%	72.0%
2001–2002	76.4%	74.5%
2002–2003	81.5%	71.7%
2003–2004	77.8%	70.8%

Glencoe Implemented →



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St. Joseph School, Waconia, Minnesota

St. Joseph School is a small, Roman Catholic K-8 school in the community of Waconia, Minnesota, which is home to 8,100 people, and is located about 35 miles west of Minneapolis. The school was founded by the Sisters of Christian Charity, who opened a brick, one-story schoolhouse in September of 1888. Since that time, the school has expanded to a two-story building and a larger, more modern Education Center, but retains its roots as an intimate learning environment. Anna Pauly is the St. Joseph School Math Specialist and teaches math to the 65 students in 6th, 7th, and 8th grades.



A Vision for the Future

Mrs. Pauly recalls the period prior to the 2001-2002 school year, when St. Joseph first implemented *Impact Mathematics*. Prior to 2001, St. Joseph used four different math series: one for kindergarten and 1st grade, one for grades 2–4, another for grades 5-6, and still another for grades 7–8. According to Mrs. Pauly, “It just wasn’t flowing from grade to grade and we needed to fix that. It was a time when we were taking an extensive, critical look at our math programs, and there was a push to find something new.

Mrs. Pauly and her math staff chose the *Everyday Mathematics* series for grades K–5 and *Impact Mathematics* for 6–8 and implemented all texts simultaneously in the 2001–2002 school year. They felt that the two series would integrate well together and had a strong balance between skills and real-life situational problem-solving. Mrs. Pauly recalls, “There just weren’t any happy mediums. Everything else was either all drilling skills or all real-life problem-solving, but not both. *Impact Mathematics* had everything we were looking for.” Ms. Pauly presented her decision to the principal, assistant principal, and school board, who all agreed with her assessment. “They were really impressed with the curricula,” says Mrs. Pauly.

Since the adoption of *Impact Mathematics*, Mrs. Pauly says that she couldn’t be happier with its success. With the previous curricula, she had to separate general students and honors students, but with *Impact Mathematics*, that is no longer necessary. She is particularly pleased with how flexible the program is and how it accommodates various learning styles. “I could pick how basic I wanted to go or how challenging. I’ve really enjoyed having that flexibility.”

**Expect more.
Achieve more.**

Student Response

Mrs. Pauly appreciates how *Impact Mathematics* aligns with one of the school's teaching philosophies: "The learning process is a partnership shared by the student, who accepts the responsibility and challenge for his or her education. The students are very interested in the program—they said that it makes you think. You have to get involved. You learn how to apply the math you've learned. If you read something and you don't get it, you re-read and re-read, so they learn concentration skills and to sort out the information they need. Also, the tests are very involved and very tough, and the students really have to spend time and 'live' with the problems. They really show their understanding."

Signs of Success

Mrs. Pauly is proud of how her students have grown with *Impact Mathematics*. They have increased their mathematical reasoning skills and learned to use math in a variety of applications. She relates, "Every year, we have a Read-A-Thon during the summer, and if you read X number of pages, you win an out-of-uniform pass for a day. That may not sound like much, but at a Catholic school, that's a big thing! My kids, on their own, decided to figure out how many pages they'd have to read over the summer to get an out-of-uniform pass for every day of the next school year! I think that's a perfect example of how they've learned to think mathematically and apply mathematical strategies to real life."

Evidence of the students' understanding of mathematical concepts is appearing in test scores and in the transition to 9th grade. As Mrs. Pauly explains, "Minnesota does a basic standards test in 8th grade, and if students don't pass, they have to complete a practice course and retake the test. All of our students passed this year. I give a lot of credit to the types of problems in *Impact Mathematics*, and how they learned to read a problem carefully. There are

two different high schools that we feed into—Waconia High School and Holy Family Catholic High School. The teachers say that they know the students who came from St. Joe's because they do so well in class. Holy Family has a very traditional program and often St. Joe's kids test out of algebra and move ahead."

Parent Response

Mrs. Pauly has also seen positive reactions from parents, who appreciate the fact that *Impact Mathematics* is challenging their children. "They like that it's not easy! They've said that concepts in their life or their work relate to what their child is learning in *Impact*. It just makes sense to parents. They're surprised at the variety of strategies their kids can use to solve problems; the kids don't only know one way to solve each problem."

A Math Program with Pride

When asked what her advice would be to others implementing *Impact Mathematics*, Mrs. Pauly replied that training is key to smoothing the transition from one curriculum to the next. But she says that the transition "was absolutely worth it. I've observed changes in student behavior in math class since we've been using *Impact*. They have to be more engaged than they were before. They have been very excited about it, because they feel challenged. I have a very intelligent math student who compares his notes with friends from other schools. He's said that we have the hardest math in town. We take great pride in that comment!"

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Sarah W. Gibbons Middle School, Westborough, Massachusetts

Sarah W. Gibbons Middle School is located in Westborough, in central Massachusetts, Worcester County, approximately one hour west of the state capital, Boston. Westborough is considered one of the fastest growing communities in all of New England, and Westborough's public schools are among the top in the state. Gibbons Middle School, the only middle school in the district, serves just over 600 students in 7th and 8th grades.



In 1999, Gibbons Middle School Mathematics Department took on the task of looking for a new mathematics program. Lynn Sullivan, Mathematics Department Chair, explains, "We had no mathematical base; people were using different textbooks, and our math materials were so old. Research indicated there is an increase in learning with active student involvement, and we wanted a program that was standards-based that everyone would use. At that time, I was one of nine teachers in the department. We picked three mathematics programs to pilot, including *Impact Mathematics*. While piloting, teachers met monthly to discuss the status, talk about pros and cons, and rate each program, topic by topic, on a 5-point scale." After the pilot-test period, Gibbons chose *Impact Mathematics*. "*Impact Mathematics* had the connections to standards, offered opportunities for active learning, provided real-world experiences, and changed the teacher's role to facilitator."

Implementing Change

Impact Mathematics was implemented in Gibbons Middle School in the beginning of the 2001–2002 school year. Ms. Sullivan describes the experience: "For the most part, people are positive and happy to have a mathematics program that everyone is using. Some of the more traditional teachers were a bit resistant. It was hard for them to give up autonomy and change from delivering information to facilitating learning." Eighth grade teacher, Megan Gerstenzang, adds, "*Impact* is different from other mathematics programs. Other programs give you examples, and you practice with problem after problem, and you can't teach from the book. *Impact* is set up so we can teach right from it." Barbara Mitchell, 7th grade teacher, adds, "I find *Impact's* lesson format clear and easy to follow. It's nice to have all of the information right there."

Ms. Sullivan believes the school was successful in implementing *Impact* because "teachers had a huge say in the process. We let our teachers try the different mathematics programs, see the benefits themselves, and gave them a voice in the selection process. When we did that, teachers came to the conclusion themselves that *Impact Mathematics* was the best mathematics program out there."

The New Mathematics Classroom

Ms. Sullivan said that with *Impact Mathematics*, math classrooms have been transformed into mathematics laboratories "that are rich in technology, math explorations, and applications. Students are actively involved, exploring mathematics and making both real world as well as interdisciplinary connections. *Impact* helps the student discover the math, instead of telling them how to do it. I think this approach makes mathematics more understandable and useable to them in the future. It deepens learning, instead of learning for the test and forgetting it." Ms. Mitchell adds, "With *Impact*, students are not just sitting there solving problems the whole time. They are engaged, and physically moving to solve problems because *Impact* is hands-on learning. Open-ended questions really challenge students to explain what they did, and allow them to solve problems using five or six different strategies, instead of only one. Students can access and solve problems in ways that are appropriate for them."

The New Math Student

According to Ms. Sullivan, "Students now come into the math classroom excited, no longer bored or intimidated. There is less math phobia, and I think it is because *Impact* gives them a chance to discuss and talk about problems. I think our students are better thinkers, problem solvers, and much better writers, because *Impact* encourages them to

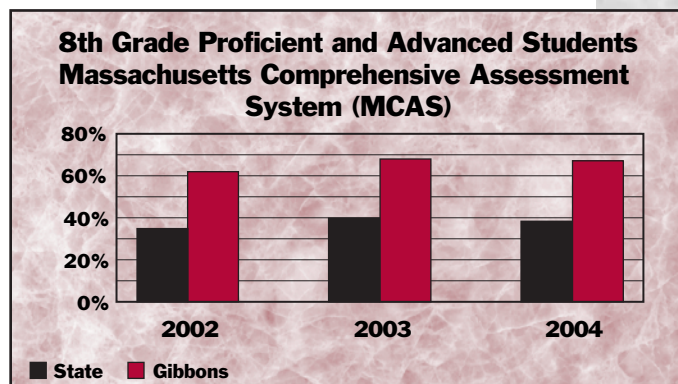
explain how they solve problems. Our middle school students are really bringing a lot to high school. I think they have a better understanding of math than ever before."

Measuring Success

Since implementing *Impact Mathematics*, Gibbons has noticed improvements in their student results on the Massachusetts Comprehensive Assessment System (MCAS), which assesses student performance by content area and grade level. In 2002, the percentage of 8th grade students in the advanced and proficient levels increased by 3% from the previous year. In 2003, the percentage of students scoring as advanced and proficient increased another 6%. Scores remained relatively constant in 2004, with a 1% drop in the percentage of advanced/proficient students.

8th Grade Proficient and Advanced Students
Massachusetts Comprehensive Assessment System (MCAS)

Year	Sarah W. Gibbons	State
2002	62%	34%
2003	68%	40%
2004	67%	39%



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Spotswood Memorial Middle School, Spotswood, New Jersey

Sspotswood Memorial Middle School is located in a small suburban community in the middle of New Jersey in Middlesex County, approximately 30 minutes north of the state capital, Trenton, and one hour south of New York City. Spotswood Memorial, the only middle school in the district, serves just over 200 students in 7th and 8th grade.



Spotswood Memorial adopted *Impact Mathematics* in the 7th grade in the 1999–2000 school year, and the following year in 8th grade. Fran Elson, District Supervisor of Math and Science, recalls, “We were not happy with the mathematics program we were using. The text was very traditional; it was designed to teach a particular concept, practice it, and then move on to a different topic, rarely revisiting the previously covered subject matter.” Stefanie Bromberg, 8th grade teacher, remembers, “We thought the books were outdated, very traditional, and our students were passive learners.”

Ms. Elson established a committee of teachers to review several standards-based programs, of which *Impact Mathematics* was one. They agreed unanimously that *Impact Mathematics* was the best for their students. Ms. Elson states, “*Impact* was developmentally appropriate for our students, while at the same time it raised the bar for what was previously expected of our middle school students. It required in-depth problem-solving and seemed to be a perfect transition program to follow our elementary *Everyday Mathematics* program.” Ms. Bromberg adds, “We liked *Impact* because it provided hands-on learning and real-life scenarios to work with. It also spreads lessons over several days, and moves from the concrete to the abstract.”

A Teacher's Experience with *Impact Mathematics*

Stefanie Bromberg has used *Impact Mathematics* with both 7th and 8th grade students since its adoption in 1999. “*Impact* has afforded me professional growth in my profession. It also provides an alternate way for me to assess my students' growth. For students, I think *Impact* brings math to life with real-world scenarios, which means students are no longer asking, ‘Why do we have to learn this?’”

With *Impact*, math is now really hands-on at Spotswood. Ms. Bromberg explains, “Students are cooperatively working together, using different materials and mechanisms to solve problems, instead of just individually doing problems with paper and pencil. I think the interaction helps them learn, and it is so nice to see students pulling each other along.”

Impact also produces higher-order learning and gets our students to think a lot more. Every problem is thought provoking, and builds on the next. Students have to think to solve *Impact* problems."

Seeing Results

Spotswood Memorial is starting to see results with *Impact*. The State of New Jersey's 2002 Grade Eight Proficiency Assessment in Mathematics results showed an increase of 18% from 2001 in students who scored between proficient and advanced proficient. In addition, Spotswood Memorial's 8th grade math club entered the New Jersey Math League in February 2003, and placed fifth in Middlesex County. Ms. Bromberg, also Math Club Advisor, says, "We have never placed before." Ms. Elson believes that because *Impact* expects more of students, they are proving themselves by rising to the occasion.

Teachers aren't the only ones seeing results with *Impact*. Ms. Bromberg reports, "Parents' comments have been very positive since implementing *Impact*. They say their children are interested and excited about math, and come home talking about what they did in math class. I have had parents say their children used to get horrible grades in math, and now they are achieving A's and B's."

8th Grade Proficient and Advanced Students
New Jersey State Mathematics Proficiency Assessment

Year	Spotswood Memorial	State
2000-2001	63%	66%
2001-2002	81%	66%
2002-2003	75%	66%

**Expect more.
Achieve more.**

Students Love Math?

The first day of each school year, Ms. Bromberg asks her students how many of them like math. She says, "Before *Impact*, very few students raised their hands. Now, after a full year of *Impact* almost every hand goes up. My students are realizing that math is not tedious, and that it can be fun. I see more and more students saying that their favorite class is math, instead of lunch! *Impact* takes a different approach to teaching and puts a challenge back in mathematics. It has been a good fit for Spotswood Memorial."



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Other Comments on *Impact Mathematics*

Pedagogy

"*Impact* is much different than a traditional textbook. *Impact* is more in tune with how I think math should be taught. In the Course 1 textbook, on page 43, there is a chart of polygons. In the past years, I drew that exact chart, before any text had that chart. *Impact* does things the way I have intuitively done for years. It is a very good textbook. It is conceptual, not memorization that will be forgotten."

Claude Valle, Teacher
Weston Middle School, Weston, Massachusetts

"With *Impact*, we have a different expectation of our kids. They are asked to think and talk about what they are doing rather than memorize it."

Dennis McCowan, Mathematics Dept. Chair
Weston High School, Weston, Massachusetts

"*Impact Mathematics* is totally different from the traditional way; it's not all lecture. It is not taught through direct instruction or a recipe approach to problem solving, rather, the style of teaching is through innovative delivery and guided discovery. The students are working through problems on their own. I think students who discover how mathematical relationships connect together build their own mathematical thinking and can more effectively recall what they have learned in the past. *Impact Mathematics* is very effective."

David Brouillard, Teacher
Obsidian Middle School, Redmond, Oregon

Content/Skills Building

"*Impact* raises the bar for a cohesive middle school program. It moves kids into thinking about big ideas in math, instead of individual problems. It gives teachers a tool for working students through the development stages of acquiring math."

Dennis McCowan, Mathematics Dept. Chair
Weston High School, Weston, Massachusetts

"It's a very strong program. It's powerful. It requires the kids to do thinking on their own and really prepares them for state assessment questions. I'm certainly anticipating an increase in our state scores. Also, I've been taking my students to a Math Counts competition for 15 years. This last year, one of my students had the highest score at the regional competition that she's ever had; out of 45 questions, I think she only missed two. I attribute that to her background and her training with *Everyday Mathematics* and *Impact Mathematics*."

Bob Kalac, Mathematics Dept. Chair
Butler Junior High, Butler, Pennsylvania

"*Impact* does a better job of developing concepts and building a basic understanding. It tells the whole story. The kids have learned more with *Impact*, and it seems to stick with them."

*Jim Rhein, Mathematics Dept. Chair
Gosben Middle School, Gosben, Ohio*

"*Impact* teaches mathematical thinking and reasoning very well. It really gets down to understanding concepts instead of just doing problems. I think that my students' reading and writing of mathematical skills have improved. Now, they know how to read math problems, and there is no separation between regular math problems and word problems. They just understand better."

*Megan Walsh, Teacher
Gosben Middle School, Gosben, Ohio*

"My students' skills have greatly improved. They don't show you how to do the problem; the students discover it on their own. And, there are different ways to solve each problem, not just one. I teach 7th and 8th grades, and I've never had kids factoring trinomials before."

*David Brouillard, Teacher
Obsidian Middle School, Redmond, Oregon*

"Kids are developing high-level skills with *Impact Mathematics*. They are better thinkers and their writing is improving. I think it is helping us district-wide."

*Jim Rhein, Mathematics Dept. Chair
Gosben Middle School, Gosben, Ohio*

"Our purpose [in adopting *Impact Mathematics*] was to move the advanced 6th grade kids into Algebra 1 in 7th grade, which is normally a high school-level, 9th grade-level course. I think *Impact* does that very well."

*Joy Donlin, Middle School Math Resource Teacher
Anne Arundel County School District, Maryland*

"I feel that *Impact Mathematics* is an excellent curriculum for middle school. I enjoy teaching something that is challenging for the students and myself. They are progressing from one concept to the next; they're not doing the same thing over and over again. It's a very comprehensive program that supports teachers and students. I'm sold on it 100 percent."

*La Dona May, Teacher
Hugh Hartman Middle School, Redmond, Oregon*

Ease of Use/Flexibility

"*Impact Mathematics* is easy to use. They give you everything you need to know, and tell you how to facilitate student learning. Also handy are the tips from other teachers in the book."

*Mike Tetreault, Teacher
Mosaica Academy, Saginaw, Michigan*

"*Impact* makes teaching easier because it has very rich materials for kids to work with. And, the daily work that kids do in *Impact* gives you a much better assessment as to where kids are in learning. It is obvious from their daily work whether or not they understand."

*Dennis McCowan, Mathematics Dept. Chair
Weston High School, Weston, Massachusetts*

"*Impact* is flexible to use with students with different learning styles, because its problems are designed with multiple levels that have different ways to solve, and some problems have extensions for the higher level students."

*Claude Valle, Teacher
Weston Middle School, Weston, Massachusetts*

Student Response

"My students now understand that it is not just about getting the right answer, but learning the process to the answer. With *Impact*, it is not boring, and we don't sit in our seats all the time. Students get up and around and they are excited. It's heartening. This one young man in my class was not into school, but once we started the activities from *Impact* that involved physical movement, he got into it. He started to do homework, which he rarely did before, and his test scores have come way up. It has given him confidence in himself."

*Mike Tetreault, Teacher
Mosaica Academy, Saginaw, Michigan*

"*Impact* has made math more accessible to all my students. They see that math is pattern recognition in a bigger way. It organizes information and teaches a mathematical way of thinking. Math is more than tables."

*Claude Valle, Teacher
Weston Middle School, Weston, Massachusetts*

"*Impact* lets kids experience the math, instead of just doing it. They experience the concepts and not just the operations. *Impact* instills in them a curiosity and a problem-solving attitude."

*Mike Tetreault, Teacher
Mosaica Academy, Saginaw, Michigan*

"I knew that *Impact Mathematics* was raising the bar, and that it's a challenging curriculum. The students wouldn't be stuck in the same old thing from year to year, with just a different color cover on the book. The kids have to think. They have to learn something and then apply it, and that's intriguing. They're used to being spoon-fed. You have to have confidence in your kids and their ability to do this. You have to allow them the opportunity to try and show you that they can do it. I think the beauty of this comes out when the kids are learning from each other. Just be open and willing and trust the curriculum."

*La Dona May, Teacher
Hugh Hartman Middle School, Redmond, Oregon*

Appendix

Research Supporting Instruction in *Impact Mathematics*: A Selected Annotated Bibliography

Following is a summary of the most significant studies in mathematics instruction that have impacted *Impact Mathematics*. Each study has reported results providing insights into at least one element critical to a successful mathematics program. These studies and many others serve as the cornerstone of the instruction found in *Impact Mathematics*. The authors of *Impact Mathematics* continue to update the program as new studies are published and new research on instructional methods becomes available. The sum of the knowledge revealed by these studies continues to support and enhance the philosophy of this program.

Battista, M.T. (1999). The mathematical miseducation of America's youth: Ignoring research and scientific study in education. *Phi Delta Kappan*, 80(6), 424–33.

Because traditional instruction ignores students' personal construction of mathematical meaning, mathematical thought development is not properly nurtured. Several issues must be addressed, including adults' ignorance of math- and student-learning processes, identification of math-education research specialists, the myth of coverage, testing problems, and theoretical dilutions and distortions.

Bay, J.M., Reys, B.J., & Reys, R.E. (1999). The top 10 elements that must be in place to implement standards-based mathematics curricula. *Phi Delta Kappan*, 80(7), 503–06.

Teachers' work with four National Science Foundation-funded curricula in the Missouri Middle-School Mathematics Project has disclosed 10 critical implementation elements: administrative support, opportunities for study, curriculum sampling, daily planning, interaction with experts, collaboration with colleagues, incorporation of new assessments, student adjustment time, and planning for transition.

Ben-Chaim, D., et al. (1989). The role of visualization in the middle school mathematics curriculum. *Focus on Learning Problems in Mathematics*, 11(1–2), 49–60.

Examines the relationship between visualization and the middle school mathematics curriculum. Gives an overview of where and how visualization interacts with the curriculum. Investigates the role of visualization in developing inductive/deductive and proportional reasoning.

Bishop, J. W. (1997, March). *Middle school students' understanding of mathematical patterns and their symbolic representations*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL, March 24–28. Available from ERIC Document Reproduction Service, ED 410–107.

This study explores seventh- and eighth-grade students' thinking about mathematical patterns. Research questions pertained to the strategies middle school students use to reason when solving pattern problems, symbolic representations the students develop, the students' interpretations

of symbolic representations, and the students' strategies for solving equation-evoking situations. The results of this study support the use of mathematical patterns to promote algebraic reasoning and provide descriptions of middle school students' reasoning as they engage in solving a specific type of pattern problem. Findings also suggest that experience exploring the relationships in sequential perimeter and area patterns may help students develop an appreciation for the meaning of expression.

Davis, B. M. (1998). *Middle school algebra: Variables for success*. (Research report.) Available from Eric Document Reproduction Service, ED 436 363.

Middle school algebra classes were observed to examine the multiple variables interacting in learning of algebra. Middle school algebra classes were especially informative because of the significant impact of the students' cognitive development transitions from concrete to formal operations. The National Council of Teachers of Mathematics (1989) informed much of the instructional practices in those classes observed. In contrast to much of the literature (i.e., Dickey, 1997), these teachers were effectively implementing developmentally appropriate and challenging algebra instruction. However, teachers acknowledged some challenges in meeting some of the NCTM standards such as use of real-life examples. Some suggestions were offered in this area as well as some recommendations to enhance metacognition in the middle school classes.

Demana, F. (2000). *Using technology to prepare all students for success in algebra*. Columbus, OH: The Ohio State University.

This paper discusses uses of TI-73 graphing calculators for middle school mathematics students. It indicates that with the appropriate use of the TI-73, students can develop understanding about variables and basic concepts of algebra, and explore mathematical topics. Background on middle school students' difficulties with those subjects is provided along with examples of teaching some middle school mathematics concepts with the TI-73 such as order of operations, solving equations, and variables.

Dossey, J.A., et al. (1988, June). *The Mathematics Report Card: Are we measuring up? Trends and achievement based on the 1986 National Assessment*. Princeton, NJ: Educational Testing Service, The National Assessment of Educational Progress, ERIC # ED300206.

This executive summary presents key findings from the 1986 National Assessment of Educational Progress (NAEP) in mathematics. It is designed to alert leaders in classrooms, families, and councils of government to the state of mathematics education in the United States. "Why Mathematics Counts" is summarized in the first section. Then, highlights from the assessment are given: the trend in mathematics performance is encouraging, particularly for students at ages 9 and 17 and for Black and Hispanic students. However, the gains have been confined primarily to lower-order skills. Other findings concerning achievement, instructional patterns, technology, course-taking, and attitudes are succinctly presented. Next, the assessment procedures are summarized, followed by some reflections on the findings. Implications for instruction are considered in terms of students' perception of mathematics, patterns of classroom instruction, and the place of mathematics in the curriculum. Finally, a summary stresses the need to teach not only skills, but also higher-order thinking strategies.

Flanders, J.R. (1987). How much of the content in mathematics textbooks is new? *Arithmetic Teacher*, 35(1), 18–23.

Mathematics textbooks for grades K–9 were examined to determine how much of content was new content rather than review of old content. New content tends to decrease from grade three through grade eight with lowest amount of new content in books for grades six, seven, and eight (below 40 percent for two series). Differences among series are identified.

Hiebert, J., & Behr, M. (eds.) (1989). *Number concepts and operations in the middle grades. Research agenda series for mathematics education (Volume 2)*. Reston, VA: National Council of Teachers of Mathematics and Lawrence Erlbaum Associates.

This book contains revised versions of the major papers presented at the Research Agenda Project Conference on Number Concepts in the Middle Grades. Part I includes chapters that deal primarily with analyses of subject matter. The four chapters in this section state that the number content in the middle grades is not a simple extension of that in the primary grades; there is much that is new and challenging, both for middle school students and for researchers. Part II includes three chapters that consider the growth in students' competence with middle school number concepts. The chapters are theoretical and deal with basic questions of learning and the nature of knowing. Part III includes four chapters that consider the effects of current instruction in the development of competence and the possible effects of experimental forms of instruction on such development. The summaries provide a retrospective view of the major issues addressed in the volume.

Higgins, K.M. (1997). The effect of year-long instruction in mathematical problem solving on middle school students' attitudes, beliefs, and abilities. *Journal of Experimental Education*, 66(1), 5–28.

Three classes of middle school students who received one year of problem-solving instruction were compared with three classes who were taught in a more traditional manner. Students receiving problem-solving instruction showed more perseverance in solving problems, more positive attitudes, and more sophisticated definitions of mathematical understanding.

House, P. A., & Coxford, A. F. (eds.) (1995). *Connecting mathematics across the curriculum. 1995 NCTM Yearbook*. Reston, VA: National Council of Teachers of Mathematics.

One of the four cornerstones of the National Council of Teachers of Mathematics (NCTM) "Curriculum and Evaluation Standards for School Mathematics" asserts that connecting mathematics to other subjects in the curriculum and to the everyday world is an important goal of school mathematics. This yearbook is designed to help classroom teachers, teacher educators, supervisors, and curriculum developers broaden their views of mathematics and suggests practical strategies for engaging students in exploring the connectedness of mathematics.

Lappan, G. (ed.) (1988). Research into practice: Gender and race equity in primary and middle school mathematics classrooms. *Arithmetic Teacher*, 35(8), 46–48.

Summarizes recent research relevant to the differential achievement of females and racial minorities in mathematics. Suggests ways for teachers to deal with the issue of equity.

Leutinger, L. (ed.) (1998). *Mathematics in the middle*. Reston, VA: National Council of Teachers of Mathematics and National Middle Schools Association.

This book contains articles that help to further the process of reform in the middle grades, recognizing that the knowledge acquired during these years greatly affects how well the secondary school curriculum will attain its goals. Critical issues facing middle grade classes in particular and all mathematics classrooms in general are discussed. The centerpiece of this book features five curriculum development projects, all explained in detail and presenting important topics concerning the reform issue. Projects, activities, and programs that encourage the implementation of the recommendations made by the National Council of Teachers of Mathematics (NCTM) are also included.

Lipsitz, J., et al. (1997). What works in middle-grades school reform. *Pbi Delta Kappan*, 78(7), 517–19.

Introduces articles in the special "Kappan" section drawing primarily on data from an ongoing longitudinal study (the Illinois Middle Grades Network), Indiana's Middle Grades Improvement Program, the national Middle Grade School State Policy Initiative, and Michigan's Middle Start Initiative. Each project used Robert Felner's Middle Grades Self-Study to gather information systematically on implemented reforms.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.

This document contains an updated and revised set of standards for mathematics curricula in North American schools (K–12) based on a trio of *Standards* documents—*Curriculum and Evaluation Standards for School Mathematics* (1989), *Professional Standards for Teaching Mathematics* (1991), and *Assessment Standards for School Mathematics* (1995). *Principles and Standards for School Mathematics* presents a vision for school mathematics that includes six principles and standards organized by grade bands that describe what mathematics instruction should enable students to know and do. Classroom examples as well as instances of student work are included throughout the document.

National Research Council (1998, September). *Nature and role of algebra in the K-14 curriculum: Proceedings of a National Symposium (Washington, DC, May 27–28, 1997)*. Washington, DC: National Academies Press.

Methods of effectively teaching algebraic thinking in elementary schools as well as secondary schools is the topic of the 19 papers.

O'Brien, T.C. (1999). Parrot math. *Pbi Delta Kappan*, 80(6), 434–38.

Parrot math (memorization) seeks to control children through external rewards and punishments, rather than harness their intelligence and curiosity. Recent standardized test results document parrot math's failure. Activities-based approaches, supported by a constructivist philosophy (involving classifying, inferring, generalizing, and hypothesizing basics) deserve a fair trial.

Phillips, E., Gardella, T., Kelly, C., & Stewart, J. (1991). *Patterns and Functions. Curriculum and Evaluation Standards for School Mathematics Addenda Series, Grades 5-8*. Reston, VA: National Council of Teachers of Mathematics.

Provides a vision and a framework for revising and strengthening the K–12 mathematics curriculum in North American schools and for evaluating both the mathematics curriculum and students' progress. The document not only addresses what mathematics students should learn but also how they should learn it. When completed it is expected that the Addenda Series will consist of 22 supporting books designed to interpret and illustrate how the vision could be translated into classroom practices. Targeted at mathematics instruction in grades K–6, 5–8, and 9–12, the themes of problem solving, reasoning, communication, and connections are woven throughout the materials, as is the view of assessment as a means of guiding instruction. Activities have been field tested by teachers to ensure that they reflect the realities of today's classrooms. Each of the guide's five sections starts with problems to explore, (called investigations), in which patterns can be used to analyze and solve the problem. This method of using patterns to investigate problem situations allows students to think before and beyond the answer: to see patterns, to generalize, to extend, to connect, and to evaluate.

Pollak, H.O. (1978). On mathematics application and real problem-solving. *School Science and Mathematics*, 78(3), 232–9.

Analyzed are textbook word problems that are typically used as applications of mathematics and shows some of the difficulties in making these problems realistic. A discussion and examples of sources of genuine mathematical applications in real life follows.

Posamentier, A.S. (1989). Geometry: A remedy for the malaise of middle school mathematics. *Mathematics Teacher*, 82(9), 678–80.

Proposes a new geometry curriculum for motivating middle school students. Discusses the treatment of geometry including visual justifications of geometric phenomena, examination of the properties of various common geometric figures, use of art and architecture, and inspection of geometric transformations. Eleven references are listed.

Resnick, L.B. (1987). The 1987 presidential address: Learning in school and out. *Educational Researcher*, 16(9), 13–20.

The differences between school learning and other learning are discussed. To make these types of learning more similar, schools must develop students' skills slowly and must stress practical problem-solving. Education then will be fulfilling its cultural function of promoting reason and analysis based on shared knowledge.

Reys, R., Reys, B., Barnes, D., Been, J., & Papick, I. (1998). What is standing in the way of middle school mathematics curriculum reform? *Middle School Journal*, 30(2), 42–48.

Discusses the implementation of a standards-based mathematics curriculum at the middle school level that engages students' active learning. Considers obstacles to this reform, including traditional beliefs, student initial reactions to new teaching practices, parental perceptions, transition from middle grades to high school, assessment of student learning, teacher preparation, and administrative support.

Romberg, T.A. (2000). Changing the teaching and learning of mathematics. *Australian Mathematics Teacher*, 56(4), 6–9.

Responds to the question of how to know whether reforms have an influence on student learning. Discusses the shift in epistemology about the learning of mathematics, systemic notions about schooling, appropriate evidence related to the notion of schooling practices, and assessing mathematics literacy.

Schoenfeld, A.H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher*, 31(1), 13–25.

Discusses the potential for providing high quality mathematics instruction for all students, addressing four conditions that are necessary for achieving this goal: high quality curriculum; a stable, knowledgeable, and professional teaching community; high quality assessment aligned with curricular goals; and stability and mechanisms for the evolution of curricula, assessment, and professional development.

Secada, W.G., & Carey, D.A. (1990). *Teaching mathematics with understanding to limited English proficient students. Urban Diversity Series No. 101*. New York, NY: Columbia University, Teachers College, ERIC Clearinghouse on Urban Education, EDO-UD-91-0.

This document provides research-based information to help school district personnel select appropriate mathematics education programs for their limited English proficient (LEP) elementary school students. A review of the mathematics education literature is discussed in the context of the reform movement in school mathematics. Two instructional programs for effectively teaching mathematics to LEP students, Active Mathematics Teaching (AMT) and Cognitively Guided Instruction (CGI), are

discussed in detail. Examples, using addition and subtraction problems, illustrate each program. Since teaching math in a student's native language may be more effective than limiting instruction to English, Spanish translations of examples are also included to demonstrate how simple presentation of problems can facilitate their solving. Recommendations are woven throughout the text and each section ends with a list of additional recommendations for teaching mathematics to LEP students.

Silver, E.A. (1998, March). *Improving mathematics in middle school: Lessons from TIMSS and related research*. Washington, DC: U.S. Department of Education.

Results from the Third International Mathematics and Science Study (TIMSS) have recently captured the attention of the United States and once again focused the nation on matters of mathematics teaching and learning. In general, the TIMSS results indicate a pervasive and intolerable mediocrity in mathematics teaching and learning in the middle grades and beyond. At Grades 7 and 8 and also at Grade 12, U.S. students achieve poorly in mathematics compared to students in much of the rest of the world. Even the 12th-grade students who take advanced mathematics courses performed substantially below students in most other nations. The results also suggest that the demands made by the U.S. school mathematics curriculum and mathematics classroom instruction are not as challenging as in other countries. This document reports the major findings from TIMSS and makes some recommendations for enhancing mathematics teaching and learning in the middle grades.

U.S. Department of Education (1997, October 20). *Mathematics equals opportunity*. White paper prepared for the U.S. Secretary of Education, Richard W. Riley. Washington, DC: USDE.

This report highlights the key findings that: (1) students who take rigorous mathematics and science courses are much more likely to go to college than those who do not; (2) algebra is the gateway to advanced mathematics and science in high school, yet most students do not take it in middle school; (3) taking rigorous mathematics and science courses in high school appears to be especially important for low-income students; (4) despite the importance of low-income students taking rigorous mathematics and science courses, these students are less likely to take them; (5) mathematics achievement depends on the courses a student takes, not the type of school the student attends; (6) students whose parents are involved in their school work are more likely to take challenging mathematics courses early in their academic careers; and (7) results of the Third International Mathematics and Science Study (TIMSS) reveal that the middle school mathematics curriculum may be the weak link in the education system in the United States. The next steps that can be taken by educators, policymakers, community members, and parents are also listed.

Van Zoest, L.R., & Enyart, A. (1998). Discourse, of course: Encouraging genuine mathematical conversations. *Mathematics Teaching in the Middle School*, 4(3), 150–57.

Describes a professional development activity that offers a way for teachers to analyze their current classroom discourse practices and move toward the goal of dynamic and productive mathematical discourse.

Warrington, M.A., & Kamii, C. (1998). Multiplication with fractions: A Piagetian, constructivist approach. *Mathematics Teaching in the Middle School*, 3(5), 339–43.

Presents a teacher's experiences with teaching fractions by employing the constructivist approach. Concludes that children will go much further with depth, pleasure, and confidence if they are allowed to construct their own mathematics to make sense to them every step of the way.

Wheelock, A. (1995, November). *Standards-based reform: What does it mean for the middle grades?* Paper prepared for the Edna McConnell Clark Foundation Program for Student Achievement. New York, NY: Edna McConnell Clark Foundation.

This paper describes the status of the standards movement in relation to the middle grades and in terms of the policy context of the 1990s. It also outlines the potential of standards-guided reform at the middle level. The standards movement today rests on content, performance, and opportunity-to-learn standards. In the middle grades these standards must be brought to bear in the various subject areas of mathematics, literacy, science, and social studies. The common thread that links emerging standards for the middle grades is the thread of learning and teaching for understanding. The status of national achievement and the academic experiences of middle school students make a clear starting point for thinking about the potential of standards for the middle grades. Standards-based reform can formalize high academic expectations for all students and set criteria for more challenging classrooms, more challenging learning, and more authentic assessment.