Growing with Mathematics

Research and Results

Volume 1

Mc Graw Hill Wright Group

Table of Contents

OVERVIEW

Aligned to NCTM Standards

Growing with Mathematics is a core mathematics program that is appropriate for all student populations. The mathematical content and sequence of the program, and the teaching methods it promotes, were determined through extensive field testing and in-depth research. At each grade level, all components and learning experiences are carefully designed to match students' interests and abilities.

The latest revision of the *Growing with Mathematics* program incorporates suggestions and recommendations of the *2000 NCTM Principles and Standards for School Mathematics* document. Both the *2000 NCTM Principles and Standards* and the *NAEYC Guidelines* had a major influence in the development of the pre K level of *Growing with Mathematics.* The publishing of this level in 2001 was closely tied to the K–5 levels, laying the building blocks for concepts that are used throughout the rest of the program.

Closing the Gap

The results from schools using *Growing with Mathematics* demonstrate that the program improves student performance in mathematics. The philosophy, content, and organization of the program ensure that understanding and skills are developed simultaneously. *Growing with Mathematics* equips students with a variety of thinking strategies they can use to solve problems effectively and confidently. School districts nationwide representing diverse populations with both high and low socioeconomic statuses have seen impressive growth in their students' ability to meet state standards.

Expert Panels Evaluate *Growing with Mathematics*

In 2001 the **National Science Foundation (NSF)** recognized *Growing with Mathematics* as a Research-Based Mathematics Program. It was listed as one of four elementary Research-Based Mathematics Education Core Curriculum Programs. To receive this recognition, a program must enable students to acquire a deep understanding, solve problems creatively, apply knowledge to new situations, work productively, and enjoy their learning experiences. *Growing with Mathematics* was the only elementary program on the NSF approval list that was not funded by the NSF. NSF approval means that schools and districts can apply for an NSF grant to support professional development for the implementation of *Growing with Mathematics.*

In 2000 the **U.S. Department of Education** identified *Growing with Mathematics* as a Promising Mathematics Program. In order to be selected for the "Promising Program" list, an expert panel composed of four different committees carefully studied *Growing with Mathematics* materials. The committees looked at the philosophy and research that guided the program, learning goals, content, instructional model, design and format, relevance to individual and societal needs, as well as results from users of the program. Their evaluation highlighted the program's well-developed learning goals as being "challenging, clear, and appropriate" for core students as well as gifted and talented, Title I, special education/special needs, and Spanish-speaking students.

In 1999 a panel from the **Northwest Regional Educational Laboratory (NWREL)** in Portland, Oregon, evaluated *Growing with Mathematics* for possible inclusion in its Catalog of School Reform Models. Evaluators looked at the research and background of development, the general approach of the program, provisions for varied groups of student populations, results from districts, and implementation assistance available from the publisher. *Growing with Mathematics* was approved and placed in the catalog, which was updated in May 2001.

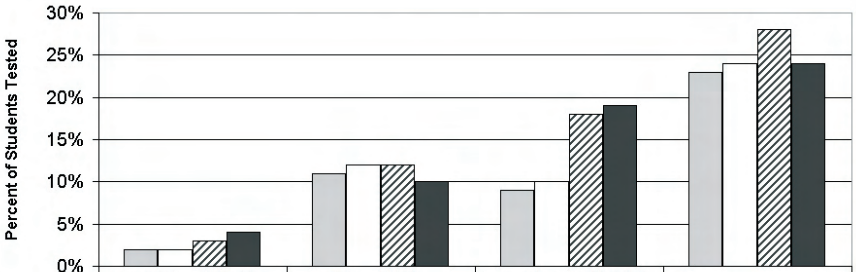
Lynn School District

Lynn, Massachusetts

Lynn School District started using *Growing with Mathematics* in its kindergarten through grade 5 classrooms in 1997. Between 1998 and 2001 this ethnically diverse district saw a dramatic increase in mathematics test scores on the Massachusetts Comprehensive Assessment System (MCAS).

The percentage of fourth grade students that scored at the Advanced and Proficient levels has increased every year between 1998 and 2001. The percent of students in Lynn School District that scored at the Advanced level has increased each year since 1999, while the percent of students scoring in the Advanced level in the overall state scores remained flat between 1999 and 2000, and decreased slightly in 2001. There was a significant increase in the percentage of students that scored at the Proficient level over the four-year period, while state scores at this level have fluctuated slightly and shown little consistent gain.

Percentage of 4th Grade Students at Advanced and Proficient Levels for Lynn School District and MA State Overall



	Lynn School District - Advanced	State (MA) - Advanced	Lynn School District - Proficient	State (MA) - Proficient
1998	2%	11%	9%	23%
1999	2%	12%	10%	24%
2000	3%	12%	18%	28%
2001	4%	10%	19%	24%

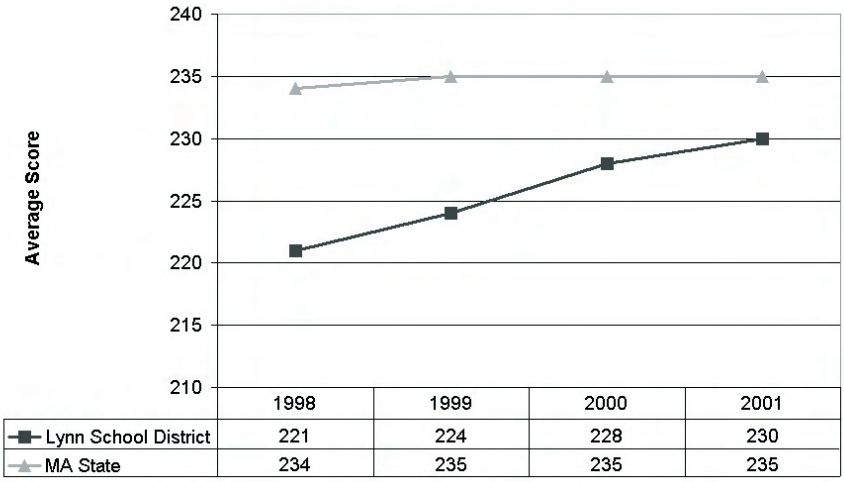
Demographics

	Lynn Public School District	State (MA)
African American	14.8%	8.8%
Asian	12.8%	4.6%
Caucasian	39.9%	75.1%
Hispanic	32.2%	11.2%
Native American	0.2%	0.3%
Eligible for Free or Reduced-Price Lunch	66.0%	26.2%
Geography	Urban	

LYNN SCHOOL DISTRICT; LYNN, MA

In addition, the average scores for all students in Massachusetts have remained constant since 1999, while the average scores of students within Lynn School District increased each year between 1998 and 2001 by an average of 3 points a year. The gap in overall test scores between Lynn School District and overall scores for Massachusetts has narrowed significantly over the four-year period

Comparison of Average Scale Scores for Lynn School District and MA State 1998–2001



	1998	1999	2000	2001
Lynn School District	221	224	228	230
MA State	234	235	235	235

Demographics

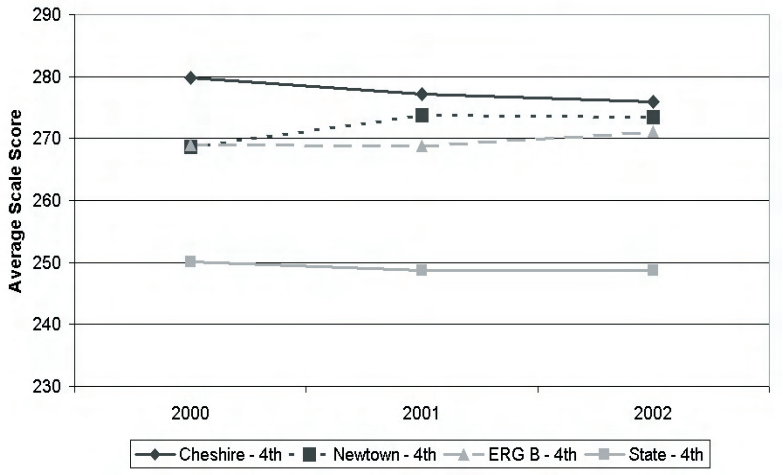
	Lynn Public School District	State (MA)
African American	14.8%	8.8%
Asian	12.8%	4.6%
Caucasian	39.9%	75.1%
Hispanic	32.2%	11.2%
Native American	0.2%	0.3%
Eligible for Free or Reduced-Price Lunch	66.0%	26.2%
Geography	Urban	

Connecticut School Districts

The state of Connecticut is organized into nine Educational Reference Groups (ERGs) that are arranged based on their similar demographics. Each school district is represented by one of the nine ERGs, thus allowing test scores in any school district to be compared against other districts with similar demographics.

The Connecticut Mastery Test (CMT) is given in September of each year to all grades 4 and 6 students in the state of Connecticut. The mathematics portion of the test measures student mastery in the following content areas: number sense, operations, estimation and approximation, measurement, spatial relationships and geometry, probability and statistics, patterns, algebra and functions (grade 6 only), discrete mathematics, and integrated understandings. Scores for ten school districts that use *Growing with Mathematics* are organized based on their respective ERG. The following graphs illustrate the school districts' growth based on their CMT scores, and compare these scores with the average scores for the ERG and the state. The data represents grade 4 scores for the 2000 and 2001 school years. All of the school districts reported have been using Growing with Mathematics since 2000.

Connecticut Mastery Test (CMT) Mathematics Scores
Grade 4—ERG B and State Comparison



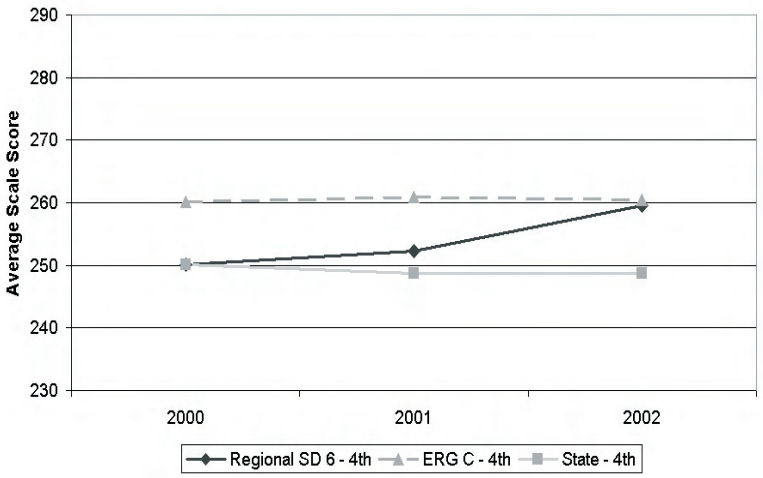
	ERG B	State (CT)
African American	2.7%	13.8%
Asian	4.1%	3.0%
Caucasian	87.6%	69.2%
Hispanic	3.7%	13.7%
Native American	0.2%	0.3%
Eligible for Free or Reduced-Price Lunch	4.7%	23.6%
Geography	Suburban	

Demographics

Districts that use *Growing with Mathematics* have demonstrated impressive growth from 2000 to 2001, with most districts scoring above their ERG average. Most of the mathematics scores from the schools using *Growing with Mathematics* are higher—and in some cases, significantly higher—than the average state scores, which showed little to no growth between the years 2000 and 2002.

In ERG B, the math scores of students in the Cheshire and Newtown districts that use Growing with Mathematics are consistently higher than the combined scores of ERG B and the state. Math scores for ERG C and the state have remained fairly constant over the three-year period from 2000 to 2002, while Regional SD 6 has shown a consistent growth rate over the same three-year period.

Connecticut Mastery Test (CMT) Mathematics Scores
Grade 4—ERG C and State Comparison

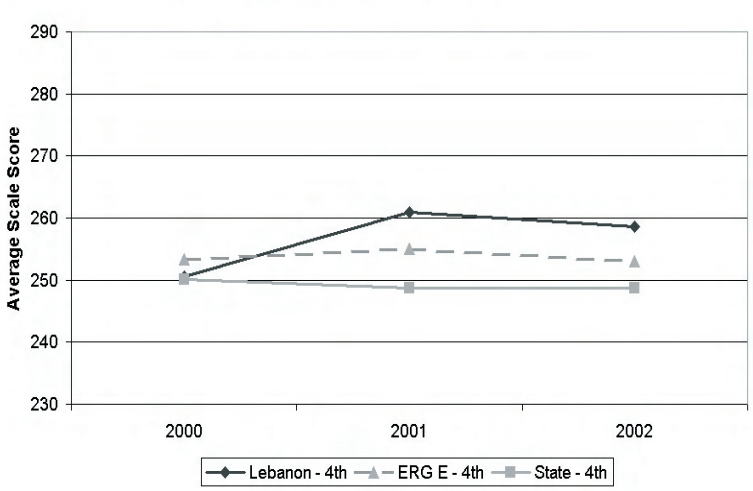


Demographics

	ERG C	State (CT)
African American	1.2%	13.8%
Asian	1.9%	3.0%
Caucasian	90.6%	69.2%
Hispanic	1.2%	13.7%
Native American	0.9%	0.3%
Eligible for Free or Reduced-Price Lunch	4.4%	23.6%
Geography	Rural	

Fourth-graders in the Lebanon School District outperformed ERG E and the state in the 2001 and 2002 school years. Fourth grade students in Montville and Waterford school districts consistently scored higher than ERG F and state scores on the CMT Mathematics assessment between the 2000 and 2002 school years.

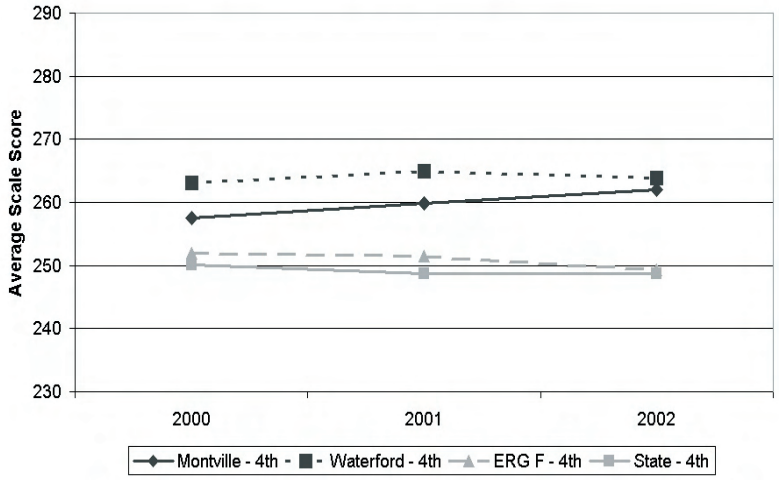
Connecticut Mastery Test (CMT) Mathematics Scores
Grade 4—ERG E and State Comparison



	ERG E	State (CT)
African American	1.2%	13.8%
Asian	0.7%	3.0%
Caucasian	94.4%	69.2%
Hispanic	1.8%	13.7%
Native American	0.3%	0.3%
Eligible for Free or Reduced-Price Lunch	9.2%	23.6%
Geography	Rural	

Demographics

Connecticut Mastery Test (CMT) Mathematics Scores
Grade 4—ERG F and State Comparison



Demographics

	ERG F	State (CT)
African American	10.1%	13.8%
Asian	2.6%	3.0%
Caucasian	79.2%	69.2%
Hispanic	5.6%	13.7%
Native American	0.5%	0.3%
Eligible for Free or Reduced-Price Lunch	21.0%	23.6%
Geography	Suburban	

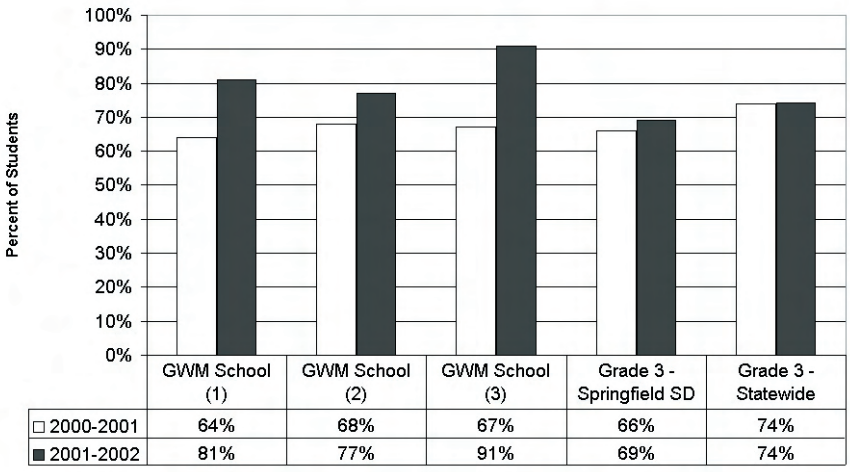
Springfield School District 186

Springfield, IL

Students in Illinois take the Illinois Standards Achievement Test (ISAT), which measures individual student achievement relative to the Illinois Learning Standards, in the spring of each year. Scores for the 2000–2002 school years compare the percentage of students in grades 3 and 5 who scored at the "Meets and Exceeds Levels" between three schools that have used *Growing with Mathematics* since 2000, Springfield School District 186 overall, and statewide. The percentage of students that met or exceeded Illinois Standards increased at a greater rate in the schools with classrooms that adopted *Growing with Mathematics,* compared to the average increase of overall scores for students in the district and statewide.

When comparing the grade 3 test scores from schools in the entire Springfield School District to the schools that use *Growing with Mathematics,*

Grade 3 Comparisons of Students that Met or Exceeded IL State Standards



	GWM School (1)	GWM School (2)	GWM School (3)	Grade 3 - Springfield SD	Grade 3 - Statewide
□ 2000-2001	64%	68%	67%	66%	74%
■ 2001-2002	81%	77%	91%	69%	74%

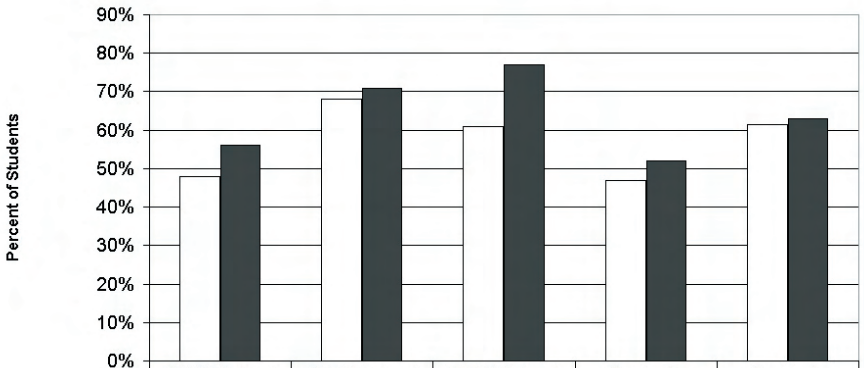
Demographics

	GWM School (1)	GWM School (2)	GWM School (3)	Springfield Public SD	State (IL)
African American	42.5%	40.1%	30.1%	23.6%	21.2%
Asian	2.6%	2.7%	4.7%	1.3%	3.5%
Caucasian	57.0%	55.6%	62.8%	70.3%	59.0%
Hispanic	0.5%	1.1%	2.1%	1.9%	16.2%
Native American	0.0%	0.5%	0.2%	0.3%	0.2%
Eligible for Free or Reduced-Price Lunch	83.2%	61.0%	44.4%	54.3%	35.2%
Geography				Urban	

SPRINGFIELD SCHOOL DISTRICT 186; SPRINGFIELD, IL

schools that used *Growing with Mathematics* increased the percentage of students meeting or exceeding Illinois Standards by three to six times as much as the district overall. Two out of the three schools with fifth grade students who were taught with *Growing with Mathematics* increased the percentage of students that met or exceeded Illinois Standards by 8 to 16 percentage points more than the school district.

Grade 5 Comparisons of Students that Met or Exceeded IL State Standards



	GWM School (1)	GWM School (2)	GWM School (3)	Grade 5 - Springfield SD	Grade 5 - Statewide
□ 2000-2001	48%	68%	61%	47%	61%
■ 2001-2002	56%	71%	77%	52%	63%

Demographics

	GWM School (1)	GWM School (2)	GWM School (3)	Springfield Public SD	State (IL)
African American	42.5%	40.1%	30.1%	23.6%	21.2%
Asian	2.6%	2.7%	4.7%	1.3%	3.5%
Caucasian	57.0%	55.6%	62.8%	70.3%	59.0%
Hispanic	0.5%	1.1%	2.1%	1.9%	16.2%
Native American	0.0%	0.5%	0.2%	0.3%	0.2%
Eligible for Free or Reduced-Price Lunch	83.2%	61.0%	44.4%	54.3%	35.2%
Geography				Urban	

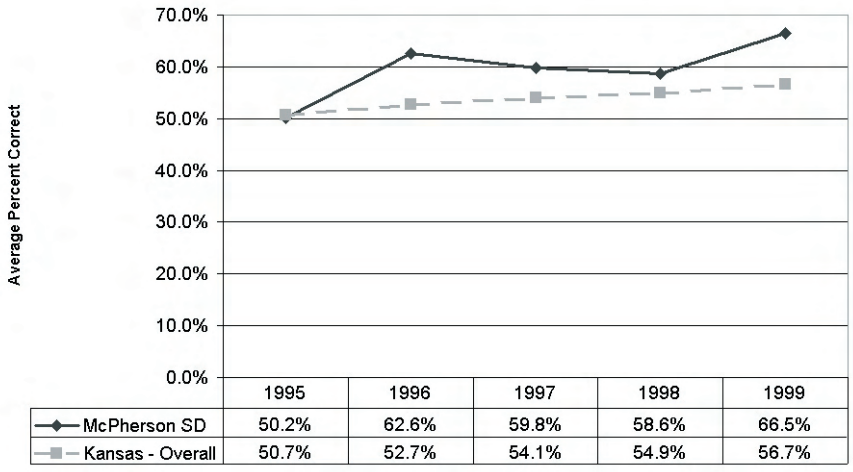
McPherson Unified School District 418

McPherson, Kansas

The Kansas Mathematics Assessment is a performance-based exam given at grades 4, 7, and 10. The charts below represent the growth in math achievement for fourth-grade students in McPherson Unified School District 418 and the combined state results for three process areas: Reasoning, Communication, and Problem Solving. The performance results for the Total Math Power score represent an average of these three process areas. (All test scores are reported in terms of percent correct.) The results compare fourth-grade scores from the state to fourth-grade scores from McPherson Unified School District, which has been using Wright Group/McGraw-Hill's *Growing with Mathematics* program since 1996.

Overall, throughout the five-year period reported, McPherson Unified School District has outperformed state scores. Reasoning scores have improved in McPherson by 16.3 percentage points, compared to a 6 percentage-point increase in the overall state scores.

5 Year Comparison of Student Performance on Reasoning Mathematics Skills



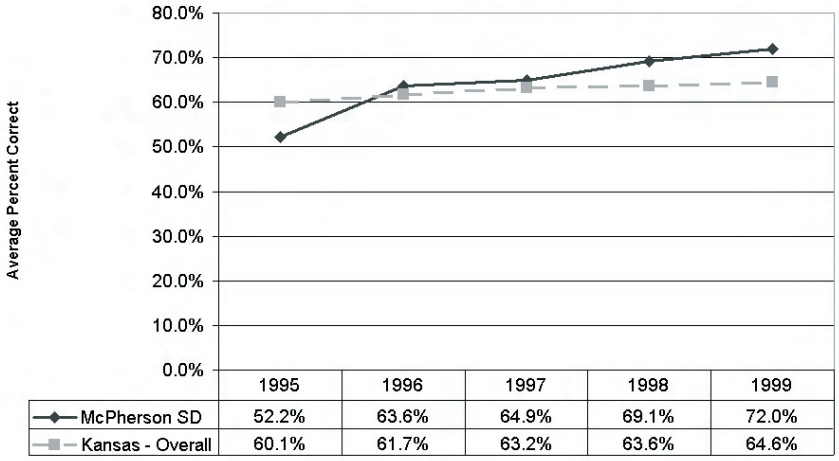
	1995	1996	1997	1998	1999
McPherson SD	50.2%	62.6%	59.8%	58.6%	66.5%
Kansas - Overall	50.7%	52.7%	54.1%	54.9%	56.7%

Demographics

	McPherson Unified School District 418	State (KS)
African American	3.0%	9.1%
Asian	0.5%	2.3%
Caucasian	92.6%	76.9%
Hispanic	2.7%	10.4%
Native American	0.5%	1.4%
Eligible for Free or Reduced-Price Lunch	20.9%	34.1%
Geography	Rural	

Communication scores have increased by 19.8 percentage points in McPherson Unified School District, compared to a 4.5 percentage-point increase overall in state scores.

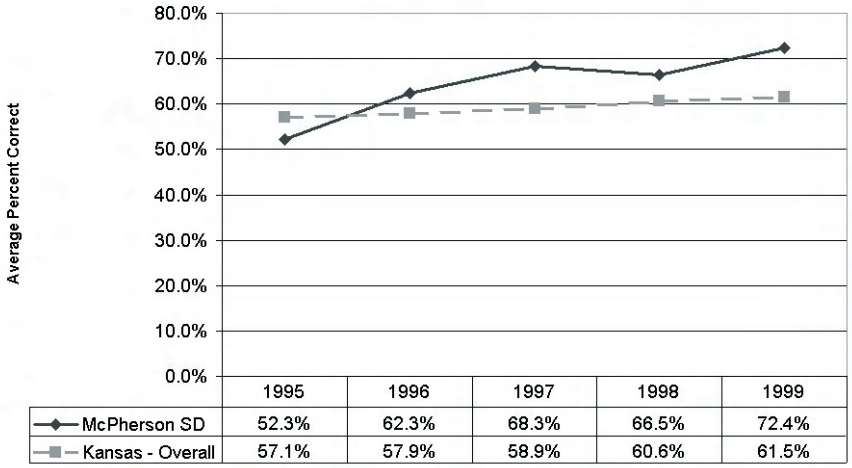
5 Year Comparison of Student Performance on Communication Mathematics Skills



	1995	1996	1997	1998	1999
McPherson SD	52.2%	63.6%	64.9%	69.1%	72.0%
Kansas - Overall	60.1%	61.7%	63.2%	63.6%	64.6%

Problem solving scores in McPherson Unified School District have increased by 20.1 percentage points, while state scores have only increased by 4.4 percentage points overall in the same five-year period.

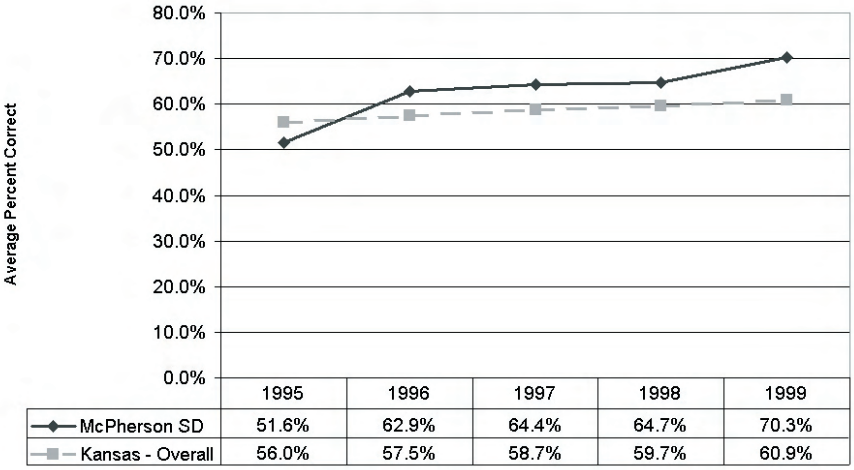
5 Year Comparison of Student Performance on Problem Solving Mathematics Skills



	1995	1996	1997	1998	1999
McPherson SD	52.3%	62.3%	68.3%	66.5%	72.4%
Kansas - Overall	57.1%	57.9%	58.9%	60.6%	61.5%

Total Math Power scores, an average of the three process groups (Reasoning, Communication, and Problem Solving) increased by 18.7 percentage points in McPherson Unified School District between 1995 and 1999. Average Total Math Power scores for the state only increased by 4.9 percentage points during the same five-year period.

5 Year Comparison of Student Performance on Total Math Power Mathematics Skills



	1995	1996	1997	1998	1999
McPherson SD	51.6%	62.9%	64.4%	64.7%	70.3%
Kansas - Overall	56.0%	57.5%	58.7%	59.7%	60.9%

Demographics

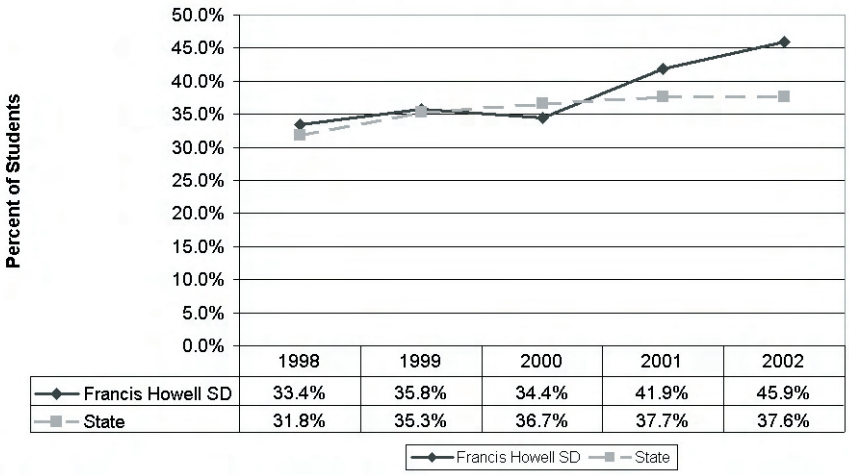
	McPherson Unified School District 418	State (KS)
African American	3.0%	9.1%
Asian	0.5%	2.3%
Caucasian	92.6%	76.9%
Hispanic	2.7%	10.4%
Native American	0.5%	1.4%
Eligible for Free or Reduced-Price Lunch	20.9%	34.1%
Geography	Rural	

FRANCIS HOWELL SCHOOL DISTRICT

St. Charles, Missouri

Between 1998 and 2002, fourth-grade mathematics scores on the Missouri Assessment Program (MAP)—the state standardized test given to all fourth-grade students in the spring of each year—increased in the ten elementary schools in the Francis Howell School District. The district has seen an increase in the number of students who scored at the Proficient and Advanced levels. Test scores for students in Francis Howell School District fluctuated up and down over the two-year period between 1998 and 2000. Since adopting *Growing with Mathematics* in 2000, students in Francis Howell School District have steadily increased their scores by 11.5 percentage points. As a comparison, the average scores for all students in the state of Missouri have remained relatively constant and have shown only a modest increase of 0.9 percentage points since 2000.

Missouri MAP Scores—Percentage of Students at Proficient and Advanced Levels



	1998	1999	2000	2001	2002
Francis Howell SD	33.4%	35.8%	34.4%	41.9%	45.9%
State	31.8%	35.3%	36.7%	37.7%	37.6%

Demographics

	Francis Howell School District	State (MO)
African American	2.6%	17.5%
Asian	0.9%	1.2%
Caucasian	94.0%	79.0%
Hispanic	1.6%	2.0%
Native American	0.2%	0.3%
Eligible for Free or Reduced-Price Lunch	5.6%	35.1%
Geography	Suburban	

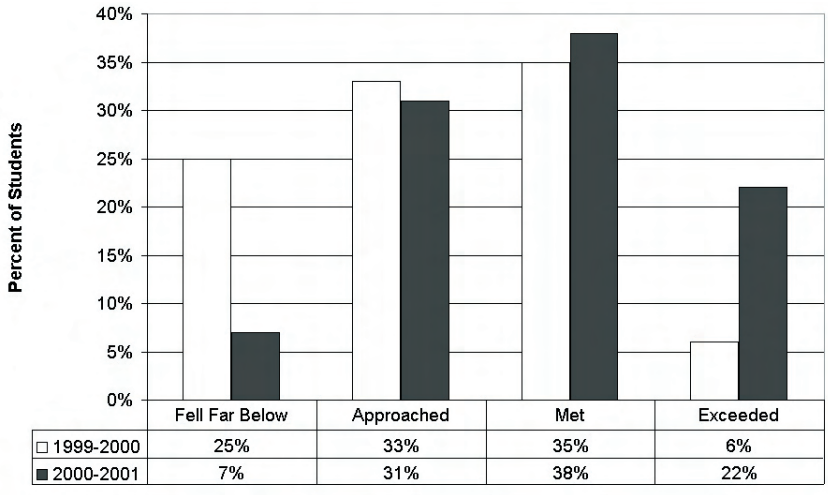
Willcox Unified School District

Willcox, Arizona

Willcox Unified School District purchased *Growing with Mathematics* in 1996. Since that time, the mathematics scores of the elementary school students have continued to rise. The charts below illustrate the third-grade scores for the AIMS (Arizona's Instrument to Measure Standards) Test and the SAT 9 (Stanford Achievement Test).

The AIMS is designed to measure student achievement of the Arizona Academic Standards. Students must achieve a scaled score of 500 to meet the standard. The results over a two-year period demonstrate a significant increase in the number of students who exceeded the Standard, while demonstrating a decrease in the number of students who fell below the Standard.

AIMS Test Results for Grade 3



	Fell Far Below	Approached	Met	Exceeded
1999-2000	25%	33%	35%	6%
2000-2001	7%	31%	38%	22%

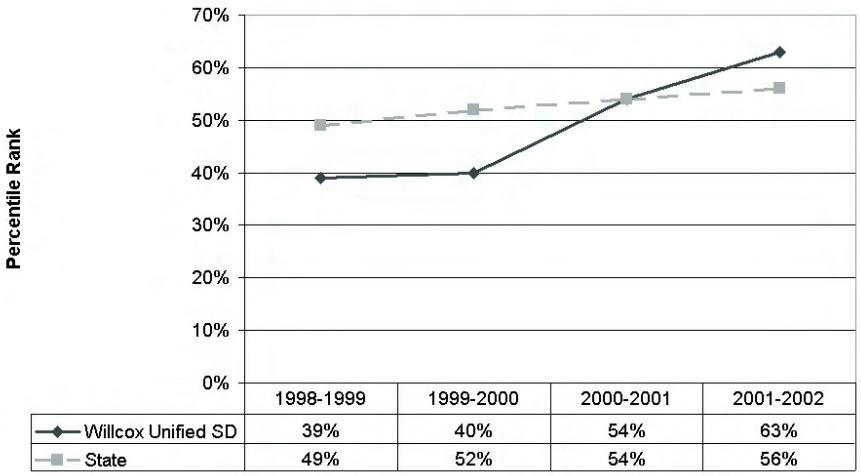
Demographics

	Willcox Unified School District	State (AZ)
African American	0.0%	4.7%
Asian	0.0%	2.1%
Caucasian	61.7%	51.3%
Hispanic	36.3%	35.3%
Native American	1.1%	6.6%
Eligible for Free or Reduced-Price Lunch	67.0%	N/A
Geography	Rural	

WILLCOX UNIFIED SCHOOL DISTRICT; WILLCOX, AZ

The SAT 9 has been given to students in this district every year since 1997. The chart below provides the percentile rank scores for the third grade students in the Willcox Unified School District. Percentiles increased from 39 in 1999 to 63 in 2002. In comparison, state scores increased at a slower rate, rising from 49 in 1999 to 56 in 2002. During this period, the Willcox Unified School District elementary scores increased at a rate three times that of overall state scores.

Stanford Achievement Test—Grade 3
Comparison of Mathematics Scores from 1999–2002



	1998-1999	1999-2000	2000-2001	2001-2002
Willcox Unified SD	39%	40%	54%	63%
State	49%	52%	54%	56%

Demographics

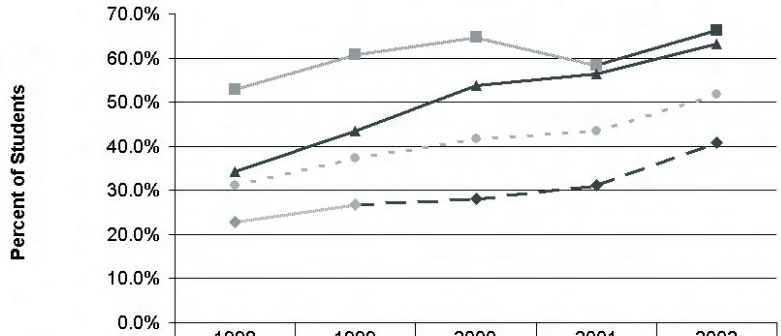
	Willcox Unified School District	State (AZ)
African American	0.0%	4.7%
Asian	0.0%	2.1%
Caucasian	61.7%	51.3%
Hispanic	36.3%	35.3%
Native American	1.1%	6.6%
Eligible for Free or Reduced-Price Lunch	67.0%	N/A
Geography	Rural	

WASHINGTON STATE SCHOOL DISTRICTS

Three demographically diverse districts in Washington state have adopted the *Growing with Mathematics* program: Shelton School District 309, Shoreline School District 412, and University Place School District 83. Each district has shown consistent growth on the Washington Assessment of Student Learning (WASL) every year since adopting the program. WASL is a Standards-based test that is given in the spring to all fourth-grade students. It measures how well students are meeting the state's grade-level expectations in reading, writing, listening, and mathematics, and it uses a variety of question formats, including multiple choice, short answer, and extended-response questions to assess student knowledge.

Shelton School District began using *Growing with Mathematics* in the fall of 1999. Since the 1999–2000 school year, WASL scores for fourth-grade students that met or exceeded the Washington State Standards have improved at a faster rate than the Washington state average.

Percent of 4th Grade Students that Met or Exceeded WA State Standards



	1998	1999	2000	2001	2002
Shelton SD	22.8%	26.7%	28.1%	31.2%	40.9%
Shoreline SD	52.8%	60.7%	64.7%	58.3%	66.3%
University Place SD	34.3%	43.4%	53.8%	56.3%	63.3%
WA State	31.2%	37.3%	41.8%	43.4%	51.8%

Note: Shoreline and Shelton began using Growing with Mathematics in 2001 and 1999 respectively.

	Shelton School District	Shoreline School District	University Place School District	State (WA)
African American	0.5%	3.3%	10.8%	5.4%
Asian	1.1%	13.3%	7.1%	7.5%
Caucasian	81.0%	71.5%	67.9%	73.5%
Hispanic	11.1%	5.1%	5.6%	10.9%
Native American	5.6%	1.0%	0.6%	2.6%
Eligible for Free or Reduced-Price Lunch	34.0%	14.4%	21.2%	31.4%
Geography	Small town	Urban fringe of large city	Urban fringe of large city	

Since 2000, Shelton School District has seen a 12.8 percentage-point increase in students who met or exceeded Washington State Standards, compared to a 10 percentage-point increase in Washington state students overall who met or exceeded them.

Shoreline School District has used *Growing with Mathematics* since the fall of 2001. The percentage of students that met or exceeded Washington State Standards were in a decline the year before they implemented *Growing with Mathematics.* After the program was implemented, the percentage of students in 2002 that met or exceeded the Standards increased by 8 percentage points to 66.3 percent of students within the district. This is the highest percentage of students meeting or exceeding Washington State Standards in the four years prior to 2002.

University Place School District has used *Growing with Mathematics* in its kindergarten through grade 3 classrooms since 1996 and in its fourth and fifth grade classrooms since 1997. A comparison of WASL results between University Place School District and the state since 1998 illustrates the rapid increase in scores that University Place School District has seen. Between 1998 and 2002, the percentage of students that met or exceeded Washington State Standards in University Place School District increased by about 85 percent, while over the same five-year period Washington state increased its percentage of students that met or exceeded Washington State Standards by 66 percent.

CURRENT RESEARCH

Reflected in the *Growing with Mathematics* Program

The latest revision of the *Growing with Mathematics* program incorporates the suggestions and recommendations of the *2000 NCTM Principles and Standards for School Mathematics* document. Both the *2000 NCTM Principles and Standards* and the *NAEYC Guidelines* had a major influence in the development of the pre K level of *Growing with Mathematics.* The publishing of this level in 2001 was closely tied to the K–5 levels, laying the building blocks for concepts that are used throughout the rest of the program.

The present edition of *Growing with Mathematics* reflects current theories for teaching and learning mathematics. Relevant and significant research findings have been taken from the fields of cognitive psychology, socio-cultural theories, and mathematics education. Some theories that have been incorporated include

- Cognitive psychology focuses on thought processes, memory, and problem solving. Research about children's learning provides valuable insights into the nature of activities that help children build understanding and knowledge (Berk, 2000). The activities in the program encourage children to interact with their world in a meaningful and challenging way.

- The language focus of the *Growing with Mathematics* program has been influenced by the research of socio-cultural theorists such as Vygotsky. The program strongly reflects the philosophy that children learn through active involvement and can be influenced through instruction (English and Halford, 1995). Communication between adults and peers, as well as peer-to-peer communication, helps children internalize and acquire new skills (Berk, 2000).

Over the past two decades, significant research has taken place regarding best practices in the teaching of specific content areas of mathematics. *Growing with Mathematics* has incorporated these research findings into the overall development of the topic sequence, individual lessons, and specific activities. Examples include

1. The emphasis on place value and number sense (Cobb and Wheatley, 1988; Fuson et al., 1997) and number representations that assist children to succeed in mathematics (Cooper, T.J., Heirdsfield, A.M., and Irons, C.J. 1996). The research shows that children need many different kinds of number experiences to help them deal with real-life situations. (Jones, G.A., Langrall, C.W., Thornton, C.A., and Nisbet, S. [2002] and Kilpatrick, J., Swaffird, J., & Findell, B. [2001]). Mental computation is stressed in the program through number sense activities (Math Chat books), activities in the lessons, and with games and resources such as target mats.

- Four types of number representations provide a basis for children to naturally work with numbers. These are: counting, quantity, rank or relative position, and place value. As the *NCTM Principles and Standards for School Mathematics* states, working with a range of number models helps children "develop flexibility in thinking about numbers, which is a hallmark of number sense."

- Research on counting has been incorporated into the early grades of *Growing with Mathematics.* The Cognitively Guided Instruction approach (CGI) to early number (Carpenter, Fenema, Franke, Levi, and Empson [1999]) includes a model of a progression of strategies children use to solve addition and subtraction word problems. Findings by Thompson (1995) suggest that as children progress through school they continue to use counting as an important part of their problem-solving repertoire, combining the counting skills with other learned skills and acquired knowledge.

- Research by Bob Wright (1998) describes observations relating to young children's knowledge of numerals and its relation to number word knowledge. His research on counting is reflected in the early number work in *Growing with Mathematics.*

- The use of visualization and imagery is an important part of the *Growing with Mathematics* program. Research by Bob Wright and others in New South Wales, Australia has confirmed the significance of visualization as a tool for learning mathematics. Subitizing, the quick identification of the number of a collection of objects (concrete or pictorial), is a strong part of the *Growing with Mathematics* early number work. This skill helps children when they add, subtract, multiply, and divide. Benchmarks, also mentioned in the *2000 NCTM Principles and Standards for School Mathematics,* are a focus of the work with numbers. Students use these reference points to help them calculate mentally (using 10 as a benchmark when solving 9+5). They are also used when students are learning fractions (½ is a benchmark that other fractions can be compared to). Many of the non-book components of *Growing with Mathematics* promote visualization as well: Resource Kits in grades K and 1 contain cards showing different pictorial representations of the same quantity, five and ten frames, number tracks, pocket charts for place value, number mats, part-part-total mats, etc. Mix-and-Match Number Flip Books at the pre K and K level are tools to help students visualize quantities.

- The program stresses the use of thinking strategies for promoting mastery of addition and subtraction facts (Thornton, 1990; Issacs and Carroll, 1999). Strategies such as count-on, count-back, doubles, and making a ten are taught in *Growing with Mathematics* and lead to better understanding of numbers and success with problem solving.

2. The importance of language and communication in learning mathematics is reflected in the program (Irons, C.J. and R., NCTM Yearbook, 1989). In *Growing with Mathematics,* the building of concepts and skills begins with the learner's prior experiences. The learning sequences build upon the child's own language and interests, and the child's language is the starting point from which mathematical language and symbolic language grow. Concrete and pictorial materials are the bridge to mathematical language and symbols. Emphasis on the pictorial stage is a very strong part of the program and is often left out of the process with other programs. Throughout the *Growing with Mathematics* program, there are a variety of activities that ensure children are constantly discussing, representing, and reasoning mathematically.

3. The approach to geometry reflects the research of Copley, 2000; Whiteley, 2001; and Yakimanskaya, 1991. In *Growing with Mathematics*, the beginning focus is on the real world as children interact with three-dimensional objects. Two-dimensional shapes are introduced after the work with three-dimensional shapes to build upon students' experiences.

4. Research shows that to become sophisticated and critical users of statistical information, children need to be provided with regular opportunities to gather, organize, display, and interpret their own data (Whitin, D.J., 1997). Whitin's research is reflected in the program beginning at the pre K level. In the early grades, children have opportunities to display data in nontraditional ways prior to constructing formal bar, line, and pie graphs. When children are given ownership for gathering and displaying data, they come to realize that data can be represented in different ways. In the Kindergarten Resource Kit there is a selection of graphing mats that helps students with organizing data, such as weather graphs and sorting circles. In grade 1 there is a graphing mat and a Venn Diagram mat. The emphasis on data analysis in the program leads children to learn how to analyze information critically—i.e., is it accurate, or is it distorted?

5. Algebraic thinking is stressed in the *2000 NCTM Principles and Standards for School Mathematics* as an important strand from pre K forward. Systematic experience with patterns helps build an understanding of the idea of function. *Growing with Mathematics* incorporates the recommendations of the Standards in pattern work, work with number relationships, and in approaching how things "change" over time. Many non-book resources are available at the lower grade levels to build algebraic concepts, such as pin people magnets for showing equality in kindergarten, and pattern sponge stamps that feature pattern block images at grades K and 1.

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