Everyday Mathematics is more than just a good idea.

As the test data indicate from a variety of sources highlighted in this booklet, Everyday Mathematics works.

It's working for over 2,000,000 elementary school students throughout the United States — in urban, suburban and rural areas — across all socioeconomic lines.

Everyday Mathematics students are mathematically literate on a wide variety of measures: state-mandated tests, local district tests, commercially available standardized tests, tests constructed by UCSMP staff, and tests written by independent researchers. The student test data on the pages that follow were shared with us from across the country.

Everyday Mathematics. Meeting All Expectations.
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In recent years, there has been a call for major changes in how mathematics is taught and assessed (National Council of Teachers of Mathematics, 1991, 1995, 2000). While instruction at the elementary level has typically focused on the practice and memorization of arithmetic facts, rules, and computation, recent education reform initiatives have placed a greater emphasis on problem solving, reasoning, and understanding. Additionally, topics that have been ignored or deferred until later grades, such as number sense, algebra, geometry, probability, and data analysis, are introduced much earlier according to the NCTM standards, giving students the time to develop a deeper understanding.

Changes in society and the workplace require greater skill and understanding of mathematics. With the availability of calculators and computers, higher-order thinking is now seen as a basic skill for all students. This represents an important shift in mathematics instruction: the idea that all students should be prepared for a more ambitious curriculum. This is especially important in urban districts with large minority populations, where few students went beyond algebra or geometry in the past.

To reflect the changes in curriculum and instruction, many states have adopted new academic frameworks and tests that assess progress along these more ambitious goals. These mathematics standards and tests generally reflect the recommendations of the National Council of Teachers of Mathematics (1989, 2000) with a focus on problem solving, reasoning, and connections. Because these state tests are used to evaluate the academic progress of schools and districts, with the results reported in the media, teachers, parents, and administrators are concerned about the effectiveness of a mathematics curriculum in meeting the standards.

The performance of elementary school students using the Everyday Mathematics curriculum was analyzed using multiple regression techniques. Here, multiple regression allowed for the measurement of several variables that can impact student test scores, such as mathematics curriculum and socioeconomic factors. Highlighted are three states which feature comprehensive assessment systems: Massachusetts, Pennsylvania, and Illinois.

In order to demonstrate the challenging nature of these exams, sample items from the fourth grade mathematics 1999 Massachusetts Comprehensive Assessment System (MCAS) are shown in Figure 1. The mathematics content strands on the MCAS include number sense, relations and functions, geometry and measurement, and statistics and probability, with each area receiving roughly equal weight on the test.

In these states where student achievement data was statistically analyzed, students using the Everyday Mathematics curriculum achieved significantly higher test scores, even after controlling for socioeconomic factors. The results here support previous research indicating that students in Standards-based curricula like Everyday Mathematics perform substantially higher than their peers on tests, especially when these tests assess problem solving, reasoning, and other higher-order thinking skills.

Given the challenging nature of these state tests, these results are important. Research has shown that although U.S. students are generally proficient at routine computations, their performance slips dramatically when questions involve application, problem solving, understanding, and reasoning (Zawojewski & Heckman, 1997). International studies indicate that mathematics instruction in U.S. classrooms focuses largely on teacher demonstration and student practice of rote procedures in contrast to higher achieving nations. In response, educators have called for instruction, curricula, and tests.
that place a greater emphasis on problem solving, application, and more complex mathematical topics at earlier grades.

The higher performance on these tests is not surprising given the more ambitious mathematics investigated in the Everyday Mathematics curriculum. Everyday Mathematics attempts to provide a balanced approach to learning mathematics, in which computational skill, conceptual understanding, and reasoning develop together during meaningful activities that emphasize problem solving and real-life applications. From kindergarten onwards, students are accustomed to explaining their reasoning in pictures, words, with manipulatives and with mathematical symbols. Furthermore, a much wider range of mathematics, e.g., geometry and algebra, is investigated in increasing depth at each grade level.

References

Multiple-choice question:
Which number fits ALL of these clues?
• a multiple of 3
• an even number
• a multiple of 8
• not a multiple of 9

a) 48  b) 54  c) 63  d) 72

Content strand: Number sense

Short-answer question:
Use the target pictured below to answer the question.

Teri tossed bean bags at this target. She scored 29 points in the FEWEST possible number of tosses. Write a number sentence that shows the sum of points Teri scored in each of these tosses.

Content strand: Patterns, relations, and functions

Open-response question:
James and Tina made these stacks of centimeter cubes.

a. Whose stack has more centimeter cubes?
Explain or show how you know you are right.

James’ stack
Tina’s stack

b. Another student named Amanda has 20 centimeter cubes in all. She has found the box shown below.

Will this box hold her 20 centimeter cubes?
Explain why it WILL or WILL NOT hold 20 centimeter cubes.

Content strand: Geometry and measurement
Background
The Massachusetts Comprehensive Assessment System (MCAS) was developed to assess the progress of students and schools along the state’s new Curriculum Frameworks and Learning Standards. The MCAS was initiated in the 1997-98 school year. Elementary mathematics is assessed at grade four.

All Massachusetts public schools with fourth grade classrooms were included in the analysis, and those using the Everyday Mathematics curriculum were identified. Eighty-three (83) schools used Fourth Grade Everyday Mathematics, with 929 schools using other curricula.

Key Findings

Average Scaled Score
In 1999, Everyday Mathematics fourth-graders had a mean scaled score about 10 points higher than non-Everyday Mathematics students on the mathematics test (see Table 1). The mean score on the 4th grade MCAS exam in schools using Everyday Mathematics was 244, compared to a mean of 234 in schools using other curricula. Two-tailed t-tests showed that the difference between the mean scaled scores of Everyday Mathematics schools and non-Everyday Mathematics schools was statistically significant (p < .001).

<table>
<thead>
<tr>
<th></th>
<th>Everyday Mathematics</th>
<th>Non-Everyday Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean score</strong></td>
<td>244.6 (8.2)</td>
<td>233 (8.7)</td>
</tr>
<tr>
<td><strong>Percent Advanced</strong></td>
<td>26.4% (15.5)</td>
<td>11.1% (10.2)</td>
</tr>
</tbody>
</table>

Note: Differences between Everyday Mathematics and non-Everyday Mathematics schools are significant on both measures.

Percent of Students at Each Competency Level
Figure 1 compares the percent of students at each of the proficiency levels: Advanced, Proficient, Needs Improvement, and Failing. As the results show, a much larger percentage of Everyday Mathematics students performed at the higher levels of achievement, with relatively few failing. More than one-quarter of Everyday Mathematics students were identified as Advanced compared to 11% of non-Everyday Mathematics students. In addition, 57% of students in Everyday Mathematics were classified as Advanced or Proficient compared to 34% of students in other curricula. Two-tailed t-tests showed that the difference between the percentage of students at the Advanced level in Everyday Mathematics schools and non-Everyday Mathematics schools was also statistically significant (p < .001).

Regression analysis
Besides curricula, a number of other variables impact learning and academic performance, e.g., percentage of low-income students and per-pupil expenditure. Two step-wise regression analyses were done using 16 educational and socioeconomic variables, with “math scaled score” or the “percent at the Advanced proficiency level” as the dependent variable. A regression model explains the effect of the Everyday Mathematics curriculum after the effects of these other variables are taken into account.

Both regression equations showed that Everyday Mathematics was a significant predictor of achievement on the MCAS. When the dependent variable was the “mathematics scaled score,” the use of Everyday Mathematics (with a coefficient of 4.35) ranked only behind district poverty rate as a predictor of achievement in the regression equation. This coefficient indicates that use of Everyday Mathematics accounted for a gain of 4.35 points in the scaled score over and above the influence of the other variables that were significant in the regression equation.
For the regression equation in which the dependent variable was the “percent at the Advanced proficiency level,” Everyday Mathematics accounted for an increase of 9.9 percentage points in the share of students at this highest level of achievement after the effect of other variables was taken into account.

Summary

Fourth-graders in the Everyday Mathematics curriculum performed significantly higher than students in other curricula on the 1999 MCAS. A higher percentage of Everyday Mathematics students scored in the Advanced proficiency level, and far fewer scored in the lowest levels. These differences favoring Everyday Mathematics remained statistically significant even when other variables were taken into account.
Background

The PSSA mathematics test is given to all public school students in fifth, eighth, and eleventh grade. Although the PSSA has been administered since 1992, scores can only be compared from 1996. Since then, scores on the mathematics assessment have been assigned an equitable scaled score, ranging from 1000 to 1600 with a mean of approximately 1300.

In 1999, 1,688 schools administered the fifth grade PSSA, 117 using Everyday Mathematics and 1,571 using other curricula. It is important to note that while about 7% of the state’s schools used Fifth Grade Everyday Mathematics, nearly half of these are in Pittsburgh, where all schools use Everyday Mathematics, and where the level of low-income students is well above the state norms. (The Pittsburgh School District serves approximately 40,000 students in grades K to 12, and 76% of these students are identified as low-income by the Pennsylvania Department of Education.) To control for these differences in socioeconomic status, regression models and analyses by quartiles are done along with descriptive statistics. The school scaled score is the unit of analysis.

Key Findings

Regression analysis

While curriculum impacts learning, a number of educational and socioeconomic variables can confound the effect. Along with each school’s mathematics scaled score, Pennsylvania reports 12 socioeconomic and demographic variables, e.g. percentage of low-income students and per-pupil spending. To control for the effect of these variables, a step-wise regression was run with mathematics score as the dependent variable. The regression analysis explains the effect of Everyday Mathematics after the other educational variables are taken into account, reporting which variables are statistically significant in predicting achievement. All Pennsylvania public schools were included in this analysis.

The resulting regression equation showed that Everyday Mathematics had a significant effect on mathematics achievement. Even after controlling for other significant variables, use of Everyday Mathematics accounted for a gain of 30.7 points on the PSSA compared to other curricula.

A second regression equation was run to see which variables impacted an increase over the 1998 mathematics score, e.g., which are predictors of improvement from the 1998 to the 1999 PSSA. Use of Everyday Mathematics was the most significant predictor of improvement in this regression equation, accounting for a gain of 12.5 points over the 1998 score even after other variables are taken into account.

Comparing Similar Schools

To examine the PSSA scores of comparable schools, all schools were divided into quartiles based on the percentage of low-income students enrolled. As Table 1 shows, students in the Everyday Mathematics curriculum scored higher than their counterparts at each of the quartiles, and z-tests showed all of these differences to be statistically significant (p < .01).

Figure 1 shows that although achievement on the PSSA dropped as the percentage of low-income students increased, the differences favoring the Everyday Mathematics schools were similar for each of the quartiles.

The PSSA mathematics test requires students to read, analyze, and communicate their reasoning in

Table 1: 1999 Average PSSA Scores by Quartile (Percentage of Low-income Students)

<table>
<thead>
<tr>
<th>Quartile</th>
<th>EM</th>
<th>Non-EM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartile 1</td>
<td>1454</td>
<td>1382</td>
</tr>
<tr>
<td>Quartile 2</td>
<td>1397</td>
<td>1336</td>
</tr>
<tr>
<td>Quartile 3</td>
<td>1339</td>
<td>1302</td>
</tr>
<tr>
<td>Quartile 4</td>
<td>1223</td>
<td>1194</td>
</tr>
</tbody>
</table>

Notes: Quartile 1 has the lowest percentage of low-income students. In each quartile, differences were statistically significant favoring the Everyday Mathematics schools.
written explanations. Because of this, and because reading is often used as a measure of academic achievement, the mathematics scores were divided into quartiles based on the fifth grade PSSA reading scores, i.e., reading level was controlled.

Results in Table 2 show that Everyday Mathematics students outperformed their peers in each quartile, and two of these differences were statistically significant. Again, this provides further evidence for the impact of Everyday Mathematics on students of all levels.

The state-reported mean fifth grade mathematics score on the 1999 PSSA was 1300. As shown in Table 3, the mean score computed for schools using Everyday Mathematics was 1299 compared to 1307 for schools using other curricula. There was no significant difference between these scores.

When the scores of all other schools outside of Pittsburgh schools are examined, Everyday Mathematics schools had a mean score of 1337 compared to 1307 for schools using other programs.

The mean 1999 fifth grade mathematics score in Pittsburgh, as reported by the state, was 1250, and although this was below the average state score, the city has increased its fifth grade math PSSA score since 1996, while the state score has remained constant at 1300. (Figure 2)

**Summary**

Everyday Mathematics has a significant effect on mathematics achievement on the PSSA. When educational and socio-economic variables are controlled in multiple regression, Everyday Mathematics is a significant predictor of mathematics achievement. Additionally, the use of Everyday Mathematics is the most significant predictor of improvement from the 1998 to the 1999 PSSA.

All schools were divided into quartiles based on the percentage of low-income students enrolled. Students in the Everyday Mathematics curriculum scored higher than their counterparts at each quartile, and all of these differences were statistically significant.

Results on the 1999 PSSA support findings on other state assessments and provide further evidence that all students, including students in lower-income districts, benefit from a more ambitious, standards-based curriculum like Everyday Mathematics.

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**Table 2:** 1999 Average PSSA Math Scores by Quartile (Average PSSA Reading Scores)

<table>
<thead>
<tr>
<th>Quartile</th>
<th>EM</th>
<th>Non-EM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1203</td>
<td>1184</td>
</tr>
<tr>
<td>2</td>
<td>1302</td>
<td>1296</td>
</tr>
<tr>
<td>3</td>
<td>1365</td>
<td>1346</td>
</tr>
<tr>
<td>4</td>
<td>1460</td>
<td>1414</td>
</tr>
</tbody>
</table>

*Notes: Students in Quartile 1 had the lowest reading score. Differences were significant in Quartiles 2 and 4.*

**Table 3:** Mean scores (and standard deviations) on the fifth grade 1999 PSSA

<table>
<thead>
<tr>
<th></th>
<th>Everyday Mathematics</th>
<th>Non-Everyday Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pennsylvania State Total</td>
<td>1299 (116)</td>
<td>1307 (98)</td>
</tr>
<tr>
<td>Pittsburgh School District</td>
<td>1257 (77)</td>
<td>—</td>
</tr>
<tr>
<td>All other schools</td>
<td>1337 (132)</td>
<td>1307 (98)</td>
</tr>
</tbody>
</table>

*Note: All schools in the Pittsburgh School District use Everyday Mathematics.*
Background

In 1999, the state of Illinois initiated a series of tests, the Illinois Standards Achievement Test (ISAT) based on new state academic standards. Elementary mathematics is assessed at both third and fifth grades in Illinois.

Public schools in Chicago and in the six collar counties surrounding the city using the Everyday Mathematics curricula were identified. At third-grade, this included 19 Chicago schools and 159 suburban schools. At fifth-grade, 17 Chicago schools and 127 suburban schools used Everyday Mathematics. Four hundred thirty-two (432) Chicago schools and 647 suburban schools used other curricula at third grade; 431 Chicago schools and 637 suburban schools used other curricula at fifth grade.

Key Findings

Average Scaled Score

At both third and fifth grade, Chicago and suburban schools using the Everyday Mathematics curriculum had a mean score about 6 points higher than non-Everyday Mathematics schools on the mathematics test. Scores for each group are shown in Table 1. Two-tailed t-tests showed that these differences were significant in all cases (p ≤ .01).

Percent of Students at Each Competency Level

Based on their test results, students are classified into four levels: Exceeds, Meets, or Below Standards; or Academic Warning. Figure 1 compares the results of third grade students in schools using Everyday Mathematics with those who used other math curricula. Similar results were found for Chicago and suburban schools at both grade

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### Table 1: Mean scores (standard deviations) on the 1999 ISAT

<table>
<thead>
<tr>
<th>District and grade</th>
<th>Everyday Mathematics</th>
<th>Non-Everyday Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 3</td>
<td>Mean (std. dev.)</td>
<td>Mean (std. dev.)</td>
</tr>
<tr>
<td>Chicago Public Schools</td>
<td>157.4 (6.9)</td>
<td>151.3 (7.4)</td>
</tr>
<tr>
<td>Suburban Schools</td>
<td>168.9 (5.6)</td>
<td>162.0 (7.7)</td>
</tr>
<tr>
<td>Grade 5</td>
<td>Mean (std. dev.)</td>
<td>Mean (std. dev.)</td>
</tr>
<tr>
<td>Chicago Public Schools</td>
<td>156.3 (5.8)</td>
<td>150.8 (6.7)</td>
</tr>
<tr>
<td>Suburban Schools</td>
<td>168.7 (5.2)</td>
<td>161.8 (8.2)</td>
</tr>
</tbody>
</table>

Note: All differences between Everyday Mathematics and non-Everyday Mathematics schools are significant.
levels, with even stronger results favoring Everyday Mathematics students in Chicago. Most (86%) suburban Everyday Mathematics third-graders exceeded or met expectations compared to 76% of the non-Everyday Mathematics students. In Chicago, at third grade, 61% of Everyday Mathematics students exceeded or met state standards compared to 40% of non-Everyday Mathematics students.

Comparing Similar Schools

Chicago-area suburban schools were divided into quartiles based on the percentage of low-income enrollment. That is, schools in Quartile 1 have the lowest share of low-income students, while the proportion of low-income students in Quartile 4 is the greatest. In all cases, Everyday Mathematics students scored higher than their counterparts, and all but one of these differences was significant. Moreover, the differences increased as the percentage of low-income students increased, suggesting that Everyday Mathematics had a greater impact on students in the lower-income levels. (Figure 2)

One would expect student achievement in both reading and mathematics to reflect demographics, teacher quality, school spending and parental involvement. In fact, there is an extremely high correlation between the ISAT reading and math scores.* Because of this strong correlation and because reading ability is often used as a measure for educational achievement or ability generally, it should be instructive to compare Everyday Mathematics schools to non-Everyday Mathematics schools with similar reading scores.

Suburban schools were placed into quartiles based on the average score on the 1999 ISAT reading test, which is also given to third and fifth grade students. Each quartile consists of schools with similar average reading scores, with those in the first quartile scoring the highest on the ISAT reading test. Table 2 below shows the average ISAT math scores of Everyday Mathematics and non-Everyday Mathematics students in each quartile. In all cases, Everyday Mathematics students performed at a higher level on the math portion of the ISAT exam, and all of these differences were statistically significant. Since schools with similar reading achievement are being compared, these results suggest that the higher math scores in Everyday Mathematics schools are attributable to differences in mathematics instruction, including the use of the Everyday Mathematics curriculum. It should also be noted that Everyday Mathematics teachers typically receive more training in the use of the curriculum than teachers in other curricula, a fact which may also contribute to the higher scores for Everyday Mathematics schools.

* Overall, the correlation between math and readings scores was 92% at third-grade and 94% at fifth-grade.

**Summary**

At both third and fifth grade, Everyday Mathematics students scored higher than their peers using other mathematics curricula. Even when other educational variables (e.g., percentage of low-income students and per-pupil expenditure) were accounted for, the differences favoring Everyday Mathematics schools were, in most cases, statistically significant. At both suburban and Chicago public schools, a substantially larger proportion of the Everyday Mathematics students exceeded or met state standards. While Everyday Mathematics schools at all levels performed higher than their peers, the analysis suggests that those with larger populations of low-income students showed greater differences.

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![Figure 2: Grade 3 ISAT Scores by Low-Income Percentage 1999](image)

Table 2: Average 1999 ISAT Math Scores by Quartile (Average ISAT Reading Scores)

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Grade 3</th>
<th>Grade 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EM</td>
<td>Non-EM</td>
</tr>
<tr>
<td>Quartile 1</td>
<td>173.3</td>
<td>170.6</td>
</tr>
<tr>
<td>Quartile 2</td>
<td>167.5</td>
<td>166.5</td>
</tr>
<tr>
<td>Quartile 3</td>
<td>163.9</td>
<td>161.5</td>
</tr>
<tr>
<td>Quartile 4</td>
<td>158.4</td>
<td>153.1</td>
</tr>
</tbody>
</table>

Note: Quartile 1 has the highest average reading scores. EM outperformed non-EM in each case. All differences are significant.
Students Prepared for Greater Success on California’s SAT-9 Test

Students using the Everyday Mathematics curriculum achieve higher scores on the SAT-9 (Stanford Achievement Test), compared to state averages, at every grade level. These results reflect the performance of over 65,000 students in public school districts that have fully implemented Everyday Mathematics in the elementary grades.

Table 1: SAT-9 Test Mean Scaled Score: 1998-2000

<table>
<thead>
<tr>
<th></th>
<th>1998</th>
<th></th>
<th>1999</th>
<th></th>
<th>2000</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State Total</td>
<td>EM Total</td>
<td>State Total</td>
<td>EM Total</td>
<td>State Total</td>
<td>EM Total</td>
</tr>
<tr>
<td>Grade 2</td>
<td>564.9</td>
<td>579.6</td>
<td>572.0</td>
<td>588.1</td>
<td>579.2</td>
<td>594.5</td>
</tr>
<tr>
<td>Grade 3</td>
<td>590.7</td>
<td>603.5</td>
<td>598.4</td>
<td>612.7</td>
<td>606.5</td>
<td>619.9</td>
</tr>
<tr>
<td>Grade 4</td>
<td>614.2</td>
<td>628.1</td>
<td>619.0</td>
<td>633.1</td>
<td>625.7</td>
<td>641.2</td>
</tr>
<tr>
<td>Grade 5</td>
<td>638.7</td>
<td>652.3</td>
<td>642.4</td>
<td>657.3</td>
<td>647.8</td>
<td>663.2</td>
</tr>
<tr>
<td>Grade 6</td>
<td>656.4</td>
<td>670.1</td>
<td>660.5</td>
<td>674.6</td>
<td>664.8</td>
<td>680.0</td>
</tr>
</tbody>
</table>

Figure 1: Everyday Mathematics students in California continue to improve their performance on the SAT-9 test.

Rocklin

In the Rocklin Unified School District, Everyday Mathematics has been an essential ingredient in helping its schools to align themselves with the state’s priority of improving student achievement and educational accountability. The Rocklin USD serves a suburban community located northeast of Sacramento.

Rocklin USD chose Everyday Mathematics because it was “far superior in its scope and sequence, rigor, manipulatives, parent links, teacher resources, and alignment with the California Standards,” according to Kevin Brown, Assistant Superintendent, Instructional Services.

Rocklin USD SAT-9 Test National Percentile Rank: 1998–2000

“Teachers love the program and parents are supportive due to the results they are seeing,” comments Brown.

Two years after implementation, scores have increased at every grade level, by an average of 11 percentile points.

**El Segundo**

El Segundo Unified School District, located 14 miles southwest of downtown Los Angeles, serves 2,700 students in kindergarten through 12th grade. “Our test scores show how the Everyday Math program has directly improved our students’ scores in math,” noted Sheralyn Smith, Assistant Superintendent — Educational Services.

“The program provides a rigorous and balanced approach to basic skills, conceptual understanding, and problem solving. Everyday Mathematics creates an environment that stimulates learning, promotes mathematical reasoning, and allows students to develop communications skills as they explain to others the strategies they used to solve problems. Finally, Everyday Mathematics sets high expectations for all students.”


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**Poway**

The Poway Unified School District in San Diego County serves the communities of Rancho Bernardo, Poway, Carmel Mountain Ranch, Sabre Springs, and Rancho Penasquitos. A total of 31,000 students attend district schools.

“Everyday Mathematics came highly recommended as a program which provides students with rich content that prepares them for more advanced study of mathematics at the middle and high school levels,” says Cindy DeClerq, Poway’s District Math Coordinator.

In addition, the program’s major philosophies mirror the district’s desire to place high academic standards that challenge PUSD’s students in an environment where outstanding teaching and support staffs are committed to the belief that all students’ learning is the key to excellence. Particularly important, according to DeClerq, is Everyday Mathematics’ emphasis on:

- The acknowledgement of children’s experiences and intuition about mathematics
- The provision of problem-solving experiences in real life contexts
- The attention to a variety of learning styles
- The meaningful practice of basic skills through activities and games
- The spiraling curriculum that ensures deepened mathematical understanding over time

Increasing Mathematics Performance on the SAT-9 in Santa Ana, California

Davis Elementary, in the Santa Ana Unified School District, serves 750 students in grades K to 5. Davis Elementary is a multi-track, year-round school. The student population is characterized by its low socioeconomic status, as 92% are eligible for free or reduced-price lunch. In addition, 93% of the students are identified as Limited English Proficient.

Davis Elementary implemented Everyday Mathematics in grades K to 5 during the 1999-2000 school year. “Everyday Mathematics offers hands-on learning, as well as sequential instruction,” explained Lillian French, Elementary Curriculum Director in the Santa Ana district. “The program provides guidance to the beginning teacher, and offers flexibility to the more experienced teacher. For students, problem solving and mental math are emphasized. This is important as many of our students are lacking this kind of number sense.”

After the first year of complete implementation, French reports that teachers like the program due to its rigor, and the challenges it presents to students. Everyday Mathematics also helps to prepare Davis Elementary students for the SAT-9 exam. In second grade for example, the National Percentile Ranking (NPR) for the “Average” Student Score almost doubled from 27 to 50.

SAT – 9 Results: National Percentile Rank “Average” Student Score — Davis School & Santa Ana Unified School District
Wichita’s Dodge/Edison School started implementing Everyday Mathematics in the 1995-96 school year.

In the five years since adopting Everyday Mathematics, Dodge Elementary School has experienced excellent student progress. This result is of special note in a school where over 60% of the students are economically disadvantaged.

Dodge/Edison enrolls over 600 students in grades K to 5. The Wichita Public Schools administers the Metropolitan Achievement Test (MAT-7) to elementary school students in grades 3, 4, and 5.

In Fall 1995, just as Everyday Mathematics was introduced as the curriculum, third-graders placed at the 39th national percentile on the math portion of the MAT-7. By 1999, third-graders at Dodge/Edison were reaching the 71st national percentile.

Overall, the three grades tested increased their percentile rankings by an average of 31 points in five years.

Furthermore, significant numbers of students now score above the 75th national percentile on the math portion of the MAT-7 test. In 1995, for example, 15% of third-graders placed above the 75th national percentile. In 1999, 44% of Dodge-Edison third graders were achieving at this level.

As the MAT-7 is administered each year to students in grades 3 to 5, gains can also be identified among the same group of students from year to year. While 1995 third-graders scored at the 39th national percentile, this same group placed at the 52nd national percentile in fourth grade and at the 69th national percentile in fifth grade.

“Teachers have embraced Everyday Mathematics,” commented an Edison Schools representative. “They have enthusiastically participated in professional development sessions, and the staff holds regular parent nights to acquaint parents with the program. As parents learn about the unique features and see such positive test results, they have become very supportive. Students particularly love math at Dodge, and look forward to math each day.”

**MAT-7 Results: Dodge/Edison Partnership Elementary School**

<table>
<thead>
<tr>
<th>Math Trend... Percentile Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th Grade</td>
</tr>
<tr>
<td>4th Grade</td>
</tr>
<tr>
<td>3rd Grade</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentages Above 75th Percentile Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th Grade</td>
</tr>
<tr>
<td>4th Grade</td>
</tr>
<tr>
<td>3rd Grade</td>
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</tbody>
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The Commonwealth Accountability Testing System (CATS) in the State of Kentucky is an ambitious program of student assessment and school accountability. Students take a national norm referenced test (the CTBS/5) at the third, sixth, and ninth grades, and are again tested in mathematics in grades five, eight, and eleven with the Kentucky Core Content Test. The Kentucky Core Content Test was first administered in spring 1999.

Results of Kentucky Core Content Tests are reported as an academic index on a scale of 0 to 140. Reaching a performance index of 100 by the year 2014 has been identified as a state goal.

Results of the CTBS are reported in national percentiles. When dealing with school scores, the national percentile reflects the percentage of students in the national norm group who fall below the mean score for the school.

**East View Elementary**

East View Elementary in rural Owensboro, Kentucky is located on the Ohio River, about 20 miles southeast of Evansville, Indiana. East View is a school-wide Title I school, with 55% of the students qualifying for free or reduced price lunch. East View is a new school building, replacing two smaller schools when it opened in fall 1997. The school also has a relatively young staff: teachers there have an average of eight years of experience teaching.

“We were looking for a challenging new mathematics curriculum, which emphasized problem solving. That’s what we found with *Everyday Mathematics*,“ recalls Principal Julie Hawkins of the school’s math adoption in fall 1998.

In the first year of using *Everyday Mathematics*, Hawkins had some concerns that the challenging program would be difficult for students who had used a traditional math program. “The new approach really engaged our students, versus the old ‘pencil-and-paper’ math exercises. I think our students opened up to math because they were interacting with it, playing games, working on projects together. “When I have lunch with students, I always ask, ‘What is your favorite class?’ Now, I frequently hear students tell me that their favorite class is math!”

Hawkins notes that teachers in her school use all of the materials available in *Everyday Mathematics*. “I think that is one of the reasons for our success with the program. The games and other hands-on activities are essential.”

Furthermore, Hawkins believes the key factor in East View’s success with *Everyday Mathematics* has been excellent professional development.

“*Everyday Mathematics* is now the benchmark against which I measure all other professional development programs,” says Hawkins. “The consultants are excellent, and let us know how we should be pacing ourselves with the curriculum, and where we are going to need to spend a little more time. Any problems or questions that come up are immediately resolved.”

“We’re sold on *Everyday Mathematics*, and have no doubts that we will be staying with the program,” concludes Julie Hawkins.

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**East View Elementary — CTBS Mathematics: Grade 3**

In spring 2000, third-graders at East View Elementary scored at the 66th national percentile, up from the 60th national percentile in 1999.

**East View Elementary — Kentucky Core Content Test Mathematics: Grade 5**

Fifth-graders at East View raised their scores on the 2000 Kentucky Core Content Test to a score of 86 points from the baseline score of 71 points the year earlier.
Grapevine Elementary

Grapevine Elementary in Madisonville, Kentucky is located in the western portion of the state, and has a K - 5 enrollment of approximately 320 students. The school serves an economically diverse population, with 58% of the students eligible for free or reduced price lunch.

Grapevine Elementary initially adopted Everyday Mathematics in grades K to 4 during the 1998-99 school year. Fifth Grade Everyday Mathematics was added in the following year.

“We needed help with mathematics,” recalled Regena Pollard, former Grapevine Elementary principal, and currently Director of Instruction for Hopkins County Public Schools. Several factors convinced Mrs. Pollard and other educators that the adoption of Everyday Mathematics would support a stronger mathematics curriculum at Grapevine Elementary.

“As a former classroom teacher, I know the importance of activity-based, hands-on programs,” Mrs. Pollard commented. “With Everyday Mathematics, the manipulatives are built right into the program. This ensures that every teacher will use them.”

Furthermore, “Everyday Mathematics is a challenging program and provides a good math foundation. It’s satisfying for the children, and their parents, to know that they can succeed even with a challenging program like Everyday Mathematics.”

To this end, “the Home Links are important as a communication tool to parents. Parents can see and understand what their children are doing in math class at school. In addition, the Home Links make real life connections, and that is important here in Kentucky.”

Results on the Grade 5 Kentucky Core Content Test in mathematics show the results of the Everyday Mathematics curriculum. Grapevine Elementary achieved a KCCT baseline performance index of 58 in 1999. Students taking the 1999 exam had used other mathematics curricula through the elementary grades. The next year, fifth graders had two years of instruction with Everyday Mathematics, and posted an index of 70 on the 2000 KCCT, a gain of 12 index points.

“I believe that the spiral curriculum in Everyday Mathematics helps students when it comes to standardized testing,” states Mrs. Pollard. “The spiral revisits topics, so that students are less likely to forget what they have already learned. It’s easier for the material to become embedded in the students’ minds with the spiral curriculum.”

Third graders at Grapevine Elementary improved their performance on the CTBS Mathematics test as well. Two years after the implementation of Everyday Mathematics, scores on the CTBS Mathematics test at grade 3 placed students at the 50th national percentile, compared to the 40th national percentile in 1998.

![Graph showing the comparison of Grapevine Elementary and State Total scores on the Kentucky Core Content Test Mathematics: Grade 5 in 1999 and 2000.](image)

Grapevine Elementary—CTBS Mathematics: Grade 3
Third-graders at Grapevine Elementary placed at the 50th national percentile in Spring 2000, versus the 40th national percentile in 1998.
The Putnam County School District is located in northeast Florida, approximately 50 miles south of Jacksonville. Putnam County is primarily a rural, agrarian county. Since adopting Everyday Mathematics during the 1997-98 school year, student scores on the Florida Comprehensive Assessment Test (FCAT) have risen significantly, according to Bob Pugh, Director of Title I Programs for the district.

The Florida Comprehensive Assessment Test (FCAT) measures student performance on selected benchmarks in reading and mathematics that are defined by the Sunshine State Standards. The Standards articulate challenging content that Florida students are expected to know and be able to do. The Sunshine State Standards include more challenging content for students to learn than previous state standards which emphasized minimum competencies.

Elementary school mathematics is assessed in grade 5 by the FCAT. The test contains questions that are likely to be answered correctly by the majority of students as well as some that can be answered correctly only by more capable students. Open-ended questions which require the student to “think, solve, and explain” their problem-solving strategies comprise 20% of the test.

Student performance on the FCAT is reported in terms of five achievement levels. Individual school buildings receive a grade based on the percentage of students achieving at Level 3 or higher. When 50% of the school is performing at Level 3 or higher, the school receives an ‘A’.

One school in the Putnam County School District which is very close to receiving an ‘A’ is Ochwilla Elementary. This is particularly noteworthy as the school serves a very rural area where approximately 70% of the students are eligible for free or reduced price lunches.

**FCAT Results:** Grade 5 Mathematics Ochwilla Elementary
The Lawrence Public School District serves a rural community located in the Fruit Belt of Michigan, 20 miles west of Kalamazoo, in the southwest corner of the state. Lawrence, Michigan is a proverbial small town, having only one traffic light. Approximately one-third of the students are eligible for free or reduced price lunch. In addition, the district serves a significant migrant population, as workers arrive each spring to work the asparagus crop and leave in late fall after the apple harvest.

Since adopting *Everyday Mathematics* in the Fall of 1994, student performance on the mathematics portion of the Michigan Educational Assessment Program has steadily increased. In the 1999-2000 school year, 93% of Lawrence fourth-graders achieved a Satisfactory score on the Essential Skills Mathematics Test, an increase of over 40 percentage points since the adoption of *Everyday Mathematics*. Significantly, no students in 1999-2000 scored in the Low range, though one-quarter of Lawrence students were in this range in 1994-95.

**MEAP Results:** Lawrence Public Schools Percent Scoring in Satisfactory and Low Levels, 1995-2000
During the 1980s, a consensus emerged among mathematics educators about how best to teach mathematics to children in school. The NCTM Standards (1989) expressed that consensus and communicated it to a broader audience. Everyday Mathematics is based largely on the same body of research that led to the Standards consensus. In this paper we describe the research findings that were most influential in the original development of Everyday Mathematics.\(^1\)

\(^1\)Everyday Mathematics was developed over a period of more than ten years beginning in about 1985, a time frame that is reflected in the dates of the references in this paper. More recent research has confirmed and extended the findings discussed here. The full text of this paper, including the references, can be found at http://everydaymath.uchicago.edu/educators/references.html.

Infants’ and Young Children’s Mathematical Knowledge

Before 1980 many people believed infants to be fairly passive and unaware of the world around them. Thanks to the work of Starkey and Cooper (1980), Strauss and Curtis (1981), and others, a very different view emerged, one that showed infants to be active, alert to the world, and aware of differences in numbers of objects and certain additive or subtractive relationships. That pioneering work has been expanded in recent years (e.g., Wynn, 1992) and shows the crucial importance of early experience in building cognitive abilities.

Research in the late 1970s and early 1980s also revealed that preschool children have much richer and more active mathematical minds than had been suspected (Gelman and Gallistel, 1978; Gelman, 1982; Resnick, 1983; Fuson & Hall, 1983; Gelman, Meck, & Merkin, 1986). They found that young children are capable of absorbing a great deal of new material, sometimes more rapidly than adults—for example, in the learning of language—but that neurological windows for learning appear to close at certain points in the development of the brain, making later learning of concepts more difficult. Also during the 1980s, certain supposed constraints on what and when children could learn, hypothesized by Piaget and others, were shown to be artifacts of the research tasks and not truly indicative of the capabilities of children (Walsh, 1991).

Many studies confirmed that young children, regardless of social-economic background, possessed considerable informal mathematical knowledge, which the curricula in use at the time failed to use (Riley, Greeno, & Heller, 1983; Carpenter & Moser, 1984; Hiebert, 1984; Cobb, 1985; Baroody & Ginsburg, 1986; Bell & Bell, 1988; Resnick, Lesgold, & Bill, 1990; Carpenter, Ansell, Franke, Fennema, & Weisbeck, 1993). For
example, even without instruction, most kindergarten children are capable of solving a wide range of simple addition and subtraction story problems by their own methods (Riley, Greeno, & Heller, 1983; Carpenter and Moser, 1984). Multiplication, division, and fraction problems are also within their reach when manipulatives are available (Carpenter, Ansell, Franke, Fennema, & Weisbeck, 1993). In brief, children know much about addition and subtraction and other operations before formal instruction begins.

Research on children's informal solution methods revealed a typical developmental progression from simple counting of objects, to use of more sophisticated counting strategies and relationships, to derived fact strategies, to use of arithmetic facts and number relationships (Bergeron & Herscovics, 1990; Fuson, 1992).

In extensive interviews with children, Max Bell and Jean Bell, developers of Everyday Mathematics, showed that knowledge of counting, reading and writing numbers, and problem-solving among kindergarten children far exceeded the expectations of kindergarten programs of the time (Bell & Bell, 1988). For example, while most programs spent the entire year focused on counting to 10 or 20, 84% of children beginning kindergarten could already count 13 dots, nearly half could count beyond 30, and many could count to 100, read and write numerals such as “57” or “100”, act out “equal sharing” division problems, and name common geometric objects.

Typical first grade textbooks of the time expected children to count only to 100 and to read and write numbers to 20, but interviews revealed that many beginning first-graders already had whole-number capabilities beyond those and could actually solve simple fraction problems. Even children’s “errors” showed substantially greater capabilities than had been supposed. For example, many beginning first-graders wrote “four hundred ninety-eight” from dictation as “4098” or “4098” and read the numeral “5004” as “five hundred and four”—wrong answers to be sure, but indicative of readiness for work well beyond the content offered in standard textbooks of that time.

### Early learning appears to be greatly enhanced by ongoing interactions between children and their world.

### Algorithms

Researchers working in the 1970s and 1980s showed that U.S. children often learn standard computational algorithms with very little understanding (Brown & Burton, 1978; Van Lehn 1983, 1986). Other researchers found that the traditional approach to teaching computation engenders beliefs about mathematics that impede further learning (Hiebert, 1984; Cobb, 1985; Baroody & Ginsburg, 1986).

On the other hand, Kamii and others demonstrated that students are capable of inventing their own effective and meaningful methods for computation (Kamii, 1985; Madell, 1985; Kamii & Joseph, 1988; Cobb & Merkle, 1989; Resnick, Lesgold, & Bill, 1990; Carpenter, Fennema, & Franke, 1992). Furthermore, these experiences were found to improve understanding of place value and enhance estimation and mental computation skills.2

### Learning in a Social Context

During the 1970s and 1980s, the work of Lev Vygotsky (1962) began to be more widely known in the United States. Vygotsky's research promoted a view of learning based on both individual and social construction, and showed the importance of social functions in supporting and extending learning. Language, tools, and social interactions all assist children in acquiring skills and concepts. For example, a problem that seems beyond the capabilities of a child can often be solved when appropriate manipulatives are available. When children interact with each other or with adults, then their learning potential, what Vygotsky called the “zone of proximal development,” is extended, increasing both the types of tasks that can be accomplished and the amount of learning that takes place. Early learning appears to be greatly enhanced by ongoing interactions between children and their world, including adults in that world. Talking about ideas, with informal error corrections by adults and peers, is often as important as thinking about ideas, and conversations can gradually become internal dialogues that guide the child’s progress through a problem.

Interviews conducted by Bell and Bell (1988) confirmed the relationships between developing mathematical capabilities and social situations. Questions that seemed beyond primary children's capabilities were often solved during the interview. Children would say, “I didn’t know I could do that!” The availability of tools further extended

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2 For a discussion of the Everyday Mathematics approach to algorithms, see [everydaymath.uchicago.edu/educators/references.html](http://everydaymath.uchicago.edu/educators/references.html).
what a child could explain, and a simple rephrasing of a question often made it quite understandable. For example, children who could not make sense of the symbol “1/2” or of the expression “12 divided by 3” could easily respond correctly to the request, “Please give me half of these blocks” or “Share these blocks among you, me, and my friend [a doll].” While learning and understanding are sometimes individual activities, they are often social activities, greatly influenced by the situation, the language used, and the materials available.

The Johnson brothers also began to publish their pioneering work on cooperative learning during the 1970s (Johnson & Johnson, 1974, 1978).

The Underachieving Curriculum

In the early 1980s, the UCSMP Resource Development Component began studying mathematics education in the Soviet Union, Japan, China, and other high-achieving countries (Wirszup & Streit, 1987, 1990, 1992). Wirszup found that other nations were much more ambitious in the scope and sequence of mathematics covered. Even in arithmetic, textbooks in other countries presented topics earlier, had a consistent pattern of spaced practice with mixed operations, and included both more types of word problems and more challenging problems than U.S. textbooks (Stigler, Fuson, Ham, & Kim, 1986; Fuson, Stigler, & Bartsch, 1988). For example, although kindergarten and first grade children had notions of doubles and other multiples, a sure grasp of the demands of equal sharing, and a clear understanding of “half of,” multiplication and division were not in the U.S. curriculum until late in second or third grade, and then primarily as rote memorization of the simplest facts. Children also had substantial capabilities from their everyday experience with decimals (money), numbers less than zero (winter temperatures), measurement, and geometry. In teaching experiments by UCSMP researchers, children showed readiness for algebra, functions, and data analysis, but all these topics were deferred to later grades or given scant attention in U.S. textbooks of the 1980s. Not surprisingly, in international studies, U.S. students consistently ranked near the bottom in comparisons with their peers in other industrialized nations. (Stevenson, Lee, & Stigler, 1986; McKnight et al., 1987). Classroom observers found that teaching practices in the higher-achieving nations differ greatly from those in the U.S. For example, although kindergarten and first grade children had notions of doubles and other multiples, a sure grasp of the demands of equal sharing, and a clear understanding of “half of,” multiplication and division were not in the U.S. curriculum until

Educators, leaders of industry, and governmental agencies realized that the U.S. was failing to produce citizens competent in the mathematics that would be needed to compete in the twenty-first century.

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Mathematical Modeling and Problem-Solving

Investigations in problem-solving (Polya, 1948, 1962; Lesh, Post, & Behr, 1987; Schoenfeld, 1987; Janvier, 1987) showed that an important step in solving a problem is choosing a model or representation for the problem situation. Researchers and theorists stressed the importance of natural language, concrete models, physical or mental visual images (including pictures, graphs, and
diagrams), and symbols in representing mathematical ideas (Bruner, 1964a, 1964b; Lesh, Post, & Behr, 1987; Silver, 1987; Hiebert, 1988). Facility with multiple representations, especially the ability to translate among representations, was found to be important in problem-solving.

Researchers also noted that the symbolic manipulations that students carry out in school are often disconnected from reality and common sense (Hiebert, 1984, 1988; Baroody & Ginsburg, 1986; Van Lehn, 1986; Silver, 1986; Resnick, 1987b; Kaput, 1987a, 1987b; Romberg & Tuft, 1987). As a result, students produce nonsense but don’t realize it, as Van Lehn and others have shown in their analysis of arithmetic errors. Research also showed, however, that if symbolism is closely related to actions and referents that are familiar to young students, then they are able to deal effectively with it (Hiebert, 1984, 1988; Carpenter, Fennema, & Franke, 1992).

Calls for increased tool use in schools were common before 1990. Both research findings (Suydam, 1984, 1986) and theoretical considerations (Bruner, 1964a, 1964b; Hiebert, 1984, 1988; Lesh, Post, & Behr, 1987; Resnick, 1987b) supported increased use of tools (a.k.a. manipulatives) in school. One particular tool coming into use during this period was the hand-held calculator. Bell (1976) recognized that calculators should play a role in curriculum and learning. Initial research (Hembree & Dessart, 1986, 1992; Suydam, 1982, 1985, 1987), since confirmed (Smith, 1997), found that calculators can be valuable tools in school mathematics.

Both research findings and theoretical considerations supported the increased use of tools (a.k.a. manipulatives) in school.

Applications and a Broader Curriculum

Interest in using applications in school mathematics increased during the 1970s and 1980s (Sharron, 1979). Bell (1972) made it clear that people’s ordinary lives provide a rich source of brief but interesting problems for school arithmetic. Usiskin and Bell (1983) proposed a scheme for categorizing the uses of numbers and operations with numbers, so that the actual uses of numbers could easily be included in an organized way in school mathematics programs. Bell (1974) outlined content for a new and ambitious mathematics curriculum. In contrast to traditional K-6 textbook programs, the proposed curriculum framework included investigations in measurement, geometry, algebra, and statistics, as well as in arithmetic. Bell’s ideas were taken up in a series of authoritative reports on the content of school mathematics (NCSM 1977, 1988; Pollak, 1983; NCTM, 1989).

Pacing and Practice

While research in reading showed that students achieved best when topics were presented at a brisk pace (Barr, Dreeben, & Wiratchai, 1983), most mathematics texts of the 1970s and 1980s moved quite slowly. An investigation by UCSMP of U.S. mathematics textbooks found that from first through eighth grade, more than half of each year’s program was typically devoted to a review of topics from previous years (Flanders, 1987). In those textbooks, a topic was typically introduced and practiced for several weeks and then largely ignored until the following year, when it was reviewed, practiced, and perhaps slightly extended. This cycle of annual repetition with little substantive development was severely criticized by researchers who studied U.S. and foreign textbooks (McKnight et al., 1987; Schmidt, McKnight, & Raizen,
1997). Texts that were essentially medleys of disconnected topics arranged in a flat “spiral” were identified as a prime reason for U.S. students’ poor performance on international tests.³

Besides a brisk pace, research findings from before 1990 supported continuous review and distributed practice. Practice has long been recognized as essential if children are to retain what they learn (Brownell, 1935, 1956; Brownell & Chazal, 1935; Rathmell, 1978; Chase & Chi, 1981; Cook & Dossey, 1982; Coburn, 1989). The positive effects of “spaced” rather than “massed” practice were recognized as early as 1885 when the German psychologist Hermann Ebbinghaus published his seminal work on memory. Over the past century, Ebbinghaus’s findings have been repeatedly confirmed and extended (Caple, 1996). Research about the role of distributed, or spaced, practice in the learning of mathematics was summarized in Suydam’s 1985 ERIC digest (ED 260891): “Long-term retention is best served if assignments on a particular skill are spread out in time rather than concentrated within a short interval.” Transfer of a skill or concept is also more likely to occur when it is practiced in a variety of contexts and situations (Anderson, Reder, & Simon, 1996).

Meaning and Skill

One of the perennial arguments in education is between those who want students to develop skill in carrying out procedures and those who want students to understand why those procedures work. Like most such either-or dichotomies, however, this is a false choice. In reality, children with weak conceptual understandings are hindered in their skill development, and children with weak skills are handicapped as they work towards higher levels of conceptual understanding (Carpenter, 1986).

Educators have long recognized that concepts and skills develop best when proper attention is given to both. In 1902, for example, Dewey stressed both that learning must be meaningful for the students and that learning must lead students into established disciplines of study. Years later, Brownell pointed out the necessity for a balance between skills and meaning: “In objecting to the emphasis on drill prevalent not so long ago, we may have failed to point out that practice for proficiency in skills has its place too” (1956). More recent researchers have also pointed out the unfortunate outcomes when a proper balance between meaning and skill is not maintained (Skemp, 1978; Baroody & Ginsburg, 1986; Resnick, 1987b).

Staff Development

During the New Math era, scant attention was paid to the staff development needs of elementary school teachers.⁴ Part of the Back-to-Basics movement of the 1970s was actually an emphasis on “teacher-proof” materials. Thus, when UCSMP was founded in 1983, the project’s Elementary Teacher Development Component was breaking new ground. One key finding from work carried out in the 1980s by Paul Sally and Sheila Sconiers at UCSMP was that staff development needed to focus on building teachers’ understanding of mathematics.

³Note that these findings do not imply that all spiral curricula are necessarily flawed, only that the traditional U.S. ones are. Indeed, Thomas Romberg, the general editor of the NCTM Standards, wrote as his first “principle of curriculum engineering” that “The main generic schemata (i.e. measurement, mappings, proportionality) that we wish to develop in school children must be identified and a spiral curriculum built around those conceptual strands” (Romberg & Tufte, 1987).

⁴High school mathematics teachers did have many opportunities for staff development, but elementary school teachers were largely neglected.
Other work at the University of Chicago showed that while teachers used a variety of teaching formats in areas such as language arts and social studies, including student projects and small-group work, in mathematics instruction by those same teachers was dominated by individuals filling in answers on page after page of arithmetic problems (Stodolsky, 1988).

Development Principles for Everyday Mathematics

The research described above and their own experience led the Everyday Mathematics authors to a number of principles for curriculum development. These include:

- Children begin school with a great deal of knowledge and intuition on which to build; by making use of this knowledge, far more can be accomplished in the primary grades than has traditionally been supposed.
- The curriculum should begin with children's experience and should work to connect that experience with the discipline of mathematics; the materials should encourage the children's own construction of knowledge.
- Curriculum development should proceed grade by grade starting at Kindergarten so that each grade can build on proven outcomes of the previous grade.
- The curriculum should be more than just arithmetic; geometry, data analysis, measurement, probability, algebra, and problem solving can be taught in elementary school; the curriculum should include rich problems, mathematical modeling, and cross-curricular connections.
- The pace should be brisk.
- Topics should be arranged in a helix; practice should be distributed rather than massed.
- The curriculum should make use of manipulatives, including calculators.
- The curriculum should include practical routines to help build the arithmetic skills and quick responses that are essential in a problem-rich environment.

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The Everyday Mathematics Writing Process: Research-Guided Revision

The principles above guided the initial drafting of the Everyday Mathematics materials, which began with kindergarten in the mid-1980s. The draft materials were written and field-tested one grade at a time. During the field tests, UCSMP staff gathered detailed critiques of the materials from the field test teachers and also carried out rigorous formative evaluation studies (Carroll, 1996a, 1995b, Carroll & Porter, 1994; Hedges, Stodolsky, & Mathison, 1987). The draft materials were revised on the basis of the evaluation studies and teacher feedback, and were commercially published.

Finally, extensive summative evaluations of the published materials were carried out by UCSMP and by a group at Northwestern University, often focusing on issues identified as problematic during the field test (Arron, 1993; Carroll, 2000a, 2000b, 1999, 1988a, 1998b, 1997, 1996b, 1996c, 1996d, 1995a, 1993; Carroll & Fuson, 1998a, 1998b; Carroll, Fuson, & Diamond, 2000; Carroll & Isaacs, in press; Carroll & Porter, 1998, 1997; Ding, 1997; Drueck, 1996; Drueck, Fuson, Carroll, & Bell, 1995; Fraivillig, 2001, 1996; Fraivillig, Murphy, & Fuson, 1999; Fuson, 1997; Fuson & Carroll, 1998; Fuson, Carroll, & Drueck, 2000; Fuson, Carroll, & Landis, 1996; Murphy, 1998). Because of this elaborate development process, the production of the first edition of EM took more than 10 years.

This writing process — research-based drafting, field-testing with formative evaluation studies, revision leading to commercial publication, and summative evaluation of the final materials — was designed to bridge the gap between research and practice. The overriding goal was to produce practical materials that ordinary teachers could use to significantly improve the mathematics education of their students.

Almost immediately after the publication of Sixth Grade Everyday Mathematics in 1996, work began on a second edition. Due to the exigencies of commercial
Everyday Mathematics Student Achievement

A large number of studies of Everyday Mathematics student achievement have been conducted. These studies have been carried out by four principal groups: (i) the elementary and evaluation components of UCSMP (see above for cites), (ii) an NSF-funded group at Northwestern University, which carried out a five-year longitudinal study of the curriculum (see above for cites), (iii) individual schools and districts using the curriculum (Everyday Learning, 2001, 1998, 1996; Greene, 1996; Briars & Resnick, 2000; Mathematics Evaluation Committee of the Hopewell Valley Regional School District, 1997), and, increasingly, (iv) independent researchers (Hawkes, Kimmelman, & Kroeze, 1997; Woodward & Baxter, 1997; Riordan & Noyce, in press).

These studies, which have used a wide range of instruments and methods to measure students’ progress and understanding, provide a broad perspective on the effects of the curriculum.

Generally, results indicate the following:

- On traditional topics, such as fact knowledge and paper-and-pencil computation, Everyday Mathematics students perform as well as students in more traditional basal programs. However, Everyday Mathematics students use a greater variety of computation methods and are especially strong on mental computation.

- On topics that have been underrepresented in the elementary curriculum, such as geometry, measurement, algebra, problem solving, reasoning, and communication, Everyday Mathematics students score substantially higher than students in more traditional programs. Total mathematics achievement typically increases significantly following the adoption of the curriculum.

The high level of Everyday Mathematics student achievement is evidence for the validity of the research on which the program is based and for the robustness of the writing process that produced the finished materials. Everyday Mathematics shows that a research-based, Standards-aligned curriculum can lead to higher student achievement. The curriculum’s wide-scale implementation — approximately 2,000,000 students currently use the materials — demonstrates, moreover, that such a curriculum can succeed in the marketplace.

Conclusion

Like the NCTM Standards (1989, 1991, 1995, 2000), the Everyday Mathematics curriculum has been influenced by a rich body of research about children learning mathematics. Many sources have informed the development of lessons, activities, and teaching suggestions. Children in the early grades are capable of much more than had been previously thought. Manipulatives facilitate modeling mathematical concepts and communication about those concepts, thus promoting the development of children’s thinking. The problem-solving approach and everyday contexts in Everyday Mathematics are similar to lessons in Japanese classrooms and other constructivist classes, but are also based on Dewey’s conception of inquiry-based learning that connects to students’ everyday knowledge.

More than 50 years of scholarship provided an initial research base for curriculum development, but a writing process that deeply involves teachers and children in the development of the materials has been essential to translating that research into practice. Teachers using Everyday Mathematics have been generous in opening their classes for observations and tests, and in helping us identify strengths and weakness of the existing K-6 Everyday Mathematics program. Through meetings, surveys, classroom observations, and interviews, these teachers continue to provide much valuable advice for the authors as they continuously work to improve the curriculum.

References

For a complete list of references for this article, please visit [our website].
Everyday Mathematics is realistic

Students learn the basics. Students get all the basics — including automatic fact recall and fundamental computation skills. Just as importantly, students develop number sense that takes them beyond the basics. Not only do students know their basic facts and computation skills, they know when, how, and why to use them.

Everyday Mathematics goes beyond arithmetic

Students build on the basics. There’s no doubt about it: Everyday Mathematics is a rigorous curriculum. Developed by the University of Chicago School Mathematics Project (UCSMP), it was extensively researched and thoroughly field-tested and revised prior to publication.

At every grade level, it expands students’ mathematical knowledge base to encompass geometry; statistics and probability; measures and measurement; algebra and uses of variables; and logical reasoning. Everyday Mathematics knows that students need this kind of rich and challenging knowledge base so they can think logically and mathematically throughout their school years and beyond, as they move into the ever-changing and increasingly demanding world of work.

Everyday Mathematics teaches higher order thinking and critical problem-solving

Students know how to solve problems. Everyday Mathematics develops skills that support conceptual learning. The program challenges students to apply their mathematics knowledge to solve real-life problems. These problems are presented in a variety of contexts — and solved in a variety of ways. Students are taught to question and verify the reasonableness of their own and others’ strategies and conclusions.

Everyday Mathematics gets results

Students become mathematically proficient. Everyday Mathematics is not just a good idea. As test scores from a variety of sources indicate, Everyday Mathematics works.