More Math for More Students in More Meaningful Ways

This booklet contains firsthand accounts by teachers of how the Core-Plus Mathematics Project curriculum, Contemporary Mathematics in Context, was implemented in their schools.

The first report shows results from the national field test of the CMIC curriculum. The rest of the reports focus on the positive experiences that teachers and students enjoyed as a result of their involvement with this exciting new curriculum.

The student performance test data provide a strong indication that Contemporary Mathematics in Context can make a big difference in the classroom.

Contents

Report No. 1, Student Achievement Results for the Core-Plus Mathematics Project ....... 2
Report No. 2, Sitka High School, Sitka, Alaska ......................... 4
Report No. 3, Ellet High School, Akron, Ohio ........................ 6
Report No. 4, Sweetwater High School, National City, California ............... 8
Report No. 5, North Lamar High School, Paris, Texas ...................... 10
Report No. 6, San Pasqual High School, Escondido, California ................ 12
Report No. 7 Sturgis High School, Sturgis, Michigan ......................16
Report No. 8 Brookwood High School, Snellville, Georgia ..............19
Student Achievement Results from the Three-Year National Field Test of the CMIC Curriculum

Background

Following two years of careful development, each Contemporary Mathematics in Context course is field tested for a full school year. This national field test is conducted in 36 high schools in Alaska, California, Colorado, Georgia, Idaho, Iowa, Kentucky, Michigan, Ohio, South Carolina, and Texas. A broad cross-section of students from urban, suburban, and rural communities with ethnic and cultural diversity is represented. Course 1 was field tested in 1994-95, Course 2 was field tested in 1995-96, and Course 3 was field tested in 1996-97. The field test of Course 4 is being conducted in 1998-99. Main student achievement findings are summarized below.

Iowa Tests of Educational Development

CMIC students significantly outperformed non-CMIC students each year on the mathematics subtest of the nationally standardized Iowa Tests of Educational Development (ITED). This finding was consistent for students with a wide range of entering mathematical achievement including those in the top quartile, for boys and girls, for students of all ethnic backgrounds, and for students in rural, urban and suburban schools. Posttest median standard scores for Courses 1, 2, and 3, respectively, are shown below. The pretest medians at the beginning of Course 1 were nearly identical for the CMIC and traditional groups in both the Course 1 and the Course 2 cohorts. Course 1, 2, and 3 "Norm" scores in the graph are based on average growth in the distribution of student scores in ITED's norm group at the end of Grade 9, 10 and 11, respectively. As a point of reference for the standard score scale, 265 is at the 54th percentile nationally at the end of grade 9 and 290 is at the 65th percentile at the end of grade 11.

ITED Posttest Medians
National Assessment of Educational Progress Results

On a test consisting of released twelfth-grade items from the 1990 and 1992 administration of the National Assessment of Educational Progress (NAEP), end-of-Course 3 CMIC students’ mean performance was considerably higher than that of a nationally representative sample of twelfth-grade students in all of the following areas: statistics and probability, measurement, algebra and functions, geometry, numbers and operations, conceptual understanding, problem solving, and procedural skill.

SAT Results

CMIC students do as well or better than comparable non-CMIC students on the SAT and ACT college entrance exams. For example, the SAT Mathematics Means for CMIC Course 3 students and for Advanced Algebra students in ten field test schools are shown below.
CMIC Program Scores Big With Teachers and Students at Sitka High School

Sitka is the fifth largest town in Alaska, with a population of 8500 people. It is located on Baranof Island, which is about 100 miles southwest of Juneau, the state capital. The economy is based on fishing, tourism, health care, and education.

About the Author
Cheryl Bach is a Sitka High School mathematics teacher who has been teaching for 15 years. She taught middle school for four years and high school for eleven years.

Background
Sitka High School is fed by one middle school and two elementary schools. We have about 500 students and about 30 staff members. Four of our instructors teach mathematics. Many of our students have lived in southeast Alaska all their lives, but others are of transient families who move with seasonal employment in the area. About 30 percent of our students have an Alaska Native heritage and come primarily from the local Tlingit tribe.

Implementation
The NSF-funded Core-Plus Mathematics Project curriculum was first used at Sitka High School in 1994. This integrated mathematics curriculum is published as Contemporary Mathematics in Context (CMIC). When we began using CMIC, we had a traditional two-track system. We offered Basic Mathematics and Consumer Mathematics for the non-college bound student. The college preparatory track consisted of Algebra, Geometry, Advanced Algebra, and Pre-Calculus. As we implemented a new CMIC course each year, we dropped the traditionally tracked classes in favor of the CMIC curriculum.

Community Involvement
Before we implemented CMIC, we spent a year helping our community understand why we were making the change. Members of the mathematics staff spoke at school board meetings, the Rotary Club, the Chamber of Commerce ... anywhere we were invited to talk about our curriculum.

We held meetings for parents and showed them sample lessons, including lessons involving the graphing calculator from the CMIC Course 1 curriculum. The proposed use of technology in the classroom brought out the most skeptical parents. Our meetings helped parents see the power of using graphing calculators for learning because of the multiple ways these calculators can represent problems using tables, graphs, and symbolic forms.

Our administrators and school board members are supportive due to the positive results we experienced from the CMIC curriculum.

Tracking
Now we offer our students the CMIC Courses 1, 2, 3, and 4 and either Advanced Placement Calculus or AP Statistics for our talented seniors. Most 9th graders, including our special education students, coming into Sitka High School take CMIC Course 1. We find that this curriculum is conducive to students working in heterogeneous cooperative learning groups. Our seniors who had been in CMIC classes for four years cite diversity as being one of the most important factors for an effective learning team.

Freshmen who start in CMIC Course 1 may continue through all four years of the curriculum, ending with CMIC Course 4 as seniors. However, we also have other options in place for them. Our top students may go directly from 8th grade mathematics into CMIC Course 2, according to middle school teacher recommendations and testing. Freshmen who start with CMIC Course 2 may opt to take either Advanced Placement Calculus or AP Statistics during their senior year.

Another option we are launching is a CMIC block class for Courses 3 and 4. This class is designed especially for students who discover late that they would like to pursue more study of mathematics. In the block class (see next section), juniors may take mathematics for two consecutive periods, which means that they have mathematics every day. We cover the entire CMIC Course 3 in the fall, and Course 4 in the spring. This opens up more options for Advanced Placement courses in their senior year.

Scheduling
Our school uses a “modified block” schedule. On Mondays, we have 50-minute periods, and students go to
all seven of their classes. On Tuesdays and Thursdays, we have the “odd” classes — periods 1, 3, 5, and 7 — for 85-minute periods. On Wednesdays and Fridays, we have the “even” classes — periods 2, 4, and 6 — also for 85 minutes each. After 6th period on Wednesday, we have a laboratory period where students may go to any teacher for help. On Friday afternoons the students are released early to allow time for teacher staff meetings and planning sessions with our colleagues. Our mathematics department finds that CMIC adapts well to this schedule.

Test Results

Sitka High School was one of the original schools to field-test the CMIC materials, so we have been involved in testing each year to determine the effectiveness of the curriculum. One annual test is the Ability to Do Quantitative Thinking subtest of the Iowa Tests of Educational Development (ITED). This is a nationally-normed exam that tests problem-solving skills.

In the Fall of 1994, our 9th grade students’ pre-test average was at the 44th percentile. After one year of the CMIC curriculum, they averaged at the 72nd percentile on the posttest. The next year they were up to the 82nd percentile, and at the end of their junior year, they tested at the 95th percentile. This growth in thinking skills is remarkable. (See Table 1.)

Table 1
ITED Ability to Do Quantitative Thinking, Sitka High School.

<table>
<thead>
<tr>
<th>Course</th>
<th>Pretest</th>
<th>Posttest 1</th>
<th>Posttest 2</th>
<th>Posttest 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIC</td>
<td>44</td>
<td>72</td>
<td>82</td>
<td>95</td>
</tr>
</tbody>
</table>

Other Results

Other test results, such as the SAT and ACT, have been most encouraging, with our CMIC students achieving above the national averages for mathematics.

Our students enrolled in CIMC Course 4 have been accepted at a number of colleges for the 1998-99 school year, including the University of California–Berkeley, UCLA, University of Colorado, Washington University, Michigan State University, Ithaca College, and others.

Enrollment Results

Currently, the Sitka School District requires only two years of high school mathematics for graduation. After implementing CMIC, we wondered how the new curriculum would impact enrollment in our math classes. Data from the last five years (before and after CMIC) shows that the numbers have held steady at about 75% of juniors and 50% of seniors taking mathematics courses.

However, since the introduction of the CMIC curriculum, the level of mathematics that our students are taking has greatly increased. Previously, in the traditional track, many of our juniors and seniors would enroll in Consumer Mathematics or Algebra I as their upper-level math courses. Now our older students are in CMIC Courses 3 and 4, where they are learning advanced algebra, trigonometry, geometric proof, advanced statistics, and the basics of differential and integral calculus. We see more of our CMIC students learning more difficult mathematics and, most importantly, retaining it.

Teacher Attitudes

At Sitka High School, we are fortunate to have four mathematics teachers who believe in the CMIC philosophy that all students can learn mathematics. Our teachers have attended CMIC summer workshops. We have arranged our schedules so that we can have common times to share ideas and help each other prepare.

Before we became involved in the CMIC curriculum, each teacher taught the same subject year after year, and there was little sharing or collegial support. With the CMIC curriculum, we are excited about the changes in content and teaching methods. It's wonderful to go to work each day knowing that you have like-minded colleagues fully supporting what you believe in.
Soaring Math Test Scores Point To Success Of CMIC Program at Ellet High School

Ellet High School is located in Akron, Ohio. The Akron City Public Schools have a total student enrollment of around 39,000 students. Ellet is one of eight high schools in the district with about 1200 students.

About the Author
James Fillmore is an Ellet High School teacher who's been teaching for 30 years. He's been the Mathematics Department Chairman since 1991.

Ellet High School became a field-test site for the Core-Plus Mathematics Project and first started using this curriculum in 1994. This NSF-funded program is now published as Contemporary Mathematics in Context (CMIC).

PTA and Parent Involvement
To inform parents about the program, we planned and held an open house meeting during the first year. Approximately 100 parents attended this meeting where we explained our efforts to find a better way to teach mathematics to their children. A second presentation was made for members of the PTA with 30 parents in attendance.

We held an after-school workshop for the eighth-grade students, who would be using the CMIC program the following year, and their parents. In addition, we held individual meetings for concerned parents at their request. We also made a presentation to the school board.

As the parents came to understand the program, they became more receptive to our implementation of it.

"As the parents came to understand the program, they became more receptive to our implementation of it."

Tracking and Placement
The majority of the first-year students at Ellet High School are placed in ten sections of CMIC classes. We also have two sections of Honors mathematics for students who are recommended, one section of traditional mathematics for students whose parents specifically request a traditional class, and three sections of low-level reformed math for students who need it.

Students are placed randomly into CMIC classes. We make an effort to keep the classes as heterogeneously balanced as possible. A student who fails a first-year CMIC class repeats the class the second year but without any new 9th graders. This limits tracking to the CMIC Course 1 class only and keeps unmotivated upper-class students from negatively influencing the new 9th grade class.

<table>
<thead>
<tr>
<th></th>
<th>CMIC</th>
<th>Traditional</th>
<th>Honors</th>
<th>Low</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th grade</td>
<td>254</td>
<td>31</td>
<td>35</td>
<td>74</td>
<td>394</td>
</tr>
<tr>
<td>10th grade</td>
<td>145</td>
<td>68</td>
<td>35</td>
<td></td>
<td>248</td>
</tr>
<tr>
<td>11th grade</td>
<td>95</td>
<td>26</td>
<td>63</td>
<td></td>
<td>184</td>
</tr>
<tr>
<td>12th grade</td>
<td>40</td>
<td>49</td>
<td>52</td>
<td></td>
<td>141</td>
</tr>
<tr>
<td>Total</td>
<td>534</td>
<td>99</td>
<td>145</td>
<td>189</td>
<td>967</td>
</tr>
</tbody>
</table>

For second-year students, we offer one section of Honors math, three sections of traditional math, and 8 sections of CMIC math. Third-year students are offered five sections of low-level traditional math, one Honors math section, and four CMIC math sections. For fourth-year students, we offer two sections of low-level traditional math, two Advanced Placement math sections, and two sections of CMIC mathematics (See Table 1). Our state requires three years of high school mathematics.

Scheduling
Ellet High School is currently on a standard nine-period-per-day schedule. Each class lasts 41 minutes. Teachers instruct six classes per day with one planning period, one duty period, and a lunch period.
Test Results

As part of the start-up of the CMIC program at Ellet High, our CMIC students took the Ability to Do Quantitative Thinking test, a subtest of the Iowa Tests of Educational Development (ITED). They took it again at the end of their first, second and third years in the CMIC program as a posttest to measure their progress. Students enrolled in the CMIC curriculum showed noticeable improvement during the first three years of implementation, going from the 10th percentile nationally to the 78th percentile.

Other Results

In our traditional math classes, students commonly turned in blank test papers. In our CMIC classes this never occurs because these students have more confidence in their mathematical ability.

On the 12th grade proficiency test, one student told our curriculum specialist that the test was difficult, but that the CMIC classes had given her confidence to try the problems even when she wasn’t sure what to do.

Because of the technology use in CMIC, students can feel more comfortable in attempting problems. They know a problem can have many different solutions.

Our students enjoy the investigative approach with small groups because they can see several ways of solving a problem. They learn to respect each other and different learning styles as they learn other students’ views and techniques. No one tells them a single “right way” to solve a problem as may be done in some traditional math classes.

Table 2
ITED Ability to Do Quantitative Thinking, Ellet High School.

<table>
<thead>
<tr>
<th>Test Time</th>
<th>Number of Students</th>
<th>School Mean</th>
<th>National Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIC 1 Pretest</td>
<td>211</td>
<td>11.5</td>
<td>10</td>
</tr>
<tr>
<td>CMIC 1 Posttest</td>
<td>194</td>
<td>13.7</td>
<td>15</td>
</tr>
<tr>
<td>CMIC 2 Posttest</td>
<td>148</td>
<td>18.2</td>
<td>74</td>
</tr>
<tr>
<td>CMIC 3 Posttest</td>
<td>100</td>
<td>17.3</td>
<td>78</td>
</tr>
</tbody>
</table>

Student Attitudes

Many students have responded that they now understand that math is practical and that it makes sense to them. Teachers never hear “When will I ever use this stuff?” or “Why do we have to learn this?” Math problems centered around real life situations make mathematics more meaningful to our students.

Here are some other comments our students have made about the CMIC program:

“Allows me to look at a problem I have never seen before and break it down into math that I can understand.”

“The Euler circuits helped me because I have a paper route and I needed to figure out the quickest way.”

“I have been able to help my father with problems he has had in his conveyor belt business when it comes to tracking and lengths on machines.”

“The Core class has helped my math education because the class doesn’t just give you an equation. They explain why you need the equation and how they got it and when to use it. It explains everything better than a regular math class.”

Students in our first class to graduate with CMIC experience in June, 1998, were accepted at the following Ohio colleges: Kent State University, Wilmington College, University of Akron, Malone College, University of Toledo, The Ohio State University, University of Cincinnati, Walsh University, Marietta College, and Bowling Green State University.

“Students enrolled in the CMIC curriculum showed noticeable improvement during the first three years of implementation, going from the 10th percentile nationally to the 78th percentile.”
CMIC Curriculum Helps Make The Difference at Sweetwater High School

Sweetwater High School, the second oldest high school in San Diego county, is located in National City, a community of 58,000 that ranks as the second most disadvantaged in California and among the poorest in the United States. The school is one of ten high schools in a district that includes communities that lie between San Diego and the U.S.-Mexico border.

About the Author
Bill Bokesch is a Sweetwater High School teacher who has been teaching for 8 years. He is the current president of the Greater San Diego Mathematics Council.

With 30.6% of its students coming from homes receiving Aid for Dependent Children and 66.5% classified as low income, Sweetwater is the only high school in San Diego County where students receive a free nutrition break and lunch as part of a special Federal Nutrition Program. Its transient rate is approximately 40%. In spite of these statistics and a high gang-related crime rate, Sweetwater High School was named a California Distinguished School during the 1996-97 school year, and received the highest accreditation from the Western Association of Schools and Colleges.

The Sweetwater Vision

Our mission is to provide our high school students a rigorous and meaningful education that gives them a firm foundation to meet the challenges of the next century. The “Vision Statement” of Sweetwater High School reads: “The Sweetwater High School graduate of the twenty-first century is a life-long learner competent in both traditional and technological literacy; flexible and thinking-enriched in meeting the complex demands of the worlds of work, home and community; and comfortable in demonstrating understanding, tolerance and empathy for a culturally diverse society.”

Implementation

During the 1993-94 school year, 80 students were randomly selected for the Contemporary Mathematics in Context Course 1 program. The class makeup included 9th, 10th, 11th, and 12th-graders. Since Sweetwater High School has a three-year math requirement, this class makeup was not unusual. Some of the 10th graders had already taken a traditional pre-algebra course with a “hands-on learning approach.

The 1994-1995 school year commenced with five classes taking CMIC courses: two Course 2 and three Course 1 classes. The CMIC Course 1 program was used as the mathematics strand in an interdisciplinary team with English and Social Studies. One hundred 9th graders were randomly selected for this team.

In the 1995-1996 school year, there were six classes offering CMIC courses: one Course 3 class, two Course 2 classes, and three Course 1 classes. Many of the students (20 out of 31) enrolled in Course 3 graduated in June, 1996, leaving only 11 students to go on to Course 4. Surprisingly, 14 students who would otherwise take Pre-Calculus volunteered to help fill the class for Course 4.

The 1996-1997 school year started with eight CMIC classes: one Course 4 class, two Course 3 classes, two Course 2 classes, and three Course 1 classes. As a result of the Course 3 posttest, our District provided funds to purchase 3 class sets of Contemporary Mathematics in Context Course 1 textbooks.

Scheduling

Sweetwater High School is currently on a block schedule. Each day is comprised of three 1-hour-and-45-minute periods and one 35-minute study period. Periods 1, 3, and 5 meet on “red” days, and periods 2, 4, and 6 meet on “gray” days. The result is that each period is visited by each student five times during any 10-day period. This schedule allows ample time for students to investigate ideas and develop a deeper understanding of the important concepts studied in the CMIC curriculum.
Our school has been a year-round school since 1991. The school takes three 3-week breaks in September, December, and March. During the September and March breaks, called Intersessions, students may take additional classes in much the same way as students who attend summer school on a traditional schedule.

“This schedule allows ample time for students to investigate ideas and develop a deeper understanding of the important concepts studied in the CMIC curriculum.”

Tracking and Placement

Students are randomly selected for enrollment in Contemporary Mathematics in Context courses at our school. Precluded from selection are Honors students who take Course 1 Honors and Course 2 Honors courses at our two feeder schools or at Sweetwater High School.

Results

Prior to the start up of the CMIC Program at Sweetwater High, students took an Iowa Tests of Educational Development test as a pretest.

<table>
<thead>
<tr>
<th>Course 1 Pretest</th>
<th>Course 1 Posttest</th>
<th>Course 2 Posttest</th>
<th>Course 3 Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>18</td>
<td>37</td>
<td>51</td>
</tr>
</tbody>
</table>

Table 1
ITED Test Results

Our students placed in the 10th percentile on the Course 1 pretest and at the 18th percentile on the Course 1 posttest. For Course 2, students placed in the 37th percentile on the posttest and the 51st percentile on the Course 3 posttest. These test-score improvements demonstrate marked learning by the participants.

Another positive result from the CMIC Program is the retention rate in the CMIC mathematics classes. For example, 90% of the 9th graders enrolled in the first CMIC Course 1 class during the 1993-94 school year completed Courses 1, 2 & 3 and chose to take Course 4.

“For example, 90% of the 9th graders enrolled in the first CMIC Course 1 class during the 1993-94 school year completed Courses 1, 2 & 3 and chose to take Course 4.”

Teacher and Student Attitudes

The Sweetwater High School teachers who are involved in teaching Everyday Learning’s Contemporary Mathematics in Context curriculum prefer teaching mathematics in this manner because they notice a positive change in student motivation and achievement.

One example we like to cite is the student who was performing below average in the first three units of Course 1. When he came to Unit 4, he was so turned on by the “Euler Circuits and Critical Paths” of this unit that he not only performed at the highest levels for this unit but his heightened interest lasted through the ensuing units as well. His remarkable turn-around was due in large part to his changed attitude toward the mathematics.

We believe strongly that the CMIC program is helping Sweetwater High School meet the lofty goals of our school’s Vision Statement.
Math Success at North Lamar High School

North Lamar High School is located in Paris, Texas, a largely rural area about 100 miles northeast of Dallas. It is part of the North Lamar Independent School District that serves more than 3000 students. North Lamar High has an enrollment of approximately 850 students.

About the Author
Barbara Eatherly is a North Lamar High School teacher who’s been teaching for over 22 years. She is a member of her District Site-Based Committee for High School and a NCTM member.

The North Lamar Vision
The North Lamar Independent School District motto is: “TEAM: Together Everyone Achieves More.” This TEAM works hard to provide quality educational opportunities for student achievement.

Implementation
North Lamar High School became a field-test site school for the Core-Plus Mathematics Project and first started using this curriculum during the 1994-95 school year. This NSF-funded program is now published as Contemporary Mathematics in Context (CMIC).

We began the 1994-95 school year with two teachers and approximately 70 students enrolled in CMIC Course 1. The students were recommended for the program by their eighth grade teachers and were considered “mathematically at risk.” Normally, they would have been placed in a course that covered traditional Algebra 1 in a two-year period followed by an informal geometry course.

The next school year, in 1995-96, we enrolled all “on level” 9th graders in the CMIC program. We continued the two-year Algebra 1 for some of our poor-performing students and our Geometry Honors course for our most-gifted students. This was the last year that any students could enroll in our two-year Algebra 1 course.

In the 1996-97 school year, all freshman students were enrolled in CMIC Course 1 classes with the exception of our honors students.

The 1997-98 school year began as the year before except that we began offering honors credit for students enrolled in CMIC Course 1 classes. Students were in ability-mixed classes, and could earn honors credit by doing modified assignments, projects, take-home tests, and so on.

Enrollment Results
We are pleased with what our students were able to accomplish with the CMIC program. For example, of the original 70 students who were part of the first pilot in the 1994-95 school year as freshmen, 20 took CMIC Course 4, seven took AP Statistics, and one took both courses. That any of these students would have taken four years of mathematics would have been highly unlikely under our traditional tracking.

Staffing
Our Mathematics Department employs three full-time mathematics teachers, one mathematics/technology coordinator, one math/science teacher, and three math/coach teachers.

Our Department meets on Tuesday mornings and other designated days to exchange information and discuss successful and not-so-successful ideas. We are a department open to change and willing to try programs that we feel will benefit our students.

Tracking
Our state requires high school students to receive three years of credit in mathematics. Currently we have three tracks for students: Traditional, Integrated Regular, and Integrated Advanced.

Our Integrated classes use the CMIC textbooks. Students who have taken Algebra 1 in eighth grade have their choice of the Traditional or Integrated tracks. All others choose Integrated Regular or Advanced. Students in the Advanced course receive honors credit by doing extra assignments and projects.

“We are pleased with what our students were able to accomplish with the CMIC program.”

Enrollment Results
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Test Results

Our students take two state-mandated mathematics tests. The first test is the Texas Assessment of Academic Skills (TAAS) test given to all 10th graders. Students must score 70% or better in reading, writing and mathematics before they can graduate from an accredited high school. As the chart below shows, with the implementation of CMIC our students maintained an overall passing rate in the math portion of the TAAS test in 1996, 1997, and a much higher than average passing rate in 1998. They achieved even higher scores in reading and writing, due in part, we believe, to the amount of reading and writing our students are required to do in the CMIC program. (See Table 1.)

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Mathematics</th>
<th>Reading</th>
<th>Writing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>74.2%</td>
<td>83.8%</td>
<td>94%</td>
</tr>
<tr>
<td>1997</td>
<td>73%</td>
<td>93.6%</td>
<td>99.4%</td>
</tr>
<tr>
<td>1998</td>
<td>86.5%</td>
<td>96.5%</td>
<td>98.2%</td>
</tr>
</tbody>
</table>

The other required test is the End-of-Course Algebra Exam (EOC) that all students enrolled in Algebra 1 must take. It allows use of graphing calculators. Because our CMIC students receive state credit for Algebra 1, Geometry and Algebra 2, they also must take the EOC test. At North Lamar High, the EOC Algebra Exam is administered at the end of CMIC Course 2.

In 1997, the passing rate for our district was 55%, which was much higher than the state average of 35%.

“...These results mean that our students are learning as much algebra as other students in the state plus they are also learning statistics, geometry and discrete mathematics.”

These results mean that our students are learning as much algebra as other students in the state plus they are also learning statistics, geometry and discrete mathematics. We feel our students were able to solve problems that they had not seen before in class because of the problem-solving skills and calculator use they experienced in the CMIC program.

Student, Teacher and Parent Attitudes

Our mathematics teachers firmly believe that the CMIC program is beneficial to our students. We have seen an increase in the number of seniors taking elective mathematics courses, students better able to communicate mathematically, and a higher level of interest in classroom topics.

Yes, we still have to concentrate on keeping all of our students on task in their learning groups, motivating students to complete homework, and managing our time between preparation for classes and grading papers. However, the praise we receive from outside our mathematics classrooms is a great motivator for us in teaching the CMIC program.

Remarks like the following offer us tremendous encouragement:

“The 10th graders from CMIC classes are attempting problems that other 10th graders would never have attempted before.”
— a UIL Calculator coach

“I now believe that my students have little trouble with the physics unit because of CMIC.”
— a physical science teacher

“I no longer have to teach how to read and interpret graphs because it is covered so well in math.”
— a biology teacher

“I wish that my older daughter had taken CMIC because my younger one did and her math has meaning to her whereas the older one is simply doing steps.”
— a parent

“I like CMIC better than regular algebra because I never could do those word problems.”
— a student

When the student above was asked what he thought we were doing in our CMIC class, he said, “Wow, all this is one big word problem — and I can do it!”

WE CALL THAT SUCCESS!
CMIC Program Helps Improve Math Scores at San Pasqual High School

San Pasqual High School is one of three comprehensive high schools located in Escondido, California, just north of San Diego. The student enrollment of San Pasqual High is approximately 2200.

About the Author
Damon Blackman is a San Pasqual High School teacher who is in his sixth year of teaching. He’s been involved in the implementation of the Contemporary Mathematics in Context program from its introduction in 1994.

Background
Beginning in 1992, the Math Department at San Pasqual High School started to investigate the problem of low-achieving students in our mathematics program. It was not uncommon to have students in our Algebra 2/Trigonometry course, for example, comment after taking their final exams, that they’ve “never seen problems like these before.” Our final exam average for that course was about 50%, with most of the exam questions pulled from homework assignments. Our Algebra 1 students were doing no better. Almost 43% of our Algebra 1 students were earning below-average grades. The courses in use provided them with lots of computation but little understanding. So we began our search for alternatives.

Two years later, in 1994, our department decided to pilot two new programs. One program followed a more traditional approach to integrated mathematics with texts that contained colorful graphics and a large number of traditional word problems.

“...the CMIC text with its balanced computation practice and real-world contexts appeared well suited to our vision.”

The other curriculum was the NSF-funded Core-Plus Mathematics Project (CPMP) which subsequently became Contemporary Mathematics in Context (CMIC). This new curriculum seemed closer to the paradigm of mathematics instruction and learning that we were seeking. Because we felt our students needed plenty of computation practice within a context to increase their understanding and retention, the CMIC text with its balanced computation practice and real-world contexts appeared well suited to our vision.

Implementation
The CMIC Program was first introduced in San Pasqual High School during the 1994-95 school year. Twelve sections of freshman mathematics were offered. Four sections used the new CMIC texts. These classes were comprised of 139 heterogeneously grouped freshmen, excepting honors or accelerated-level students who normally placed in Geometry as freshmen. After completing Courses 1, 2 and 3, CMIC students could opt to take AP Calculus or AP Statistics in their senior year. The other eight sections, representing 272 students, used the newly piloted “traditional” text and followed the sequence of Algebra 1, Geometry, Algebra 2/Trigonometry, and Pre-Calculus.

All students enrolled in CMIC and traditional classes were recommended by their eighth grade teachers to take Algebra 1.

Tracking
The typical paths our students can take in mathematics are: Traditional, Accelerated Traditional, Integrated, Accelerated Integrated, and Remedial.

Students on the Traditional track take Algebra 1, Geometry, Algebra 2 with Trigonometry, and Pre-Calculus. Students on the Accelerated Traditional track take Geometry, Algebra 2 with Trigonometry, Pre-Calculus, and Advanced Placement Calculus.

Students on the Integrated track take the CMIC Courses 1, 2, and 3 for the first three years and can choose CMIC Course 4, Pre-Calculus, Advanced Placement Statistics, or Advanced Placement Calculus in their fourth year.

Students on the Accelerated Integrated track take CMIC Courses 2 and 3 in their first two years and can take CMIC Course 4, Pre-Calculus, AP Statistics, or AP Calculus during their last two years.

Students on the Remedial track take “Introduction to High School Math” the first year and then enter into the Traditional or Integrated track.

In addition to the above, Accounting and Business Math are also offered to students in their junior or senior year.
Scheduling
Our school uses a fairly typical course schedule: Tuesdays through Fridays, with six 58-minute periods. Teachers teach five periods and have one preparation period. Mondays are our staff development days. Students start school 45 minutes later, so we have six 50-minute periods on Mondays.

Enrollment Results
One strong indicator of our success with the CMIC curriculum is the increased number of students enrolled in mathematics courses (Table 1). Students taking the CMIC curriculum stay in mathematics longer and have more fourth-year mathematics options.

Of the original 139 students who enrolled in the CMIC program in our 1994-95 pilot year, 113 enrolled in Course 2 for their sophomore year. That's a retention rate of 81.3%. Over the next two years the trend continued. Ninety-two juniors enrolled in CMIC Course 3 (66.2%) and 47 enrolled in a fourth year of math (33.8%). Of the 47 CMIC students who took a fourth year of math, 29 enrolled in CMIC Course 4, two in Pre-Calculus, 11 in AP Statistics, and 5 in AP Calculus. A total of 16 students followed the sequence of CMIC Courses 1, 2, and 3, and then either AP Statistics and AP Calculus in their senior year.

"Students taking the CMIC curriculum stay in mathematics longer and have more fourth-year mathematics options."

On the other hand, of the original 272 freshmen enrolled in the traditional Algebra 1 program, only 130 sophomores enrolled in Geometry — a retention rate of 47.8%. The next year only 94 juniors out of the original 272 — a 34.6% rate — went on to take Algebra 2/Trigonometry. Overall, only 28 out of the starting group took four years of college preparatory mathematics. This is a scant 10.3% enrolled in Pre-Calculus. None of these students made it to AP Calculus or AP Statistics.

Table 1
Continuing in Math: San Pasqual High School Class of 1998 Enrollment by Percent*.

<table>
<thead>
<tr>
<th>Enrollment Level</th>
<th>CMIC</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sophomores in CMIC 2 vs. Geometry</td>
<td>81.3%</td>
<td>47.8%</td>
</tr>
<tr>
<td>Juniors in CMIC 3 vs. Algebra 2</td>
<td>66.2%</td>
<td>34.6%</td>
</tr>
<tr>
<td>Seniors in Pre-Calc, AP Calc, AP Stats, or CMIC 4</td>
<td>33.8%</td>
<td>10.3%</td>
</tr>
</tbody>
</table>

*CMIC and Algebra 1 enrollment each considered as 100% Freshman year.

The results for the CMIC students are very encouraging. They mean that one out of three students in the CMIC curriculum are likely to take four years of math versus only one out of ten who start in Algebra 1 in the traditional track.

In our second pilot year, more than 300 students enrolled in CMIC Course 1 as freshmen. Even with this much larger population, our statistics continue to show a marked increase in enrollment over the next two years — 75.1% for sophomores and 53.8% for juniors.

"The results for the CMIC students are very encouraging. They mean that one out of three students in the CMIC curriculum are likely to take four years of math versus only one out of ten who start in Algebra 1 in the traditional track."
San Pasqual High School Report (continued)

**Standardized Test Results**

Results from three national standardized tests are very encouraging. Of special note are PSAT and SAT scores. Since the number of our students taking these tests is increasing, we anticipated a substantial decrease in standardized test scores. This did not happen.

In our first two years, the combined PSAT results for the classes of 1998-1999 showed competitive scores (Table 2). Juniors in CMIC Course 3 scored an average of 50.21, while juniors in Algebra 2/Trigonometry scored an average of 50.96 on the mathematics portion.

**Table 2**

Combined* two-year PSAT results for San Pasqual High School classes of 1998-1999 by math class.

<table>
<thead>
<tr>
<th>Math Class</th>
<th>Combined Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juniors in CMIC 3</td>
<td>50.21</td>
</tr>
<tr>
<td>Juniors in Algebra 2</td>
<td>50.96</td>
</tr>
</tbody>
</table>

SAT Results

The SAT results show the positive effects of the integrated curriculum even more clearly. Students at our school view the PSAT as an “optional” test and the SAT as a “required” test, since many colleges and universities look at SAT scores for admission. The average SAT 1 math score for our CMIC Course 3 students was 539 versus 542 for juniors in Algebra 2/Trigonometry (Table 3). However, while the number of students taking the SAT was about the same in each group, 40% of the students in CMIC Course 3 took the SAT as compared to only 21.7% of the Algebra 2/Trigonometry students. The CMIC program effectively doubled the rate at which students took the test!

**Table 3**

San Pasqual High School class of 1998 SAT 1 math scores by math course.

<table>
<thead>
<tr>
<th>Math Course</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIC 3</td>
<td>539</td>
</tr>
<tr>
<td>Algebra 2</td>
<td>542</td>
</tr>
</tbody>
</table>

*Note: results were combined since only 6 juniors in Algebra 2 took the PSAT in 1997.
The Ability to Do Quantitative Thinking Test Results

Our CMIC students also took the Ability to Do Quantitative Thinking test, which is a subtest of the Iowa Tests of Educational Development (ITED), as a pretest in September of their freshman year and then again as a posttest at the end of each CMIC course. Our students’ percentile ranks improved each year for three consecutive years. (The fourth year posttest has not yet been administered.) In the chart below (Table 4), Group A reflects students who completed both CMIC Course 1 pretest and posttest, Group B reflects students who completed CMIC Course 1 pretest and Course 2 posttest, and Group C reflects students who completed CMIC Course 1 pretest and Course 3 posttest.

Table 4

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Students</th>
<th>Pretest Percentile</th>
<th>Posttest Percentile</th>
<th>Percentile Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>97</td>
<td>88</td>
<td>91</td>
<td>+3</td>
</tr>
<tr>
<td>B</td>
<td>91</td>
<td>89</td>
<td>97</td>
<td>+8</td>
</tr>
<tr>
<td>C</td>
<td>55</td>
<td>94</td>
<td>96</td>
<td>+2</td>
</tr>
</tbody>
</table>

Community Involvement

We realized from the start that the CMIC program was different from what parents, the school board, and the community were used to in a mathematics program. To address this concern, we provided for ongoing feedback. Each year we held an information meeting to both update parents and address their concerns. We emphasized the use of applications in the program and why mathematics itself is important. We made time for parents on an individual basis and even invited them into our classrooms. We also provided ongoing feedback to the community and our school board by regularly attending PTA and school board meetings. Our students also expressed to us their enhanced interest in mathematics. We found that community newspapers and local television stations were an excellent source for spreading the news. It also helped to have a supportive administration.

We believe that the success our department has had in implementing the CMIC curriculum over the past four years is rooted in this proactive approach. We found that concerned parents, for example, who challenged the value or rigor of the CMIC curriculum were won over when they understood the reasons this curriculum serves students so well.

Student and Teacher Attitudes

Students are saying good things like the following about CMIC: “I love this class. Every day I learn something new and I really have to think;” and, “I can’t do homework in front of the TV anymore.”

Teachers are enthusiastic about what they can now teach our students. One teacher stated, “Getting the answer used to be the end of a problem. Now it’s just the beginning.”

Our entire department uses our staff development time to share and promote ideas that can be used in the CMIC program. We enthusiastically offer support to each other at other times during and after school because we believe in the CMIC program.

Some Final Observations

Many students and parents prefer the scope and sequence of CMIC over other courses. They appreciate the value of its rigorous mathematics and how, for example, it emphasizes statistics in each of its four years. A high school senior has little motivation to take Pre-Calculus if Calculus is not a college requirement for graduation. The CMIC curriculum offers these students more statistics as well as topics in business and finance.

In conclusion, we believe there are three major reasons why San Pasqual High School has successfully implemented this new integrated curriculum. First, our entire department utilizes our staff development time to the fullest extent. Second, we meet regularly before, during, and after school. Third, and most important, our department believes that the CMIC program offers MORE powerful mathematics to MORE students in MORE relevant and meaningful ways.
Integrated Mathematics Curricula and CMIC Materials Add Up to Success at Sturgis High School

Sturgis High School is located in Sturgis, Michigan, in the southwestern part of the state. It is part of the Sturgis Public School District that serves more than 3000 students. Sturgis High School has an enrollment of approximately 900 students.

About the Author
Jay Newman (Ed.D.) served as the Principal of Sturgis High School and Assistant Superintendent for Curriculum and Instruction for the Sturgis Public Schools during the implementation of the Core-Plus Mathematics Curriculum. He is currently the Superintendent of the St. Joseph County Intermediate School District in Centreville, Michigan.

Background
How do we as a nation move from mediocre mathematics performance to number one in the world? Some schools have tried using the same old materials and methods and have just hit them harder. This is like speaking English louder and slower so that a monolingual, Spanish speaking child will understand the intricacies of the American judicial system. If we want to see fundamental changes in student performance we will need to see fundamental changes in the basic processes of mathematics education.

In 1992, Sturgis High School came to that conclusion. If we wanted our students to be better than mediocre, we knew we would need to have a much better system for delivering mathematics instruction. In pursuit of this goal, teachers, administrators, business community members, parents, and students began the search for curricular materials that would provide an appropriate content, sequence and intensity to adequately challenge and prepare students for the world beyond high school. In reviewing existing programs, we found nothing that met our needs until we accepted the invitation to participate in a pilot project: The Core Plus Mathematics Project, through Western Michigan University.

Implementation
Upon reviewing the philosophy and the intent of the Core-Plus project, we quickly determined that what we thought was the best course of study and what the Core-Plus writers were proposing were closely aligned. It was not an easy transition. Initially, students and parents balked at a mathematics approach that was not the traditional algebra, geometry, trigonometry sequence. Numerous parent meetings were held and demonstrations were conducted so parents could see how students would still receive the fundamental mathematics concepts and skills yet receive them in a way that showed them how math had everyday applications. It was demonstrated that the integrated approach created a basis for connecting concepts in a way that is consistent with what happens in the world of work and in advanced studies of biology, chemistry, psychology, and business. It was our belief that relevance and rigor could peacefully coexist in a quality mathematics program.

Initially the Integrated Mathematics program co-existed with the traditional sequence of Algebra, Geometry, Advanced Algebra/Trigonometry, Pre-Calculus, and Calculus. The more remedial courses of General Math and Pre-Algebra were dropped from the curriculum. After a first year of dramatic success, enrollments in traditional math classes began to drop. After two years, there was inadequate enrollment in Algebra to continue offering the course. After the third year, Geometry also was dropped due to inadequate enrollment. Finally, after the fourth year of the program, there was inadequate enrollment to continue the Advanced Algebra/Trigonometry course. Because the Course IV material was so closely aligned to what was being taught in Pre-Calculus, those two classes were merged into one, making the transition complete. After five years, the only vestige of the prior curriculum is a course in Consumer Math, which students can take after completing Course I and II of the Integrated Math Curriculum.

Results
We are now six years into our conversion from traditional to reform mathematics. Our students have moved from general math, pre-algebra, algebra, geometry, trigonometry, etc., to Integrated Math I, II, III, IV and Calculus. Enrollments in upper level math classes have steadily increased, achievement scores have
consistently improved, and every graduate leaves Sturgis High School with a mathematics experience that includes studying the important concepts of algebra, geometry, trigonometry, probability, statistics, and discrete mathematics. Prior to these changes, only 30% of the graduates had completed course work in Algebra, Geometry, and Trigonometry and less than 10% had any of the rest of those listed areas.

In Michigan, a major measure of success has been the Michigan Educational Assessment Program High School Test. Prior to having students participate in three years of Integrated Mathematics, 27.9% of Sturgis High School 11th graders scored in the highest category on the 1993 M EAP test in Math. The latest results (1996-97) on this test — a much more difficult test with higher standards for achievement (now called the High School Proficiency Test) — saw 65% of Sturgis High School 11th graders scoring in the highest category.

Table 1
Sturgis High School math scores on the High School Michigan Educational Assessment Test.

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>27.9%</td>
</tr>
<tr>
<td>1996-97</td>
<td>65%</td>
</tr>
</tbody>
</table>

Another critical comparison of before and after is how students do on college entrance examinations. During this same time, period Sturgis has seen a slight increase in the ACT Math sub-test score, from an average of 22.2 to 22.8, and a significant increase on the Mathematical Reasoning portion of the SAT test. On the SAT, the scores have increased from an average of 520 to 590. One final measurement of success has been the ongoing pre and post-testing done using algebraic reasoning sub-test from the Iowa Tests of Educational Development. Sturgis High School students have consistently shown significantly more growth than students in traditional mathematics curricula. In addition, Sturgis High School average scores in algebraic reasoning have been well above the 90th percentile.

Attitudes
As a school district, we have scrutinized our progress in mathematics over the last six years. Our community and parents have continuously asked us to provide proof that the program is working. From the data provided previously it can be easily shown that the Core-Plus Mathematics Project materials have made a dramatic improvement in mathematics achievement. Perhaps, however, anecdotal data provides the most telling story. Consider these observations from students who have taken Integrated Mathematics at Sturgis High School.

“I thought my high school math classes were very difficult and I wasn’t sure if what they were teaching me was what I should be learning. We had to think about everything we did and we had to always be able to explain how we got our answers. Now I’m in college and I had to take college level math. My professor expects us to be able to think and explain how we got the answers we came up with. Most of my classmates are really struggling but I’m used to this. I’m getting one of the highest grades in the class.” (A student at Michigan State University)

“I took 5 math courses at Sturgis High School, Integrated Math I through IV and then Calculus. Math wasn’t easy. There was always so much work to do. We had to really think about what we were doing. Not just do a bunch of problems but really think through everything. Now I’m in college and I’m a pre-med major. I have to take more Calculus in college and my college is using a Calculus program that’s like the math I had in high school. So far I’ve been getting an A in the class and as I look ahead to the rest of the material on the syllabus. I don’t anticipate any problems getting an A in this class. Some of the kids in my study group are from schools that had a different kind of math. I have to help them understand how to think the way the professor wants us to think.” (A student at Western Michigan University)

“I graduated from Sturgis High School before they started the new math program. When I went to college I decided to major in accounting. There was a lot of math required in my major. In my very first class my professor told us that this was not going to be the same old math that we took in high school. He told us we would have to think and be able
to explain how we got our answers. I have a younger brother at Sturgis High School and he took the Integrated Math classes they now teach. He's learning math the way I'm supposed to be doing it. He says it's a lot of work but he really understands what he's doing. I really wish I had the chance to take that math in high school. It would have helped in my college math much more than the math I had. (A graduate of Hope College)

“When I was in high school I didn't want to take math. All of the math I took before high school seemed unrelated to what I wanted to do. All I wanted to do was graduate, get a job, and get on with my life. I knew how to add, subtract, multiply, and divide. What else did I need to know? My high school math class was not easy. I actually wanted to drop math and take something else but the Principal told me I had to have math to graduate and there were no other options. In my math class we learned about taking measurements and using those measurements to make decisions. We were required to do some simple statistics to figure out if one way was better than another. Sometimes we had to find out if what was being done was making a difference in a certain situation or not. Now I have a job in a factory. I am required to keep track of the quality of the stuff I make. Every single day I use the math I learned in high school to help me do my job. (An employee at a Kalamazoo manufacturing plant.)

Conclusions

The statistics provide a compelling story of success. It is hard to argue with the dramatic improvements that have been seen in math test scores. However, the actual statements of students who have seen the impact of the program on their later year’s experiences put that data into perspective. The goal of any education program is to help students have the personal power of knowledge, skills, and abilities necessary to be successful in their future endeavors. Based on our experience, we have concluded that the Integrated Mathematics curriculum, supported by the Contemporary Mathematics in Context materials, has been one of the best curricular decisions made by the Sturgis Public Schools.

It is our conclusion that any school system can see similar gains. Using the Contemporary Mathematics in Context materials from Everyday Learning Corporation coupled with the appropriate training in how to best deliver the curriculum, any school can see their students excel in mathematics. It is, however, critical to note that doing so without adequate training in the methods necessary to successfully teach the curriculum could be disastrous, because it is not only the curriculum that makes the program a success. Adopting a curriculum without changing to a more learner-centered teaching approach may not result in any significant improvement. This mathematics program requires that we not do business as usual.
Impressive SAT Test Results for CMIC Students at Brookwood High School

Brookwood High School is located in Snellville, Georgia, a suburb of Atlanta. It has a student population of 2700. The majority of its graduates pursue a post secondary education.

Background

Brookwood High School became a field-test site school for the Core-Plus Mathematics Project in 1994, which is when we first started using this curriculum, now published as Contemporary Mathematics in Context (CMIC).

We had 10 sections of Freshman Algebra 1 scheduled for the fall of 1994. These classes were normally filled with students in our middle track, also known as the College Prep track.

As a national field test school, we randomly selected five of those sections to participate in the Core-Plus Mathematics Project and the other five sections to take our traditional program.

Results

We were impressed by the results because, when the January test was administered, our CMIC students had not yet completed some of the traditional algebra and geometry coursework covered on the SAT. Also, our CMIC students were not used to multiple choice tests. In addition, we noticed a significant difference in the number of CMIC students attempting and being successful with the student-produced response questions.

One final result made us even more aware of the CMIC program’s effectiveness. Every junior in the state of Georgia must pass the Georgia High School Mathematics Graduation Test in order to graduate. All of our CMIC students passed this test in the spring of 1997.

Table 1
SAT Math Score Comparison
SAT math scores for Brookwood High School 11th graders taking the SAT in January and March of 1997.

The top graph represents the scores of the students in the CMIC program. The five number summary is:

- N = 40
- MinX = 370
- Q1 = 450
- Med = 490
- Q3 = 540
- MaxX = 610

The lower graph represents the scores of the students in the regular academic algebra II. The five number summary is:

- N = 32
- MinX = 350
- Q1 = 425
- Med = 465
- Q3 = 500
- MaxX = 600
Brookwood High School Report (continued)

Postscript

Brookwood is one of 15 high schools in a school system of approximately 97,000 students in Gwinnett County, Georgia. When Brookwood became a part of the national pilot, our system was in the process of adopting textbooks for a seven year cycle. Since the Core-Plus materials were not in hard bound textbook form yet, we were not allowed to consider them for adoption. However, there continued to be interest from other schools; and once the materials were published as CMIC textbooks, other schools requested to use them. Four other schools were selected.

Because the schools in Gwinnett County are very diverse, we were interested in determining if CMIC would be as successful in other schools as it was in Brookwood. One of the schools chosen is in a rural area. One is in an area with a high ESL population. One has a school population similar to Brookwood where many of the parents have college degrees. The fourth school has a high proportion of students from low socioeconomic level families.

This is the second year these students have been using CMIC. In each of these schools we have classes using CMIC and classes using the previously adopted textbooks. We plan to do a comparison of our eleventh graders in 1999 similar to the study done by Brookwood. This information will be used as we begin our next adoption cycle in the spring of 2000.