

# **How Does the Use of Two Different Mathematics Curricula Affect Student Achievement?**

**A Comparison Study in Derby, Kansas**

**by**

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The Derby (Kansas) school district serves about 7,000 students and is located in a suburb southeast of Wichita. The district includes a lower poverty area of south Wichita. The high school has almost 2,200 students in grades 9-12. Approximately 19% are minority students (2% Native American, 5% Asian, 6% African American, 6% Hispanic). Thirty percent of the student population is in the lower socioeconomic group. Due to the low number of minority students in our study, they will not be reported separately. Our students mainly come from aircraft industry and Air Force families. Many of these families located here because our school district has a strong reputation for excellence. Derby School District is above the state average on the state mathematics assessment, but scores had not been improving at the rate needed to meet the requirements of No Child Left Behind.

## **Design of Study**

Five years ago, the district started researching ways to better meet the needs of students with different learning styles. As a result we planned and designed a careful pilot study. We chose the Core-Plus Mathematics program, an integrated high school mathematics program, as the curriculum for one group of students. The current Algebra 1 and Geometry textbook series, Heath McDougal Littell, *Algebra 1: An Integrated Approach* and *Geometry An Integrated Approach*, by Larson, Kanlod & Stiff (c. 1998) was retained for the control/traditional group. Meetings were held with our eighth-grade parents and students to inform them of the comparison study. In order to be considered as a potential student in the Core-Plus Mathematics courses, students and parents needed to commit to participation for at least two years, both ninth and tenth grades. Since there were more applications than could be accommodated, students were randomly selected from the volunteers to participate in the pilot classes. Most of the randomly chosen students were those who would normally have been recommended for Algebra 1 as freshmen. Each of the 60 Core-Plus Mathematics students was matched with a ninth-grade Algebra 1 student based on their seventh-grade state mathematics assessment scores. The two groups were not matched by gender, ethnicity, or socioeconomic status. Outcome measures used for the study were the Kansas 10th-Grade State Assessment, elective mathematics course enrollment, and a comparison of results on a beliefs survey completed as entering freshmen and again near the end of the sophomore year.

The design of this study involved comparing student achievement for students taught courses by teachers who were using familiar textbooks (some experienced and some with little experience) with students taught the new Core-Plus Mathematics program by experienced classroom teachers who had not previously taught this program. Professional development was provided for the Core-Plus Mathematics instructors because there was new mathematical content in the program and familiar content was often developed in new ways. In addition, there were new expectations for the work of teachers and of students in the program. The two mathematics faculty teaching the Core-Plus Mathematics courses participated in week-long professional development workshops each summer.

## Comparisons Using 10th-Grade 2002 Kansas State Math Assessment

At the end of 10th grade, 43 of the original 60 matched pairs remained at Derby for the duration of the study and completed the State Mathematics test and survey. The mean scores on the Spring 7th-grade 1999 Kansas State Mathematics Assessment for the 43 matched pairs were 52.7% for the traditional (algebra and geometry) group and 52.9% for the Core-Plus Mathematics group. The background of these students is summarized in the table below.

### Composition of 43 Matched Pairs

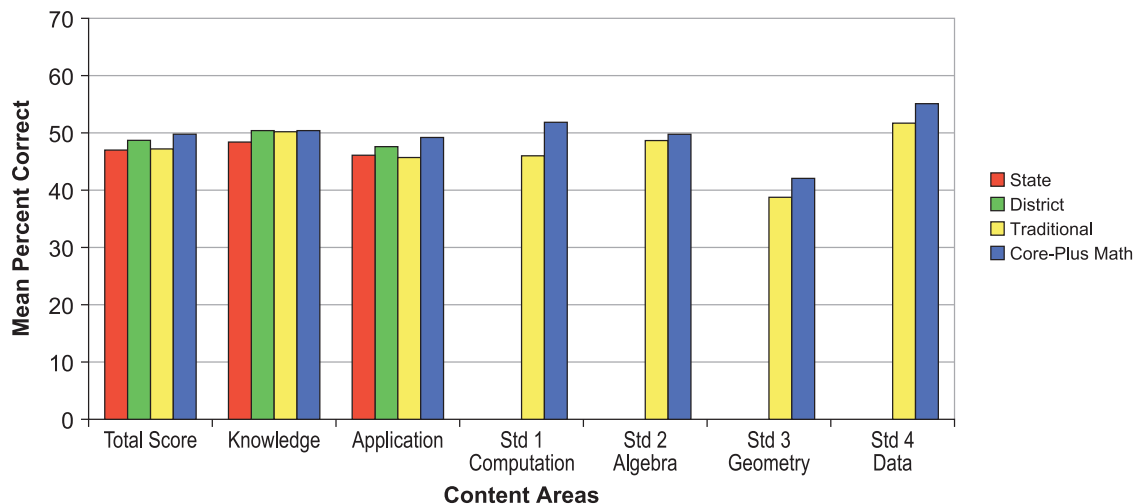
	Minority	Male	Female	Free/reduced Lunch	Recommended for math placement below algebra
<b>Traditional</b>	7	22	21	3	0
<b>Core-Plus</b>	9	25	18	4	3

In the spring of 2002, all sophomore students at Derby High School took the Kansas State Mathematics Assessment. The results for the two matched pairs cohorts for the Total Score and the six subtest scores are summarized in the following table and graph along with the district and state means. Matched-pairs *t*-tests results and effect sizes (ES) using Cohen's D are also shown in the table.

### Results on the 2002 10th Grade Kansas State Math Assessment Mean Percent Correct

43 Matched Pairs	State	District	Alg 1/Geom	Core-Plus	<i>t</i> -values	<i>p</i> -values	ES
<b>Total Score</b>	47.0	48.7	47.2	49.8	1.031	0.3083	0.210
<b>Knowledge</b>	48.4	50.4	50.2	50.4	0.053	0.9581	0.011
<b>Application</b>	46.1	47.6	45.7	49.2	1.395	0.1705	0.275
<b>Computation</b>			46.0	51.8	1.363	0.1802	0.296
<b>Algebra</b>			48.7	49.7	0.340	0.7358	0.069
<b>Geometry</b>			38.7	42.0	0.961	0.3422	0.187
<b>Data</b>			51.7	55.1	0.858	0.3957	0.187

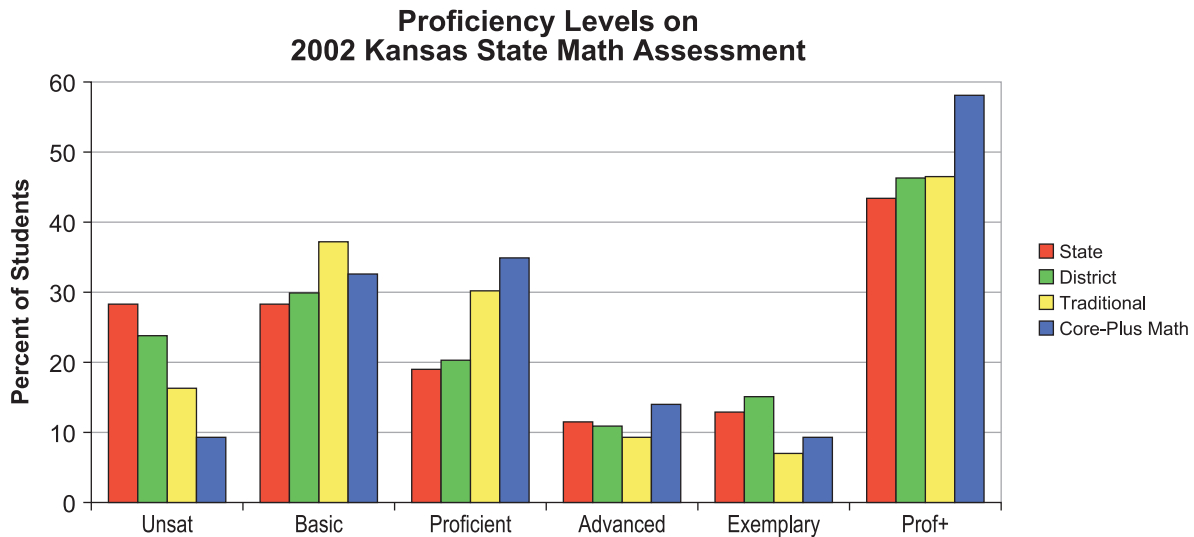
### Results on 2002 10th Grade Kansas State Math Assessment



The percentages for the various levels of performance on the 2002 Kansas State Mathematics Assessment are given in the table below. Also reported is the percentage of students attaining each proficiency level for the state population, the Derby district, the traditional group, and the Core-Plus Mathematics group. The percentage of students meeting proficiency on the state test was 46.5 ( $n = 20$ ) for the traditional cohort and 58.2 ( $n = 25$ ) for the Core-Plus Mathematics cohort. A two-sample  $z$ -test of proportions conducted for the proportions of students scoring Proficient and Higher favored the Core-Plus Mathematics group ( $z = 1.0795$  and  $p$ -value  $\approx 0.28$ ).

**Percentage of Students at Each Proficiency Level on  
2002 10th Grade Kansas State Math Assessment**

	State	District	Alg 1/Geom $n = 43$	Core-Plus $n = 43$
<b>Unsatisfactory (less than 35%)</b>	28.3	23.8	16.3	9.3
<b>Basic (35%-47%)</b>	28.3	29.9	37.2	32.6
<b>Proficient (48%-59%)</b>	19	20.3	30.2	34.9
<b>Advanced (60%-69%)</b>	11.5	10.9	9.3	14.0
<b>Exemplary (70%-100%)</b>	12.9	15.1	7.0	9.3
<b>Proficient and Higher (48%-100%)</b>	43.4	46.3	<b>46.5 (<math>n = 20</math>)</b>	<b>58.2 (<math>n = 25</math>)</b>



## Enrollment in Senior-Level Mathematics

The senior courses for the students enrolled in the algebra-geometry-advanced algebra sequence were College Algebra or Precalculus. The senior course for the students enrolled in the Core-Plus Mathematics program was Course 4. Enrollment data are presented in the following table. Far more Core-Plus Mathematics students enrolled in a fourth-year elective college preparatory mathematics class than the comparison group.

	<b>Alg 1/Geom <i>n</i> = 43</b>	<b>Core-Plus <i>n</i> = 43</b>
<b>Number enrolled in senior math</b>	20	34
<b>Percent enrolled in senior math</b>	46.5%	79.1%

A two-sample  $z$ -test conducted for the proportions of students enrolled in a senior college-preparatory mathematics course favored the Core-Plus Mathematics cohort and this difference was highly significant ( $z \approx 3.123$  and  $p$ -value  $\approx 0.0018$ ).

## Results from the Beliefs Survey

Pre- and post-indicators of mathematical beliefs and disposition were administered to all students at the beginning of their freshman year (Fall, 2000) and at the end of their sophomore year (Spring, 2002). Selected questions are given below along with the percentage of students who agreed and disagreed with the statement.

**I want to take a math course taught in the same way next year.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	26.3%	72.7%
<b>Alg 1/Geom</b>	36.1%	27.5%

**I feel really pleased doing math at school when the problems are challenging.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	22.8%	68.1%
<b>Alg 1/Geom</b>	36.5%	46.2%

**This course made mathematical ideas interesting to me.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	25.9%	55.3%
<b>Alg 1/Geom</b>	31.4%	20.0%

**Learning math helps people know if something makes sense.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	57.9%	75.0%
<b>Alg 1/Geom</b>	61.5%	47.4%

**Most of the problems in the course are realistic.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	47.4%	70.8%
<b>Alg 1/Geom</b>	61.2%	35.9%

**This course helped me feel confident that I can solve math problems.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	45.6%	66.0%
<b>Alg 1/Geom</b>	53.9%	40.0%

**I learned more mathematical ideas by using the calculator.**

	<b>Fall 2000</b>	<b>Spring 2002</b>
<b>Core-Plus</b>	56.4%	73.0%
<b>Alg 1/Geom</b>	44.9%	43.2%

## **Summary**

The results favor the Core-Plus Mathematics group for all measures used in this study. Since the percentage of students proficient on the 10th-grade state assessment is one of the measures used for adequate yearly progress under the No Child Left Behind legislation, the 58.2% proficient for the Core-Plus Mathematics group compared with the 46.5% proficient for the traditional group is important to the district. In addition, 79.1% enrollment of Core-Plus Mathematics students in the senior mathematics course as compared with 46.5% enrollment for the traditional group may reflect the more positive attitude of Core-Plus Mathematics students that was reflected in the survey results. It is well documented that enrollment in senior mathematics courses is highly correlated with success in the first college mathematics course, thus the significantly larger proportion of Core-Plus Mathematics students who enrolled in 12<sup>th</sup> grade mathematics is considered another positive outcome for that program.