

# RESEARCH

This section summarizes key findings from various research studies on the CMP curriculum and provides bibliographical information for dissertations and research papers related to CMP. The research described here is representative of a growing body of work showing that *Connected Mathematics* is an effective middle school curriculum that is accessible to all students.

The research studies are separated into two categories, those conducted by the CMP team during the last year of field testing and those conducted by other professionals who have been studying the effects of CMP in a variety of settings since its publication.

**The summaries indicate the special populations involved in each study:**

**Minority:** Results for minority students were reported as a subset of the general population.

**Gifted:** Results for gifted and talented students were reported as a subset of the general population.

**Low/High SES:** The districts involved had a significant percentage of low (or high) socioeconomic status (SES) students, including a significant number of students who received free or reduced-price lunch.

**Diverse:** The study included students from a variety of geographic (rural, urban, or suburban) or economic settings and/or students with a variety of racial or ethnic characteristics.

**ESL:** The districts involved included a significant number of students for whom English is a second language.

## CMP FIELD TEST REPORTS

### REPORT 1 EVALUATION RESULTS FROM THE FIELD TESTING

#### SPECIAL POPULATIONS: DIVERSE

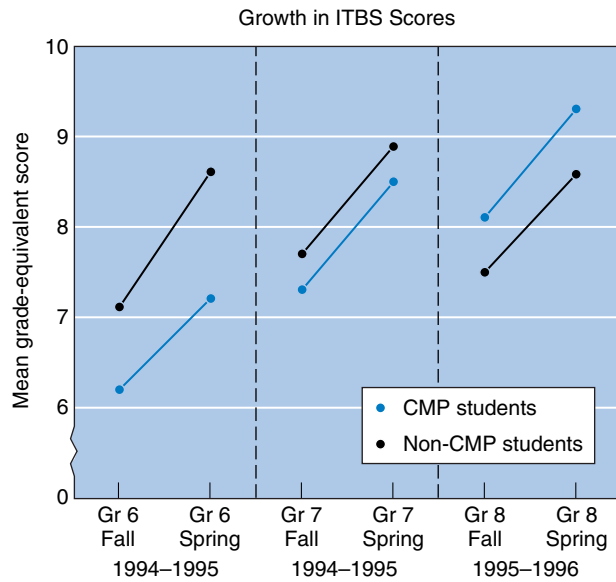
**DESCRIPTION** During the fourth and fifth years of CMP development, Ridgeway, Zawojewski, Hoover, and Lambdin (2003) conducted a study comparing the results of CMP students and students who used traditional middle school mathematics curricula. The students were evaluated at the beginning and end of the school year using the following two tests:

- The Iowa Test of Basic Skills (ITBS), which assesses basic mathematical skills
- A test designed by the NSF-funded Balanced Assessment Project (Schoenfeld et al.) to assess student attainment in mathematical reasoning, communication, connections, and problem solving

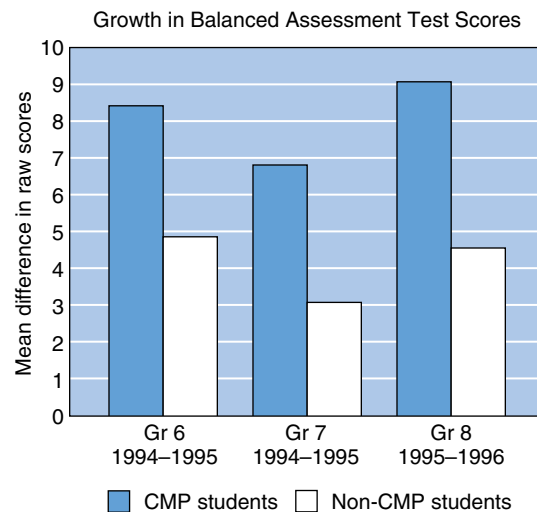
The study was conducted during the 1994–95 school year with grades 6 and 7 students and during the 1995–96 year with grade 8 students. More than 2,000 students from urban, suburban, and rural communities in a variety of geographic regions took part in the study. Approximately two-thirds of the participants used *Connected Mathematics*.

## FINDINGS

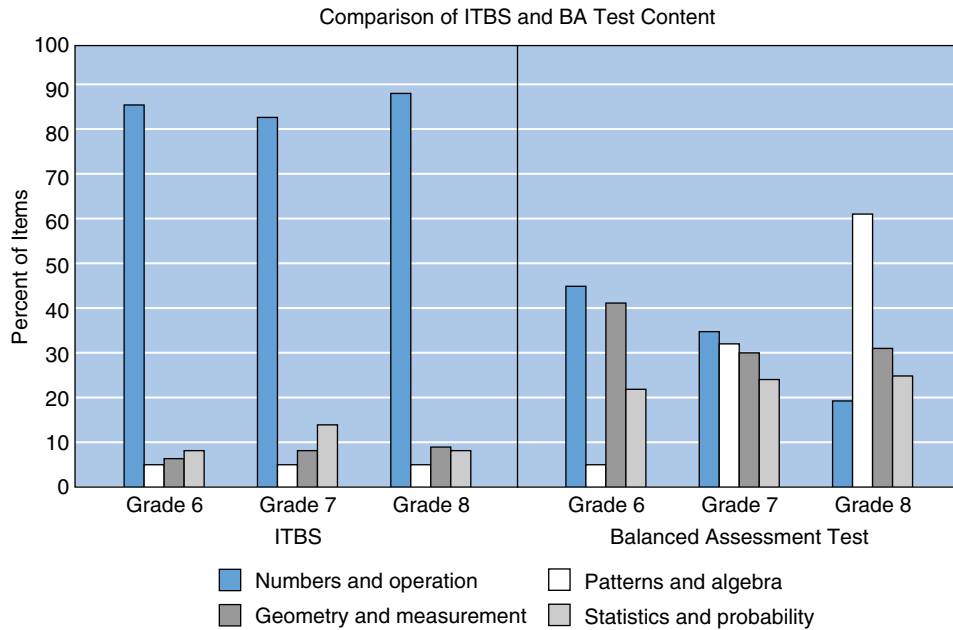
*Basic Skills:* The study found that gains made by the CMP students on the ITBS were comparable to gains made by the non-CMP students and to gains made by the test-publisher’s representative sample. The graph below summarizes the results for each grade level. Note that the graph should not be interpreted as longitudinal: the data for grades 6 and 7 were gathered in the same year, so the results are from different students. However, some of the grade 8 results are from students who were part of the grade 7 sample.



*Problem Solving:* The study found that the CMP students at all three grade levels showed significantly greater growth than their non-CMP peers on the Balanced Assessment test. The test consisted of challenging, open-response items that required students to reason mathematically, communicate ideas, make connections, and solve problems.



The graph below shows the distribution of content on both the ITBS and the Balanced Assessment tests used in the study. At all three grade levels, the great majority of items on the ITBS involve number and operations, while the Balanced Assessment test incorporates number-and-operations items with problems involving algebra, geometry, and statistics. Therefore, the CMP students demonstrated greater growth in a variety of mathematical content areas.



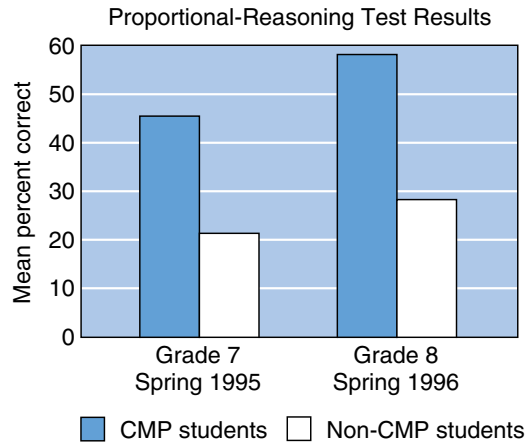
## REPORT 2 PROPORTIONAL REASONING STUDY

### SPECIAL POPULATIONS: DIVERSE

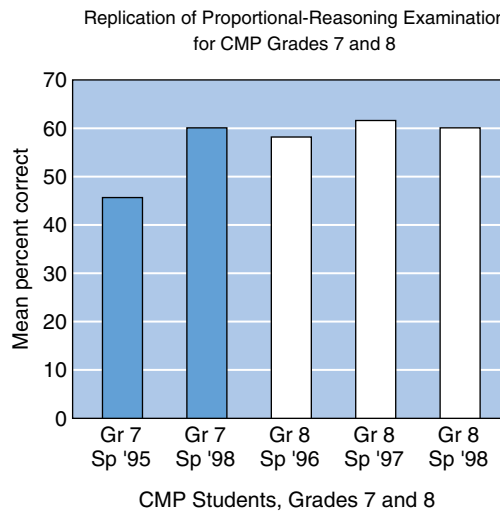
**DESCRIPTION** Ben-Chaim et al. (1997, 1998) conducted a study to investigate the proportional-reasoning abilities of CMP and non-CMP students. (See also Miller and Fey 2000.) In the spring of 1995, 124 grade 7 CMP students, who had also studied *Connected Mathematics* in grade 6, and 91 non-CMP students were tested to assess their understanding and skill in proportional reasoning. The items on the test were contextual problems involving rates, ratios, and scaling. In the spring of 1996, 108 of the CMP students and 39 of the non-CMP students were given the test again in grade 8.

**FINDINGS**

The graph below summarizes the results of the testing in proportional reasoning. CMP students outperformed non-CMP students not only in grade 7, when proportional reasoning is the focus of several units, but also in grade 8. Moreover, CMP students showed greater growth in their achievement from grade 7 to 8.



A replication of the study was conducted to further investigate this observation. When the proportional-reasoning test was administered in 1997 and 1998 to CMP students in grade 8 who had also studied *Connected Mathematics* in grades 6 and 7, the results again revealed that the students retained much of their proportional-reasoning understanding (Ben-Chaim et al. 1998).



Of the thirteen items on the proportional-reasoning test, five were rate items. Student answers on these items were classified as correct, incorrect, or no response. Correct answers were then categorized according to whether they were accompanied by no support work, correct support work, or incorrect support work. Incorrect answers were categorized as being accompanied by no support, support indicating partial understanding, or support indicating incorrect thinking. The table below shows that 53% of the answers provided by CMP students were supported by correct work, while only 28% of the answers provided by non-CMP students included correct support work.

Percent of Total Grade 7 Responses on Rate Items Falling into Each of Seven Classifications							
	<i>Correct Answer</i>			<i>Incorrect Answer</i>			<i>No Response</i>
	<i>Answer only</i>	<i>Correct support work</i>	<i>Incorrect support work</i>	<i>Answer only</i>	<i>Partial understanding</i>	<i>Incorrect thinking</i>	
<b>Gr 7 CMP students</b>	<b>3</b>	<b>53</b>	<b>9</b>	<b>2</b>	<b>15</b>	<b>10</b>	<b>8</b>
<b>Gr 7 Non-CMP students</b>	<b>6</b>	<b>28</b>	<b>21</b>	<b>4</b>	<b>10</b>	<b>23</b>	<b>8</b>

# REPORTS ON EXTERNAL RESEARCH

## REPORT 3 FIRST UNIVERSITY OF MISSOURI STUDY

### SPECIAL POPULATIONS: MINORITY

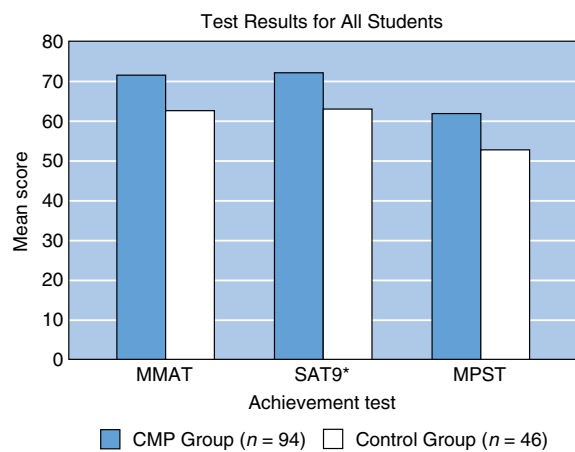
#### DESCRIPTION

Lapan et al. (1998) examined the impact of a year-long implementation of two standards-based middle grades mathematics curricula on mathematics achievement. The study involved a control group and two treatment groups. One of the two treatment groups used *Connected Mathematics*. A total of 255 grade 6 students participated. The following standardized tests of traditional mathematics achievement and mathematics problem solving were administered at the end of grade 5 to provide baseline data and again at the end of grade 6, after one year of implementation:

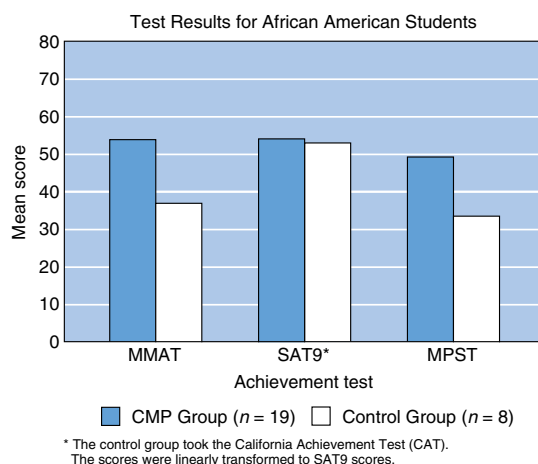
- Missouri Mastery and Achievement Test (MMAT)
- Stanford Achievement Test, version 9 (SAT9)
- SAT Open-Ended Mathematics Problem Solving Test (MPST)

#### FINDINGS

No significant differences were found between the groups with respect to traditional mathematics achievement. However, students in the two standards-based curricula significantly outperformed the control group in mathematics problem solving. No gender differences in traditional mathematics achievement or mathematics problem solving were found. Mathematics problem-solving scores for African American students in the two standards-based curricula were significantly higher than scores for African American students in the control group” (Lapan et al. 1998). The graphs below and on the next page compare the results for the control group with the results for the CMP treatment group. This longitudinal study will continue to follow a subset of the students through grades 7 and 8. (See Report 5 on p. 14.)



\* The control group took the California Achievement Test (CAT). The scores were linearly transformed to SAT9 scores.



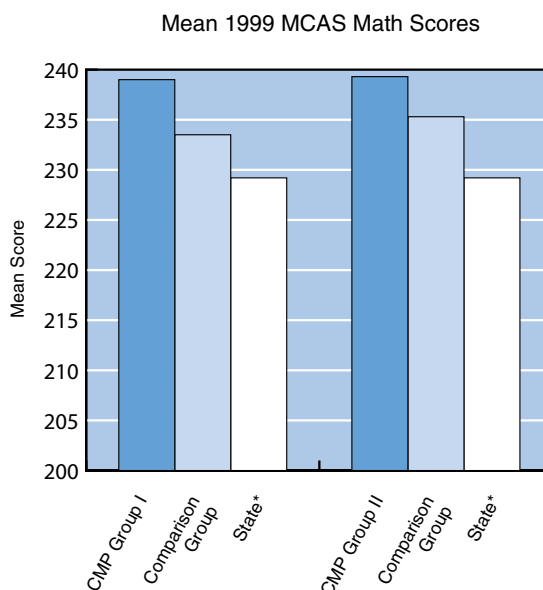
## REPORT 4 MASSACHUSETTS STUDY

### SPECIAL POPULATIONS: MINORITY, LOW SES, DIVERSE

**DESCRIPTION** Riordan and Noyce (2001) investigated the impact of standards-based mathematics programs on student achievement in Massachusetts. The study compared statewide standardized test (MCAS) scores of grade 4 students using an elementary standards-based program and grade 8 students using *Connected Mathematics* to scores of demographically similar students using traditional curricula.

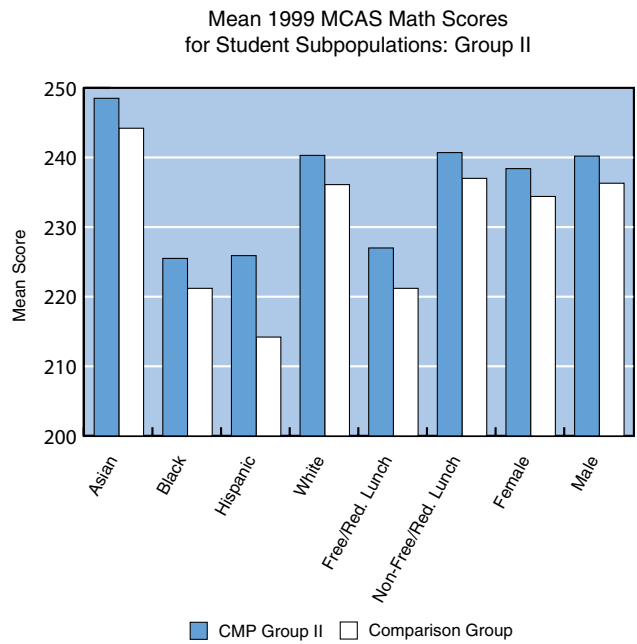
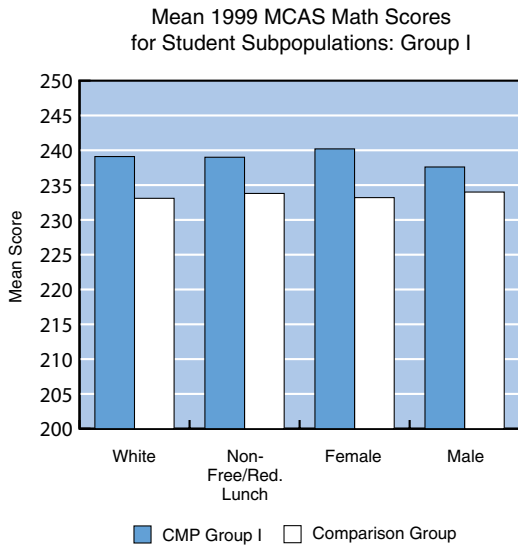
The 21 participating *Connected Mathematics* schools were divided into two groups. Group I consisted of one school that had implemented the program for four years. Group II consisted of 20 schools that had used the program for either two or three years. Each group was matched with a comparison group based on mean scores on previous state tests, the percentage of students receiving free or reduced-price lunch, and racial and ethnic makeup.

**FINDINGS** As the graph below shows, CMP students in both groups performed significantly better on the 1999 MCAS than did students attending the comparison schools.



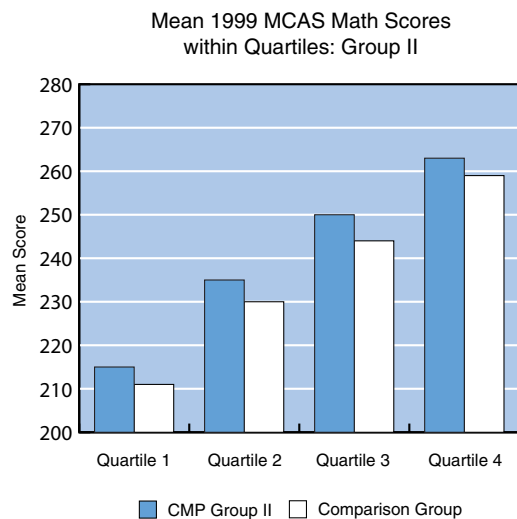
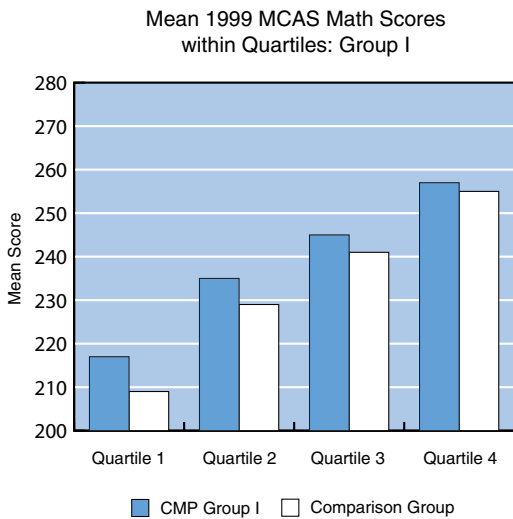
Note: MCAS scores range from 200 to 280.  
\*The 1999 statewide mean score is shown for regular education students who had been in their districts for at least three years. The state scores also include the CMP schools in the study.

Differences in favor of *Connected Mathematics* were consistent across student subpopulations.



Note: For Group I, comparisons were not made for Blacks, Asians, Hispanics, and students eligible for free and reduced-price lunch because the sample sizes for these groups were too small (i.e., fewer than 10 students per school).

The study also compared mean scores within each quartile. The results suggest that *Connected Mathematics* is effective for all students, including those at the upper and lower ends of the achievement spectrum.



In addition to the above results, the study found that CMP students outperformed comparison students in all mathematical strands and in both multiple-choice and open-response questions.

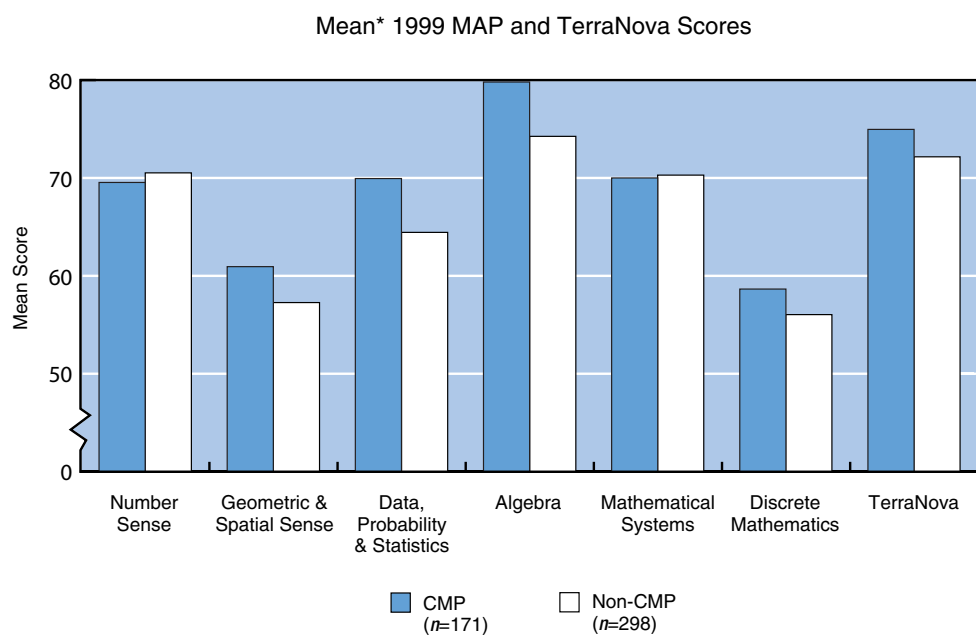
## REPORT 5 SECOND UNIVERSITY OF MISSOURI STUDY

### SPECIAL POPULATION: HIGH SES

**DESCRIPTION** Reys et al. (2003) compared the mathematics achievement of grade 8 students in the first three school districts in Missouri to adopt standards-based middle grades mathematics curricula to the achievement of students in similar districts who had not used standards-based materials. (See Report 3, p. 11.) Achievement was measured using the mathematics portion of the Missouri Assessment Program (MAP), which consists of two sections of open-ended items and one section of multiple-choice items drawn from the TerraNova assessments.

One of the three standards-based districts in the study used *Connected Mathematics*. In grade 6, all students in the district were enrolled in a course using *Connected Mathematics*. In grades 7 and 8, about 75% of the students continued to use *Connected Mathematics* as their primary text. The remaining 25% were enrolled in an accelerated program and used *Connected Mathematics* as a supplement to an algebra 1 text. This CMP district was matched with a comparison district based primarily on prior mathematics achievement and the percentage of students eligible for free or reduced-price lunch. All the students in the comparison district took the same mathematics course in grades 6 and 7. In grade 8, 40% took pre-algebra, while 60% took algebra 1. It should be noted that both the CMP district (13% free and reduced lunch) and the comparison district (11% free and reduced lunch) are affluent districts with consistently high test scores and a large percentage of students who go on to attend college.

**FINDINGS** CMP students received significantly higher scores on the algebra items than the comparison students, even though a much greater percentage of students in the comparison district were enrolled in an algebra 1 course (60% versus 25%). CMP students also received significantly higher scores on Data, Probability, and Statistics items. The differences in scores for the other strands and for the TerraNova portion of the test were not significant.



\*T-Test of comparisons of 1999 MAP Content Standard and TerraNova scores for CMP school and comparison school  
\*\* p < 0.05

## DISSERTATIONS

Over the past several years, a number of doctoral candidates have done research on topics related to the CMP curriculum. Below is bibliographical information about their dissertations.

- Bay, J. M. 1999. Middle school mathematics curriculum implementation: The dynamics of change as teachers introduce and use standards-based curricula. Doctoral dissertation, University of Missouri, Columbia. *Dissertation Abstracts International*, 60(12): 4354.
- Celedon, S. 1998. An analysis of a teacher's and student's language use to negotiate meaning in an ESL/mathematics classroom. Doctoral dissertation, University of Texas at Austin. *Dissertation Abstracts International*, 59(09): 3331.
- Covington-Clarkson, L. M. 2002. The effects of the Connected Mathematics Project in a Midwestern urban middle school district. Doctoral dissertation, University of Minnesota, St. Paul. *Dissertation Abstracts International*, 61(12): 4709.
- DeGroot, C. 2000. Three female voices: The transition to high school mathematics from a reform middle school mathematics program. Doctoral dissertation, New York University, 2000. *Dissertation Abstracts International*, 61(04): 1332.
- Grunow, J. E. 1998. Using concept maps in a professional development program to assess and enhance teachers' understanding of rational numbers. Doctoral dissertation, University of Wisconsin, Madison. *Dissertation Abstracts International*, 60(03): 636.
- Herbel-Eisenmann, B. A. 2000. How discourse structures norms: A tale of two middle school mathematics classrooms. Doctoral dissertation, Michigan State University, East Lansing. *Dissertation Abstracts International*, 62(01): 107.
- Hull, L. S. H. 2000. Teachers' mathematical understanding of proportionality: Links to curriculum, professional development, and support. Doctoral dissertation, University of Texas, Austin. *Dissertation Abstracts International*, 62(02): 500.
- Keiser, J. M. 1997. The development of students' understanding of angle in a non-directive learning environment. Doctoral dissertation, Indiana University, Bloomington. *Dissertation Abstracts International*, 58(08): 3053.
- Kersaint, G. 1998. Pre-service elementary teachers' ability to generalize functional relationships: The impact of two versions of a mathematics content course. Doctoral dissertation, Illinois State University. *Dissertation Abstracts International*, 59(05): 1500.
- Krebs, A. K. 1999. Students' algebraic understanding: A study of middle grades students' ability to symbolically generalize functions. Doctoral dissertation, Michigan State University, East Lansing. *Dissertation Abstracts International*, 60(06): 1949.
- Lubienski, S. T. 1996. Mathematics for all? Examining issues of class in mathematics teaching and learning. Doctoral dissertation, Michigan State University, East Lansing. *Dissertation Abstracts International*, 58(01): 116.
- Rickard, A. 1993. Teachers' use of a problem-solving oriented sixth-grade mathematics unit: Two case studies. Doctoral dissertation, Michigan State University, East Lansing. *Dissertation Abstracts International*, 54(10): 3695.
- Schneider, C. 2000. Connected Mathematics and the Texas Assessment of Academic Skills. Doctoral dissertation, The University of Texas at Austin. *Dissertation Abstracts International*, 62(02): 503.

- Van Dyke, C. L. 2001. The shapes of things to come: Mathematics reform in the middle school. Doctoral dissertation, Pacific Lutheran University. *Master's Abstracts International*, 40(02): 287.
- Wasman, D. 2000. An investigation of algebraic reasoning of seventh- and eighth-grade students who have studied from the Connected Mathematics curriculum. Doctoral dissertation, University of Missouri, Columbia. *Dissertation Abstracts International*, 61(09): 3498.

## PAPERS PRESENTED AT RESEARCH CONFERENCES

Below is a list of papers based on CMP-related research that have been presented at conferences.

- Ben-Chaim, D., J. Fey, W. Fitzgerald, C. Benedetto, and J. Miller. 1997. A study of proportional reasoning among seventh and eighth grade students. Paper presented at the annual meeting of the American Educational Research Association, Chicago.
- Burdell, C. and J. Smith. 2001. "The math is different, but I can deal": Studying students' experiences in a reform-based mathematics curriculum. Paper presented at the annual meeting of the American Educational Research Association, Seattle.
- Clarkson, L. M. 2002. The effects of the Connected Mathematics Project in a Midwestern urban middle school district. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.
- Herbel-Eisenmann, B., J. P. Smith, and J. Star. 1999. Middle school students' algebra learning: Understanding linear relationships in context. Paper presented at the annual meeting of American Educational Research Association, Montreal, Canada.
- Hoover, M. N., J. S. Zawojewski, and J. Ridgeway. 1997. Effects of the Connected Mathematics Project on student attainment. Paper presented at the annual meeting of the American Educational Research Association, Chicago.
- Jansen, A. and B. Herbel-Eisenmann. 2001. Moving from a reform junior high to a traditional high school: Affective, academic, and adaptive mathematical transitions. Paper presented at the annual meeting of the American Educational Research Association, Seattle.
- Lambdin, D. V. and G. Lappan. 1997. Dilemmas and issues in curriculum reform: Reflections from the Connected Mathematics Project. Paper presented at the annual meeting of the American Educational Research Association, Chicago.
- Lubienski, S. T. 1997. Successes and struggles of striving toward "Mathematics for All": A closer look at socio-economics. Paper presented at the annual meeting of the American Education Research Association, Chicago.
- Preston, R. V. and D. V. Lambdin. 1997. Teachers changing in changing times: Using stages of concern to understand changes resulting from the use of an innovative mathematics curriculum. Paper presented at the annual meeting of the American Educational Research Association, Chicago.
- Smith, J. and D. Berk. 2001. The "Navigating Mathematical Transitions Project": Background, conceptual frame, and methodology. Paper presented at the annual meeting of the American Educational Research Association, Seattle.

- Smith, J. P., B. Herbel-Eisenmann, J. Star, and A. Jansen. 2000. Quantitative pathways to understanding and using algebra: Possibilities, transitions, and disconnects. Paper presented at the Research Pre-Session of the annual meeting of the National Council of Teachers of Mathematics, Chicago.
- Smith, J. P., J. Star, and B. Herbel-Eisenmann. 2000. Studying mathematical transitions: How do students navigate fundamental changes in curriculum and pedagogy? Paper presented at the annual meeting of the American Educational Research Association, New Orleans.
- Smith, J. P., E. A. Phillips, and B. Herbel-Eisenmann. 1998. Middle school students' algebraic reasoning: New skills and understandings from a reform curriculum. *Proceedings of the 20th Annual Meeting of the PME, North American Chapter*, 173–178, Raleigh.
- Smith, J. P., B. Herbel-Eisenmann, and J. Star. 1999. Middle school students' algebra learning: Understanding linear relationships in context. *Proceedings of the 1999 Research Pre-session of the Annual Meeting of the National Council of Teachers of Mathematics (NCTM)*. Reston, Virginia: National Council of Teacher of Mathematics.