A Matched Study of Washington State 10th Grade Assessment Scores of Students in Schools Using The Core-Plus Mathematics Program

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Background

The first schools to implement the Core-Plus Mathematics Program (CPMP) in the state of Washington were in the greater Seattle area. During the 1998-99 school year, five high schools began their implementation process. The number of adopting schools grew steadily throughout the next six years. By the 2004-2005 school year, there were 22 high schools in the state that were in at least their second year of using Core-Plus Mathematics. How does the mathematics achievement of students in these 22 CPMP high schools compare to that of students in more traditional mathematics programs?

The state of Washington administers a required examination in the late spring of the 4th, 7th, and 10th grade years. This examination is commonly referred to as the Washington Assessment of Student Learning (WASL) exam. The WASL assessment was designed by Washington teachers and reflects what students should know and be able to do based on the state's Essential Academic Learning Requirements (EALRs). More information can be found online at: http://reportcard.ospi.k12.wa.us/. The study reported here compares the 2004-05 WASL mathematics pass rate of grade 10 students in the 22 high schools in Washington that were in at least their second year of using Core-Plus Mathematics with those of 22 matched schools using a variety of mathematics curricula. No school was selected as a matching school if it used any of the NSF-funded NCTM Standards-based programs.[1]

Matching Schools

Drawing from the entire set of high schools in the state of Washington, a school was matched to each CPMP school as closely as possible on the following variables (all known to be correlates of student mathematics achievement) in the order given: national percentile rank of 1999-2000 ninth-grade ITED-Q mean score, percent of students qualifying for free and reduced lunch, percent of underrepresented minority students,[2] and school enrollment. ITED-Q scores from 1999-2000, rather than from a later year, were used in order to have a measure of each school's average mathematical achievement prior to the use of the Core-Plus Mathematics curriculum.[3] The matching resulted in a "match sample" of 22 schools that fit the CPMP sample well, both school-by-school and on average as shown in the following table.

	CPMP Mean	Match Mean	CPMP SD	Match SD	CPMP Min	Match Min	CPMP Median	Match Median	CPMP Max	Match Max
ITED-Q	65.0	65.3	9.5	8.7	49	50	65.5	65	83	82
F/R Lun %	21.9	21.2	16.7	12.0	5.4	2.5	19.1	21.6	84.1	50.7
Un. Min %	10.6	10.1	6.2	6.1	3.9	3.6	8.6	8.0	23.3	22.4
Enrollment	1,287	1,293	577	455	203	262	1,412	1,375	2,502	2,109

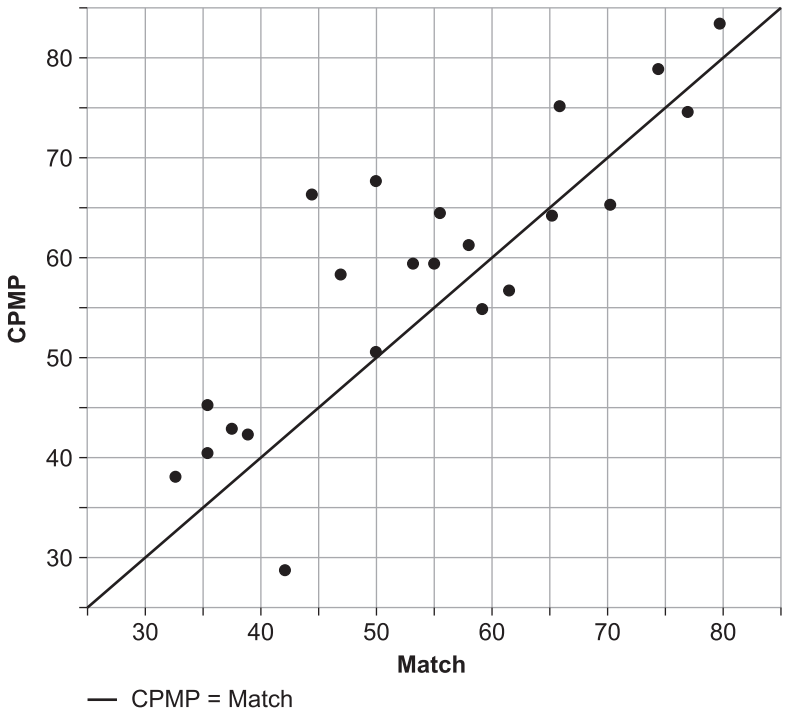
The samples were also matched to the extent possible on the grade range of students served by the school (i.e., grades 9–12, 10–12, 8–12, or 6–12). See the endnote[4] for more details. The somewhat smaller standard deviations of the match sample are to be expected, since there are fewer potential matches for CPMP schools that are at the very high or very low end of the state distribution on each of these variables. For example, the CPMP school with maximum enrollment (2,502) is one of the largest schools in the state. There are very few schools with similar enrollments, so the chance that one of them is also similar on the other matching variables is small compared to schools nearer the average enrollment of just under 1,300 students.

Comparing WASL Pass Rates

Following the matching, the numbers of students completing, and percent passing, each tenth-grade WASL test in each of the 44 schools were entered into our data file. The total numbers of students in each sample of 22 schools completing each tenth-grade WASL test in 2004-05 and the percent of students who passed are given in the next table. As the table shows, the overall passing rate was considerably higher in the CPMP sample in Mathematics and Science and slightly higher in Reading and Writing.

	Mathematics		Reading		Writing		Science	
	N	% Pass	N	% Pass	N	% Pass	N	% Pass
CPMP	7,337	61.2	7,366	81.0	7,293	74.1	7,282	47.0
Match	7,126	55.7	7,175	79.0	7,070	72.6	7,080	42.9

Of particular interest in this study are the percents of students passing the WASL Mathematics test in the 22 matched pairs of schools. In the following scatterplot, each point shows the percent of students who passed in the CPMP school plotted against the percent of students who passed in the matching school. The line on the plot shows where a point would lie if the matched pair had equal percents of students pass the WASL. Sixteen of the 22 points lie above the line, indicating that the students in these CPMP schools passed at a higher rate than the students in the matching schools.



WASL Math Pass Data, Grade 10, 2004-05

Equivalently, 16 of 22 differences (*CPMP – match*) in percentages of students passing the WASL Mathematics test were positive. These differences ranged from 21.7 to –13.5 with median 4.25 and mean 4.0. Further, the size of these differences is statistically significant. The test of significance, a paired *t*-test, showed that the mean difference in passing percentages for the CPMP schools minus the matched schools is significantly greater than zero ($t = 2.41$; $p = .025$).

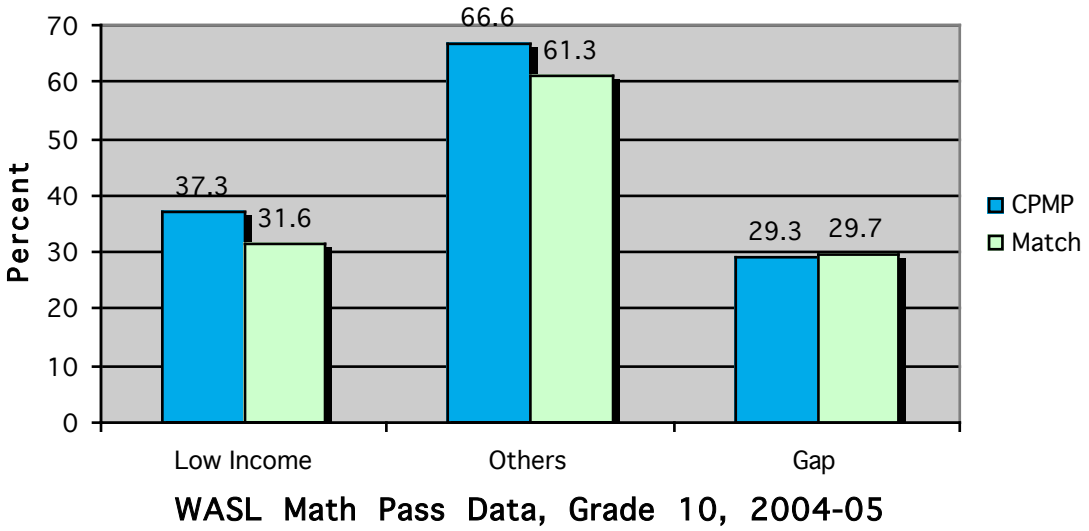
The passing percents on the WASL Science test were higher in the CPMP school in 17 of the 22 matched school pairs. Differences (*CPMP – match*) in percent of students passing the WASL Science test ranged from 20.4 to –23.5 with median 3.6 and mean 3.4. Using all 22 matched pairs of schools, the differences in passing percentages in CPMP schools and their matches are not statistically significant ($t = 1.52$; $p = .144$).

However, it is informative to consider that the matched pair in the lower left of the above plot was not an especially good match. The CPMP school in that pair is a grade 6–12 school, very unusual in the state of Washington. In order to match this CPMP school with another grade 6–12 school, it was necessary to choose a "match" that did not fit as well as the other matched pairs on the three most important matching variables. (The CPMP school in the pair was 7 points lower on the ITED-Q, 33.4 percentage points higher on percent of students qualified for free or reduced lunch, and 17.5 percentage points higher on percent of underrepresented minorities.) Perhaps not surprisingly, this matched pair is the one with the minimum difference in percentages passing in both mathematics (–13.5%) and science (–23.5%). If this pair is removed from the analyses, the differences in passing percentages significantly favor the CPMP schools in the 21 remaining matched school pairs in both mathematics ($t = 3.22$; $p = .004$) and science ($t = 2.44$; $p = .024$).

The Low-Income Achievement Gap

A continuing issue in education is the achievement gap between students from low-income families and those from other families. The following table and graph give the numbers of students from low-income families (eligible for free or reduced lunch) and the percent of those who passed the tenth-grade WASL Mathematics test in each sample. The same data are provided for students of families that are not classified as low income.

	Low Income Students		Other Students		
	N	% Pass Math	N	% Pass Math	% Gap
CPMP	1,351	37.3	5,986	66.6	29.3
Match	1,344	31.6	5,782	61.3	29.7



WASL Math Pass Data, Grade 10, 2004-05

The WASL Mathematics pass rate was higher in the CPMP sample for both the students from low-income families and for the other students. The gap in the pass rate was slightly less in the CPMP sample, but the difference in gaps between the CPMP and the match schools does not approach statistical significance.

Summary of Findings

The pass rate on the 2004-05 Tenth-Grade WASL Mathematics test for the 22 Washington high schools that were in at least their second year using the Core-Plus Mathematics curriculum was compared to that of a sample of 22 schools carefully matched on prior mathematics achievement, percent of students from low-income families, percent of underrepresented minorities, and student enrollment. The main findings are the following.

- The pass rate in mathematics was significantly higher in the schools using the Core-Plus Mathematics program.
- The higher pass rate in the Core-Plus Mathematics schools was evident for both students from low-income families and those from other families.
- Although the higher pass rate in mathematics is consistent across income levels, there is no evidence that using the Core-Plus Mathematics curriculum either increases or decreases the "achievement gap."

Pass rates on the WASL Science test were also higher in the schools using the Core-Plus Mathematics program (significantly higher when one outlying pair of schools is removed).

Data in this report are found on the Office of Superintendent of Public Instruction (OSPI) internet site: http://www.k12.wa.us/.

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[1] The match schools used a variety of textbook programs, but none used another NSF-funded, NCTM Standards-based curriculum. Examples of the main textbook series used in match schools are the following: Addison-Wesley Secondary Mathematics Series (Focus on Algebra, Focus on Geometry, etc.), Freeman's Geometry, Glencoe's Mathematics series, McDougall Littell Integrated Mathematics, Key Curriculum "Discovering Algebra" and "Discovering Geometry" books, University of Chicago School Mathematics, and College Preparatory Mathematics.

[2] The percent of underrepresented minorities is the sum of the percents of Native Americans, African Americans, and Hispanics.

[3] For grades 10-12 schools, the mean of the national percentile ranks across all junior high or middle schools in the district was used for the ITED-Q. If a school opened after 1999-2000, the earliest available ninth-grade ITED-Q percentile was used.

[4] The CPMP sample has 14 schools that include grades 9 to 12, four are grades 10 to 12 schools, one includes grades 8 to 12, and one includes grades 6 to 12. Because of the more important need to approximate the other matching variables and the relatively small numbers of schools in the state that serve the last three grade level intervals, it proved to be impossible to get a one-to-one match on grade levels of the schools. In the final analysis, the match sample contains 15 schools that include grades 9 to 12, three grades 10 to 12 schools, one grades 8 to 12 school, and one grades 6 to 12 school. The fact that there is one fewer grades 10 to 12 school in the match sample is a partial explanation for why the number of students taking the tenth-grade WASL tests is slightly smaller in the match sample than in the CPMP sample even though total school enrollments in each sample are nearly equal.