Student Achievement on MAC/MARS and California's State Tests

David Foster
Founder and Partner
Silicon Valley Mathematics Initiative

Since 1998 a group of school districts in Northern California have taken a different approach to mathematics assessment. These districts have supplemented the state testing system with a coordinated program of support and learning for teachers based on a common set of assessments given to students. In an effort to provide a richer assessment measure for school districts, the Silicon Valley Mathematics Initiative formed the Mathematics Assessment Collaborative (MAC). MAC contracted with the Mathematics Assessment Resource Service (MARS), creators of Balanced Assessment, to design exams for grade 2 through pre-calculus. Each grade-level exam is made up of five tasks. The tasks assess mathematical concepts and skills that involve the five core ideas aligned to the CCSSM taught at that grade/course. The exam also assesses the CCSSM standards of mathematical practice. The tasks require students to evaluate, optimize, design, plan, model, transform, generalize, justify, interpret, represent, estimate, and calculate their solutions.

The MAC exams are scored using a point-scoring rubric. Each task is assigned a point total that corresponds to the complexity of the task and the proportional amount of

time that the average student would spend on the task in relation to the entire exam. The points allocated to the task are then allocated among its parts. Some points are assigned to how the students approach the problem, the majority to the core of the performance, and a few points to evidence that, beyond finding a correct solution, students demonstrate the ability to justify or generalize their solutions. In practice, this approach usually means that points are assigned to different sections of a multi-part question.

The combination of constructed-response tasks and weighted rubrics provides a detailed picture of student performance. Where the state's norm-referenced, multiple-choice exam asks a student merely to select from answers provided, the MAC exam requires the student to initiate a problem-solving approach to each task. Students may use a variety of strategies to find solutions, and most of the prompts require students to explain their thinking or justify their findings.

Comparing Student Achievement between CST and MAC

The quality of information that the Mathematics Assessment Collaborative has provided to its member districts has helped the districts maintain their commitment to professional development that concentrates on improving teacher understanding. California offers significant incentives and sanctions for student achievement on the state STAR exam, and many districts across the state are thus tempted to embrace narrow quick-fix methods of test prep (drill on practice tests and focus on strategies for answering multiple-choice tests) and "teaching to the test."

To counter this temptation, MAC has been able to show that, even when a significant number of students are improving on the state test, their success may not translate into greater mathematical understanding as demonstrated by success on the more demanding performance assessments. The statistics also indicate that, as students move up the grades, the disparity increases: more and more students who appear to be doing

well on the state exam fail to meet standards on the performance exam. Conversely, success on the MARS exam becomes an ever-better predictor of success on the state's STAR exam.

	Below standards on MAC/MARS test	Meetingor Exceeding on MAC/MARS test
Below standards on CA state test	Accurately identified as struggling	Misidentified as struggling ("hidden gems")
Meeting or Exceeding on CA state test	Misidentified as understanding ("false positives")	Accurately identified as understanding

Crosswise tables have been used since 1999 to compare the MAC/MARS performance assessment results with the current California state math test. The four quadrants indicate how the two tests correlate. The tables below compare student achievement between the California's state mathematics test (SAT-9 between the years 1999 and 2002 then CST between the years 2003- 2013 now the CAASPP 2015 - 2019) and the MAC/MARS tests. The upper left quadrant (red) indicates the percent of students below standards on both exams. The lower right quadrant (green) shows the percent of student meeting or above standard on both exams. The sum of these two quadrants, usually about 60% - 80%, indicates how one test predicts the success on the other. The opposite quadrants indicate the circumstances when a student is successful on one exam and unsuccessful on the other. The lower left quadrant (purple) indicates the percent of students meeting standard on CST but not MAC. The converse is the upper right quadrant (blue) that shows the percent of students below standard on CST but meeting standard on MAC. In all grade levels/courses, more students meet CST standards than MAC. This effect becomes quite dramatic throughout the grades. By middle school the effects are sobering. One in four of those students who meet standard on the state math test are below standard on a test that requires students to construct their responses and justifying their solutions. The converse effect is less than a half and often a much smaller percent.

1999	MARS	Level
SAT-9 Level	Below Std	Meet Std
Below Std	29%	4%
Meet Std	22%	45%

2002	MARS	Level
SAT - 9 Level	Below Std	Meet Std
Below Std	28%	5%
Meet Std	11%	52%

2004	MARS	Level
CST Level	Below Std	Meet Std
Below Std	34%	2%
Meet Std	10%	54%

2007	MARS	Level
CST Level	Below Std	Meet Std
Below Std	32%	5%
Meet Std	11%	52%

2010	MARS	Level
CST Level	Below Std	Meet Std
Below Std	28%	3%
Meet Std	22%	47%

2013	MAC	Level
CST Level	Below Std	Meet Std
Below Std	19%	2%
Meet Std	23%	56%

2015	MAC	Level
CAASPP Level	Below Std	Meet Std
Below Std	32%	3%
Meet Std	16%	49%

2016	MAC	Level
CAASPP Level	Below Std	Meet Std
Below Std	27%	5%
Meet Std	15%	53%

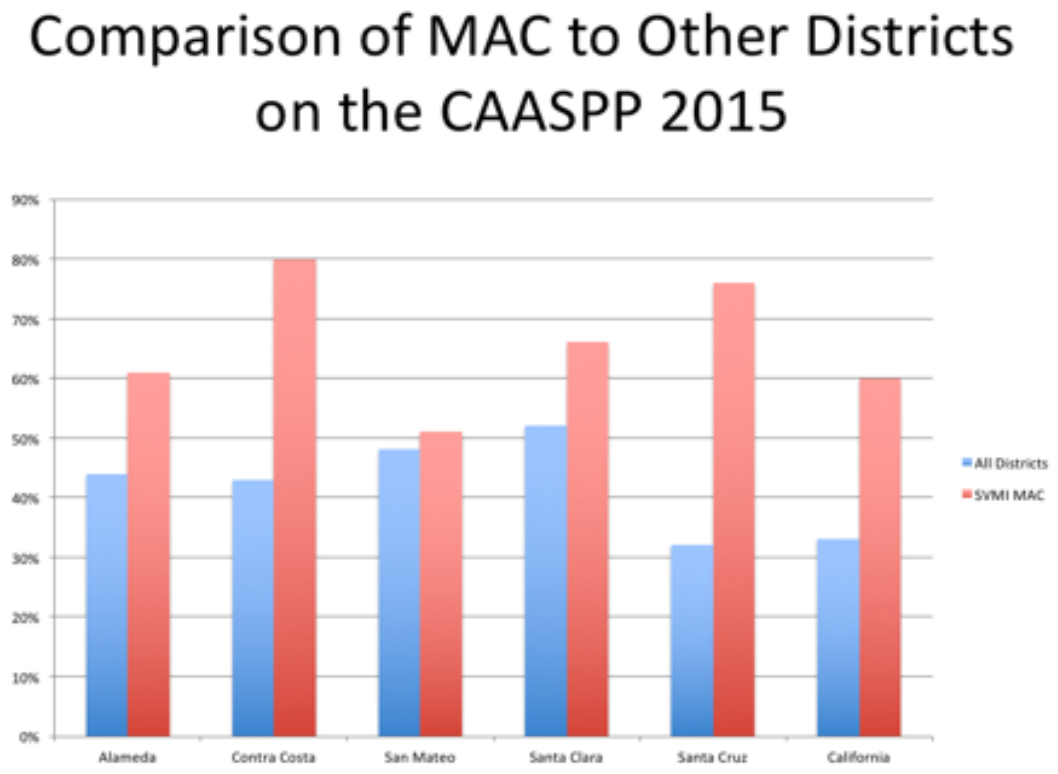
2017	MAC	Level
CAASPP Level	Below Std	Meet Std
Below Std	29%	3%
Meet Std	24%	44%

2018	MAC	Level
CAASPP Level	Below Std	Meet Std
Below Std	21%	4%
Meet Std	9%	66%

2019	MAC	Level
CAASPP Level	Below Std	Meet Std
Below Std	22%	3%
Meet Std	10%	65%

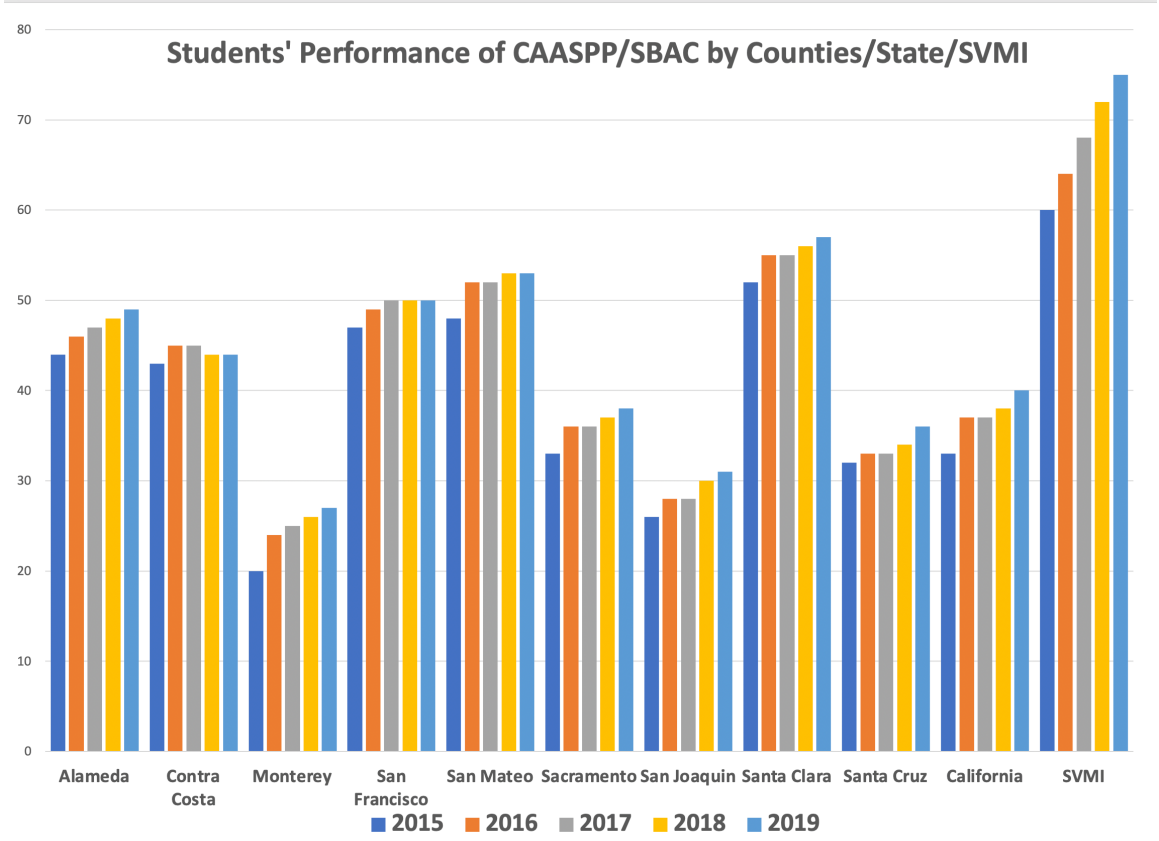
Comparing Student Achievement between MAC and CAASSP

In the spring of 2015, with the adoption of the Common Core State Standards in Mathematics, California began assessing students in grade 3 – 8 and 11th grade with a new math assessment. The SMARTER-Balanced Assessment Collaborative (SBAC) developed a math test which is administered to student on-line. California's version of that test is called CAASPP. Districts in SVMI continued to administer the MAC/MARS performance assessment along with the CAASPP to their students in the spring of 2015. Students who were administered both assessments outperformed the student who were only administered the CAASPP significantly regardless on county, even though the demographic of the student populations were very similar between each county comparison.



That trend continue the following years 2016 through 2019. Even though the targeted

Northern California counties in the study showed flat or incremental growth in achievement between 2015 and 2019 on the CAASPP, student who were also administered the MAC performance assessment from the Silicon Valley Mathematics Initiative once again outperformed all other students in their counties on the state CAASPP test. The growth in achievement by the SVMI MAC students increases from year to year as the performance in the counties remain relatively flat since 2016.



The MAC/MARS tests accurately predict students' performances on the California state math tests whether it was the SAT-9, CST or current CAASPP test, between 70 and 80 percent of the time. It also signals the false-positive about 15 – 20 percent of time, identifying student who outperformed on the state test and who will mostly struggle in the subsequent years. The MAC/MARS test also identifies strong math students who unfortunately under performed on the day of the state exam.

References for these findings can be sited from:

MAC Final Reports 1999 – 2009, Fisher, Foster, Becker*; The Robert N. Noyce Foundation's Annual Report 1999 – 2009*

MAC Final Reports 2010 – 2019., Educational Data Systems (EDS), Foster*; The Silicon Valley Mathematics Imitative Annual Report 2010 – 2019.*

Boaler J., Foster D.; Raising Expectations and Achievement. The Impact of Wide Scale Mathematics Reform Giving All Student Access to High Quality Mathematics, YouCubed, 2014

Paek P, Foster D, Improved Mathematical Teaching Practices and Student Learning Using Complex Performance Assessment Tasks, paper presented April 15, 2012 at the annual meeting of the National Council on Measurement in Education (NCME), Vancouver, Canada. Available at http://www.svmimac.org/

Foster D, Poppers A.; How Can I Get Them to Understand? Formative Assessment and Reengaging Students in Core Mathematics, Chapter 1, New Frontiers in Formative Assessment, Publication Harvard Press 2011

Foster D., Poppers A.; Using Formative Assessment to Drive Learning; The Silicon Valley Mathematics Initiative: A Twelve-year Research and Development Project, The Noyce Foundation, www.noycefdn.org, 2009

Foster D., Noyce P. & Spiegel S. When Assessment Guides Instruction: Silicon Valley's Mathematics Assessment Collaborative. MSRI's "ASSESSING STUDENTS' MATHEMATICS LEARNING: ISSUES, COSTS AND BENEFITS" 2007

Foster D. & Noyce P. The Mathematics Assessment Collaborative: Performance Testing to Improve Instruction, Phi Delta Kappan, 2004