Lesson Study

Supporting Mathematically Powerful Classrooms

Lesson Study Alliance

David Foster

Chicago - May 17, 2018

What I plan to discuss

- SVMI's Lesson Study History and Structure.
- How Lesson Study Influenced All We Do.
- How Lesson Study Can Be A Vehicle for Innovation

Optimism

"Optimism is an essential ingredient for innovation. How else can the individual welcome change over security, adventure over staying in safe places? A significant innovation has effects that reach much further than can be imagined at the time, and creates its own uses. It will not be held back by those who lack the imagination to exploit its use, but will be swept along by the creative members of our society for the good of all. Innovation cannot be mandated any more than a baseball coach can demand that the next batter hit a home run. He can, however, assemble a good team, encourage his players, and play the odds."

Robert N. Noyce

SVMI's MISSION

- SVMI is a comprehensive effort to improve mathematics instruction and student learning. The Initiative is based on **high performance expectations**, ongoing **professional development**, **examining student work**, and **improved math instruction**.

SVMI's Resources and Programs

Professional Development

Summer Institutes and Math Workshops throughout the school year.

Math Talks

Promoting Classroom Discourse and Conceptual Understanding

Performance Assessments

Problems of the Month

School-wide Problem Solving

Math Coaching

Math Network Meetings and Workshops for Coaches and Principals

Lesson Study Project

School Team Mini - Grants

SVMI's 3 Basic Principles

- Our central focus is on student learning.
- Elicit and use students' thinking to inform learning.
- Support teachers within the classroom and collaborating.

Teaching

The most significant factor in student learning

We Must Focus on Instruction

"Teaching has 6 to 10 times as much impact on achievement as all other factors combined … Just three years of effective teaching accounts on average for an improvement of 35 to 50 percentile points."

Schmoker (2006, p.9)

Good Instruction Makes A Difference

Good teaching can make a significant difference in student achievement, equal to one effect size (a standard deviation), which is also equivalent to the affect that demographic classifications can have on achievement.

Paraphrase Dr. Heather Hill, University of Michigan

"There is more variability in teachers within a school than there is teaching between schools."

Phil Daro

Our research indicates that there is a 15% variability difference in student achievement between teachers within the same schools.

Deborah Loewenberg Ball

"What Matters Very Much is Which Classroom"

If a student is in one of the most effective classrooms he or she will will learn in 6 months what those in an average classroom will take a year to learn. And if a student is in one of the least effective classrooms in that school, the same amount of learning take 2 years.

Most effective classes learn 4 times the speed of least effective.

Dylan Wiliams, University of London

Stanford University School of Education

We were led to teacher professional development as the fundamental lever for improving student learning by a growing research base on the influences on student learning, which shows that teacher quality trumps virtually all other influences on student achievement.

(e.g., Darling-Hammond, 1999; Hamre and Pianta, 2005; Hanushek, Kain, O'Brien and Rivken, 2005; Wright, Horn and Sanders, 1997)

Lesson Study

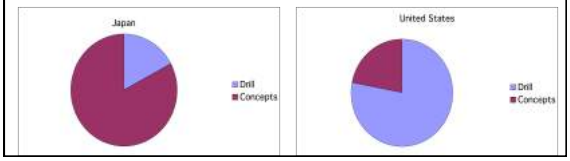
Learning from Student Work

Professional development that is going to make a difference to students in the classroom must be teacher-driven and student-focused. Lesson study is both of these things.

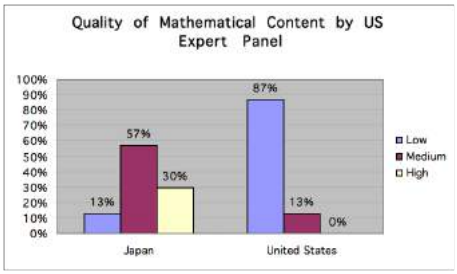
Principal Lynn Liptak, Paterson P.S. #2

Third International Math and Science Study

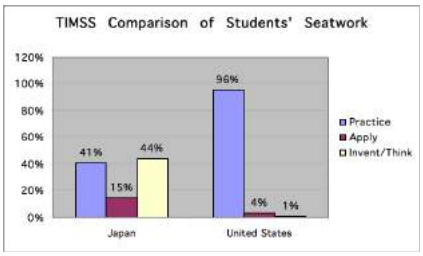
"Mathematical thinking, such as exploring, developing and understanding concepts, or discovering multiple solutions to the same problems, was described as the goal of of the lesson by 71% of Japanese teachers compared with 24% of U.S. teachers." TIMSS Pursuing Excellence 1996



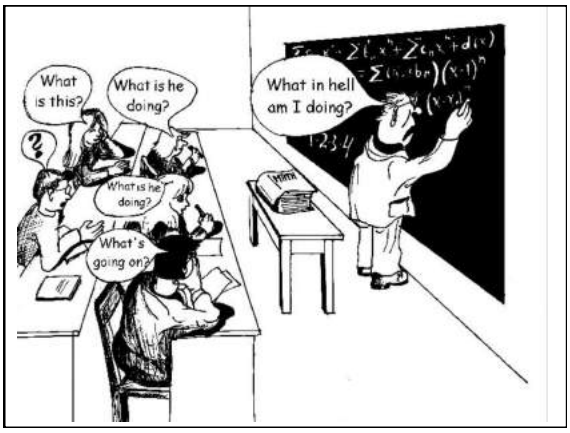
"U.S. teachers rarely developed concepts, in contrast to Japanese teachers, who usually did."



"The U.S. emphasis on skills rather than understanding is also carried over into the type of mathematical work that students are assigned to do at their desks during class."



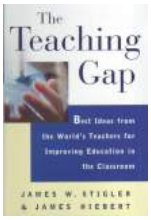
Let's Start by Watching a Math Classroom Video



In contrast to expert recommendation that well-taught lessons focus on having students think about and come to understand mathematical concepts, U.S. eighth-grade mathematics teachers usually explained that the goal of their lesson was to have students acquire particular skills.

Pursuing Excellence, 1996

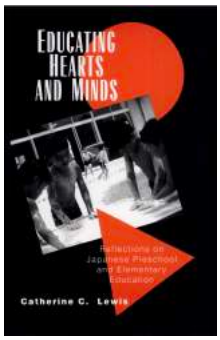
Teachers are the Key



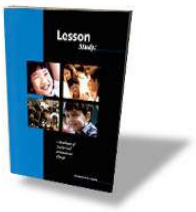
Improving something as complex and culturally embedded as teaching requires the efforts of all the players, including students, parents and politicians. But teachers must be the primary driving force behind change. They are the best positioned to understand the problems that students face and to generate possible solutions.

James Stigler and James Hiebert,
The Teaching Gap

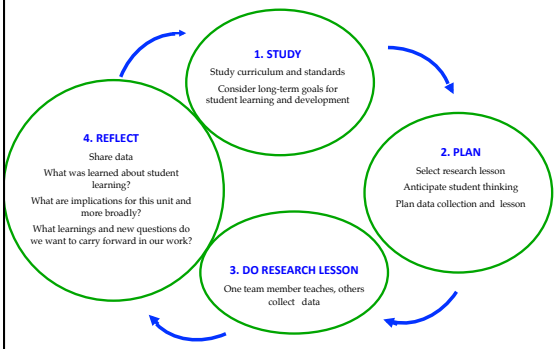
SVMI PD 1998-99 School Year



Lesson Study Group at Mills College



Lesson Study Cycle



Learning from the Experts

SVMI was one of the first organizations to invite Japanese LS experts to American

Akihiko Takahashi

(Japanese Lesson Study/TTP – Teaching Through Problems)

You think you understand something

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Novel Situation

83 - 28

103 - 28

→ Confusion

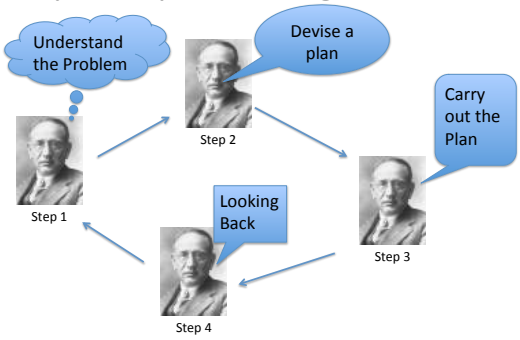
disequilibrium

Perseverance

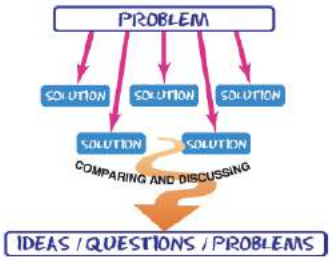
↓

True Understanding and New Learning

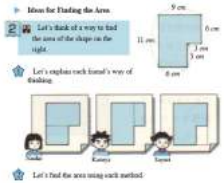
Polya's Steps to Solving a Problem

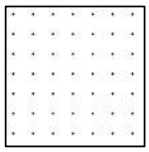


Teaching Through Problem Solving



Dr. Takahashi's research lessons were based upon student's thinking





An example of preparing a research lesson

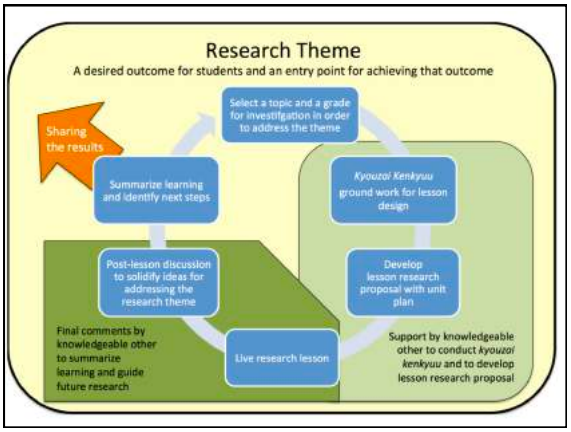
1) Decide on the topic of the research lesson and who will teach the lesson. Develop a rough idea of a lesson plan and conduct *kyozaikenkyu* related to the topic.
2) **Three weeks before the research lesson:** The first lesson-planning meeting is held to discuss the rough draft to check for consistency with other grade groups' approaches.
3) Develop the first draft of the lesson plan based on the discussion at the first meeting.
4) **Two weeks before the research lesson:** The second lesson-planning meeting is held to discuss the lesson plan and the team's focus strategies.
5) Update the draft lesson plan and the focus strategies.
6) **One week before the research lesson:** Finalize the lesson plan and send it to the invited final commentator of the research lesson (the knowledgeable other) via express mail, including a handwritten letter by the teacher who will teach the lesson.
7) Print the lesson plan. Share the tasks needed to prepare for the research lesson, including the preparation of materials such as manipulatives, posters, and worksheets.
8) **On the day of the research lesson:** Conduct the research lesson and the post-lesson discussion. Support the teacher who teaches the research lesson.

Note: Although each grade group is mainly responsible for the preparation and execution of its lesson, the above preparations should be done through the grade band team's collaboration.

Highland's School

"Lesson study changes each one of us a little bit, thereby changing the school."

-- Highlands Teacher



How Does Lesson Study Affect Student Achievement?

Two Analyses:

1. How treatment and comparison students performed on math tasks that directly related to the research lessons planned and taught in the lesson study project?
2. How treatment and comparison students performed on performance assessment exams across all core ideas assessed?

The pattern of scores in both analyses indicates the students in the classrooms of teachers who participated developed more knowledge and skills than they those in the classrooms of all teachers. These results are robust across grades, districts and analyses.

Data from fifty classroom teachers, one RSP teacher, several coaches, and 1936 students participated in the Lesson Study program during the 2009-10 school year was provided for this analysis.

Data Analysis, Evaluation of the 2009-10 Lesson Study Project - Waterman

What teachers value about lesson study

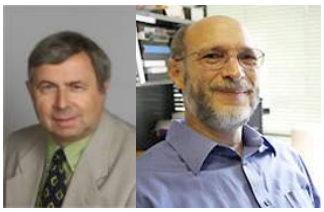
- Teachers feel like professionals – in charge of their own professional learning.
- They value the opportunity to collaborate to solve common problems of learning.
- Teachers develop deeper understanding of mathematics and student learning and how they play out across the grade levels.
- They collaborate and create lessons and activities that can be used immediately in their classrooms.
- Teachers gain important insights about instructional practices that extend well beyond the specific lesson designed.
- They learn to focus on student thinking and the conceptions the students hold.

Case Study

How lesson study fostered an innovation in teaching that transforms intervention, remediation and re-teaching.

Next Generation Performance Assessments

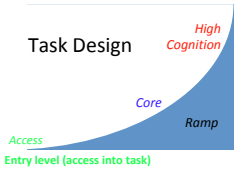
MARS – Summative and Formative Assessment Tests



MARS Team
Mathematics Assessment Resource Service

Performance Assessments

To Inform Instruction And Measure Higher Level Thinking



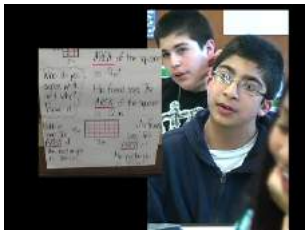
Entry level (access into task)
Core Mathematics - (meeting standards)
High Cognition (conceptually deeper, beyond)

- The original task design was developed by Mathematics Assessment Resource Service (MARS) is an NSF funded collaboration between U.C. Berkeley and the Shell Centre in Nottingham England.
- The Assessments target grades K – Algebra 2 - Trigonometry and are aligned with the Common Core State Math Standards.

SHELL CENTRE | BALANCED ASSESSMENT | MARS | SVMI SILICON VALLEY MATHEMATICS INITIATIVE

Formative Assessment

Navigating the Assessment Cycle to Inform Instruction



Looking at Student Work

The process of studying student work is a meaningful and challenging way to be data-driven, to reflect critically on our instructional practices, and to identify the research we might study to help us think more deeply and carefully about the challenges our students provide us. Rich, complex work samples show us how students are thinking, the fullness of their factual knowledge, the connections they are making. Talking about them together in an accountable way helps us to learn how to adjust instruction to meet the needs of our students.

Annenberg Institute of School Reform

Educational Research:
Formative Assessment and Student Work to Inform Instruction

- *Assessing Student Outcomes*; Marzano, Pickering, McTighe
- *Inside the Black Box*; Black,Wiliams
- *Understanding by Design*; Wiggins, McTighe
- *Results Now*; Schmoker
- *Professional Learning Communities at Work*; Dufour, Eaker
- *Accountability for Learning*; Reeves
- *Math Talk Learning Community*; Fuson, et al
- *Normalizing Problems of Practice*; Little, Horn
- *Change the Terms for Teacher Learning*; Fullan
- *Working toward a continuum of professional development*; Loucks-Horsley, et al.

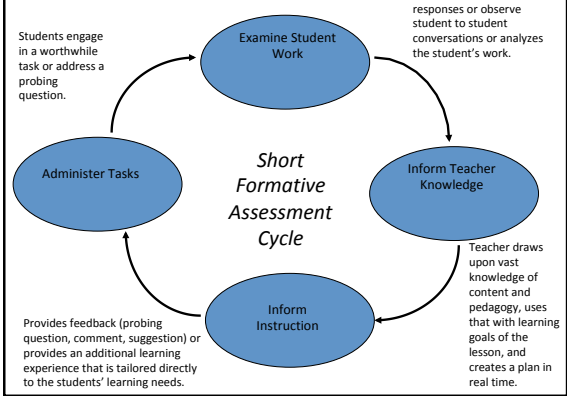
Inside the Black Box

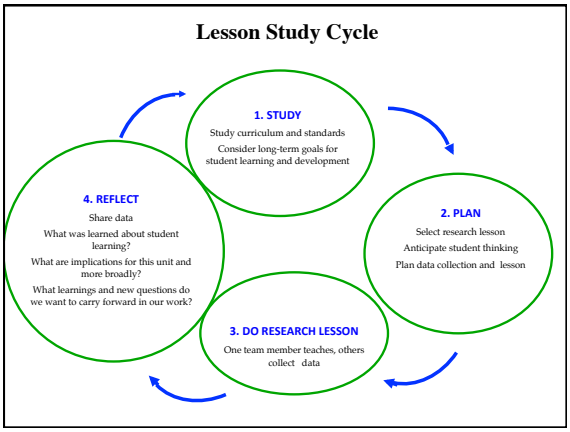
by Paul Black and Dylan Wiliam, *Phi Delta Kappan*, copyright 1998 http://blog.discoveryeducation.com/assessment/files/2009/02/blackbox_article.pdf

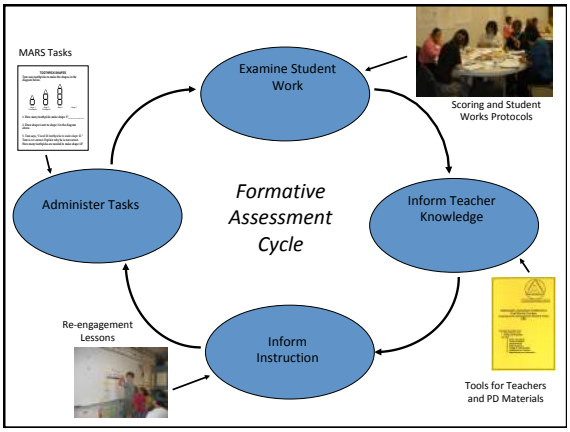

Inside the Black Box
Raising Standards Through Classroom Assessment

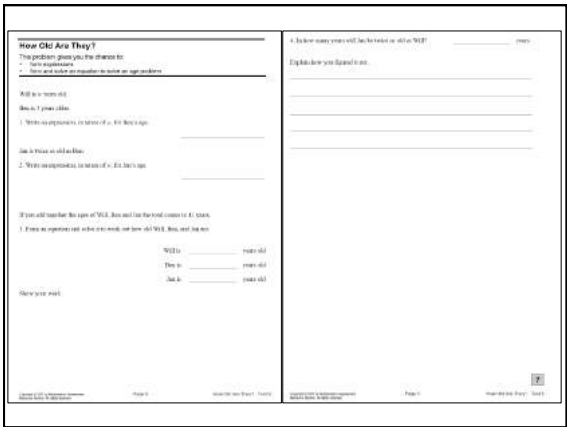
Follow up research:

Working Inside the Black Box








How Old Are They?

This problem gives you the chance to:
- form expressions
- form and solve an equation to solve an age problem

Will is w years old.

Ben is 3 years older.

1. Write an expression, in terms of w, for Ben's age.

Jan is twice as old as Ben.

2. Write an expression, in terms of w, for Jan's age.

If you add together the ages of Will, Ben and Jan the total comes to 41 years.

3. Form an equation and solve it to work out how old Will, Ben, and Jan are.

Will is _____ years old
Ben is _____ years old
Jan is _____ years old

Show your work.

4. In how many years will Jan be twice as old as Will? _____ years

Explain how you figured it out.

_____

_____

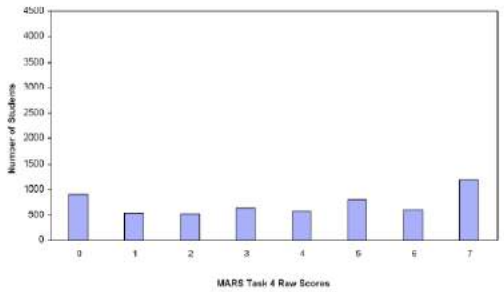
_____

_____

_____

Task 4 - How Old are They?

Mean: 3.79 StdDev: 2.48



The maximum score available for this task is 7 points.
The minimum score for a level 3 response, meeting standards, is 5 points.

1. Write an expression, in terms of *w*, for Ben's age.

Jan is twice as old as Ben.

2. Write an expression, in terms of *w*, for Jan's age.

1. Write an expression, in terms of *w*, for Ben's age.

w-3

Jan is twice as old as Ben.

2. Write an expression, in terms of *w*, for Jan's age.

12w-3

1. Write an expression, in terms of *w*, for Ben's age.

Jan is twice as old as Ben.

2. Write an expression, in terms of *w*, for Jan's age.

3. Form an equation and solve it to work out how old Will, Ben, and Jan are.

Will is 3 years

Ben is 6 years

Jan is 12 years

Show your work.

3x2=6

6x2=12

4. In how many years will Jan be twice as old as Will? 3 years

Explain how you figured it out.

I figued this out because I doubled the x numbers.

4. In how many years will Jan be twice as old as Will? 7 years

Explain how you figured it out.

I first subtracted 8 from 22 to get 14. Then I divided 14 by two because each year is the same as two years for Will because you have to multiply his age by 2 to see if it is half as much as Jans. I also made a table to check my work.

W	9	10	11	12	13	14	7
J	22	23	24	25	26	27	28

How Old Are They?

Points	Understandings	Misunderstandings
0	69% of the students with this score attempted the problem.	Students were confused about writing an expression for Ben's age. Some tried to give a numerical value, such as w=3. Others used an incorrect operation, such as y=w-3 or 3w.
1	Students could express symbolically an additive relationship.	Students didn't understand the constraints of the relationships. Almost 5% of the students thought Will was 32. 10% of the students gave answers where Jan was not twice Ben's age. More than 20% gave answers that did not add to 41.
3	Students could write an additive expression and find the ages of the three children.	Students did not use algebra to find the ages of the students. More than 30% of the students used guess and check.
5	Students could write an additive expression, find the ages of the three children, and find the elapsed time for when Jan would be twice as old as Will.	17% of the students did not attempt part 4 of the task. 10% thought it was impossible because Jan was already more than twice Will's age. 4% made tables but couldn't interpret the elapsed time and thought it would be 7 years. About 3% gave negative answers for elapsed time.
6		Students with this score struggled with using algebra to solve for the students ages in part 3 or writing an algebraic expression for Jan's age.18% 11% added a new variable, 2b. 8% wrote 2w, ignoring the "+3". 5% forgot the parentheses, e.g. w+3*2 or 2w+3. 3% tried to use exponents.

Re-teaching vs. Re-engagement

- Teach the unit again.
- Address basic skills that are missing.
- Do the same or similar problems over.
- Practice more to make sure student learn the procedures.
- Focus mostly on underachievers.
- Cognitive level is usually lower.

- Revisit student thinking.
- Address conceptual understanding.
- Examine task from different perspective.
- Critique student approaches/ solutions to make connections.
- The entire class is engaged in the math.
- Cognitive level is usually higher.

Teachers in other districts, as well, were applying "re-engagement" to various mathematical topics. Many teachers had seen the re-engagement strategy demonstrated in public research lessons taught during annual meetings of the regional lesson study network. For example, SMFCSD teacher Mareva Godfrey (who observed Fisher's group at the January, 2008 regional network meeting) tried out re-engagement in her teaching. She wanted to try it because

> ... typically, our math…program asks us to invite students to come up and share different algorithms they used, *but for the same answer, the correct one* [emphasis added]. This [using re-engagement] gave me an opportunity to look through the student papers [after the lesson], group answers, whether right or wrong, and look for patterns in misconceptions. Then the students addressed the misconceptions through the discussion. Of course, the correct answer and the different ways of solving the problem were also discussed.

Catherine Lewis, 2012

Affects on our work in SVMI

Lesson Study has been the lens of change:

- De-privatize teaching – End to teacher isolation – Informs math instruction.
- In how we examine student thinking, student work and design future learning experiences, curricula and assessments.
- Fostered a major shift in how we conduct professional development (focused on student thinking).
- How and what to value from our performance assessments.
- The tools we created to assist us in our work (Toolkits, student analysis instruments, Number Talks, POMs, lesson planning, etc.).
- The need for and methodology in the design of re-engagement lessons.
- LS has become the highest form of professional development and professional learning of teachers, math coaches and school leaders.

There are two versions of math in the lives of many Americans: the strange and boring subject that they encountered in classrooms and an interesting set of ideas that is the math of the world, and is curiously different and surprisingly engaging. Our task is to introduce this second version to today's students, get them excited about math, and prepare them for the future.

— Jo Boaler —

AZQUOTES

NOYCE FOUNDATION

Raising Expectations – *Jo Boaler & David Foster*

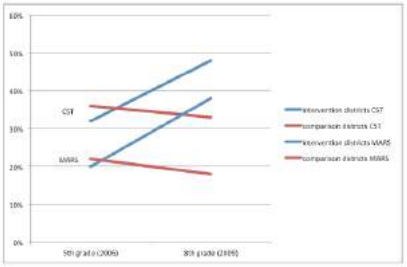
Raising Expectation and Achievement
Dr. Jo Boaler and David Foster

- Eight school districts in the Bay Area made a commitment at the start of the project to teach high-level mathematics to all students.
- In the comparison districts math instruction remained traditional.
- The intervention teachers engaged students in problem solving, conceptual understanding, balanced with skills as called for in the CCSSM.
- In the spring of each of the 4-year study the summative MARS Performance Exam was administered to students in both groups.

Student Demographics	Intervention Districts	Comparison Districts
Percent of Students that Qualify for NSLP	30%	25%
English Language Learners	21%	17%
American Indian, African American, Hispanic/Latino, Pacific Islander and Filipino	65%	59%
Parent Education - No College	43%	38%

	Intervention Districts	Comparison Districts
Middle School Students Studied	2489	6378
Percent of Students Meeting Standard CST 2006	32%	36%
Percent of Students Meeting Standard MARS Performance Assessment 2006	20%	22%

Raising Expectations and Achievement



Inside Mathematics Website

http://www.insidemathematics.org

Mathematics Assessment Pro
UC Berkeley & Shell Centre for Mathematical Education

http://map.mathshell.org/materials/lessons.php

Silicon Valley Mathematics Initiative

http://www.svmimac.org