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 Resources and Programs

• Professional Development
  - Summer Institutes and Math Workshops throughout the school year
  - Problems of the Month
  - 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.

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.
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 Williams, University of London
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; Hamme 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 Lyn 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 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.”

Quality of Mathematical Content by US Expert Panel

Let’s Start by Watching a Math Classroom Video

“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

1. **STUDY**
   - Study curriculum and standards
   - Consider long-term goals for student learning and development

2. **PLAN**
   - Select research lesson
   - Anticipate student thinking
   - Plan data collection and lesson

3. **DO RESEARCH LESSON**
   - One team member teaches, others collect data

4. **REFLECT**
   - Share data
   - What was learned about student learning?
   - What are implications for this unit and more broadly?
   - What learnings and new questions do we want to carry forward in our work?

Learning from the Experts

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

Akihiko Takahashi
(Japanese Lesson Study/TTP – Teaching Through Problems)

- You think you understand something
- Novel Situation
- Dis-equilibrium
- Confusion
- Perseverance
- True Understanding and New Learning

Polya’s Steps to Solving a Problem

- Understand the Problem
- Devise a plan
- Carry out the Plan
- Looking Back

Teaching Through Problem Solving

- Dr. Takahashi’s research lessons were based upon student’s thinking
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 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 2396 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

Performance Assessments
To Inform Instruction And Measure Higher Level Thinking

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.

Educational Research:
Formative Assessment and Student Work to Inform Instruction

- Assessing Student Outcomes; Marzano, Pickering, McTighe
- Inside the Black Box; Black, Williams
- 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, Ph.D.
Delta Kappan, copyright 1998

Follow up research:
Working Inside the Black Box

Lesson Study Cycle

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What was learned about student learning?
What are implications for the unit and classroom?
What learnings and new questions do you want to carry forward in your work?

MARS Tasks
Tools for Teachers and PD Materials
Re-engagement Lessons
Scoring and Student Works Protocols

How Old Are They?
This problem gives you the chance to:
• Find a formula for expressing the life span of a tree in years in terms of its age
• Solve the problem of finding the age of a tree in years

Name _______________________
Class _______________________
Date _______________________

1. Write an expression, in terms of x, for the tree’s age

2. Write an expression, in terms of y, for the tree’s age

How old is it? ________________________
How old is it? ________________________
How old is it? ________________________
4. In how many years will she be twice as old as Bill?

Explain how you figured it out.

1. Write an expression, in terms of w, for John's age.
   John is twice as old as Bill.
   \[ w = 2 \times 3 \text{ years} \]

2. Write an expression, in terms of w, for Bill's age.
   Bill is 3 years old.
   \[ w - 3 \]

3. Write an expression, in terms of w, for John's age.
   John is twice as old as Bill.
   \[ w - 3 \times 2 \text{ years} \]

How Old Are They?

<table>
<thead>
<tr>
<th>Points</th>
<th>Understanding</th>
<th>Misunderstandings</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Students could write an additive expression and find the ages of the three children.</td>
<td>Students did not use digits to find the ages of the children. More than 30% of the students used words and numbers.</td>
</tr>
<tr>
<td>5</td>
<td>Students could write an additive expression, find the age of the older sibling, and find the age of the younger sibling.</td>
<td>Students did not use digits to find the age of the older sibling. More than 30% of the students used words and numbers.</td>
</tr>
<tr>
<td>4</td>
<td>Students could write an additive expression, find the age of the older sibling, and find the age of the younger sibling.</td>
<td>Students did not use digits to find the age of the older sibling. More than 30% of the students used words and numbers.</td>
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<td>Students could write an additive expression, find the age of the older sibling, and find the age of the younger sibling.</td>
<td>Students did not use digits to find the age of the older sibling. More than 30% of the students used words and numbers.</td>
</tr>
<tr>
<td>2</td>
<td>Students could write an additive expression, find the age of the older sibling, and find the age of the younger sibling.</td>
<td>Students did not use digits to find the age of the older sibling. More than 30% of the students used words and numbers.</td>
</tr>
<tr>
<td>1</td>
<td>Students could write an additive expression, find the age of the older sibling, and find the age of the younger sibling.</td>
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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.

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

Raising Expectations — Jo Boaler & David Foster

NOYCE FOUNDATION
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.

<table>
<thead>
<tr>
<th>Student Demographics</th>
<th>Intervention</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Students from Qualify for NCLB</td>
<td>30%</td>
<td>29%</td>
</tr>
<tr>
<td>ENGLISH LANGUAGE LEARNER</td>
<td>24%</td>
<td>17%</td>
</tr>
<tr>
<td>American Indian, African American, Hispanic, Asian, Pacific Islander</td>
<td>64%</td>
<td>58%</td>
</tr>
<tr>
<td>Percent of Students - No College</td>
<td>4%</td>
<td>3%</td>
</tr>
</tbody>
</table>

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<tr>
<th></th>
<th>Intervention</th>
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</tr>
</thead>
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<tr>
<td>Middle School</td>
<td>76%</td>
<td>61%</td>
</tr>
<tr>
<td>Percent of Student Meeting Standard CST 200</td>
<td>72%</td>
<td>26%</td>
</tr>
<tr>
<td>Percent of Student Meeting Standard MARS Performance Assessment V05</td>
<td>70%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Silicon Valley Mathematics Initiative (SVMI)

Combining 20 Years of Improving Mathematics Instruction & Student Learning:
State, Region, District, Professional Development, Teacher, Student Success, Parents, Partners

Inside Mathematics Website

http://www.insidemathematics.org

Mathematics Assessment Project

UC Berkeley & Shell Centre for Mathematical Education

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

Silicon Valley Mathematics Initiative

http://www.svmimac.org