The Real Change Agents: Building Professional Learning Community

By David Foster
Silicon Valley Math Initiative
www.noycefdn.org/math/resources
Outline of Presentation

• A Context: International, National and State Math Achievement.
• Pathways and Pitfalls in High School
• What are effective instructional practices?
• A case for PLC as a long term solution.
• What effective PLCs have done.
• How to get started.
The world has been flattened.

The number of jobs requiring science and engineering skills in the US labor force is growing almost 5 percent per year.

Two-thirds of the nation’s mathematics and science teaching force will retire by 2010.

The number of Americans who graduate with just engineering degrees is 5 percent, as compared to 25 percent in Russia and 46 percent in China.

In the fiscal 2005 budget passed by the Republican Congress in November 2004, the budget for the National Science Foundation was actually cut by 1.9 percent.

The brain gain started to go to brain drain around the year 2000.

It is a truism, but the more educated you are, the more options you will have in the flat world
"Kevin will be giving my report on outsourcing."
PISA uses a concept of mathematical literacy that is concerned with the capacity of students to analyse, reason and communicate effectively as they pose, solve and interpret mathematical problems in a variety of situations involving quantitative, spatial, probabilistic or other mathematical concepts.

The highest percentage of students at Levels 5 and 6 were found in Korea (27%) and the partner Chinese-Taipei (32%). Finland, Switzerland, Belgium and the Netherlands all had more than 20% of students at these top levels (Table 6.2a).

The United States of America (ranked 35 out of 57)

PISA is a triennial survey of the knowledge and skills of 15-year-olds. It is the product of collaboration between participating countries and economies through the Organisation for Economic Co-operation and Development (OECD), and draws on leading international expertise to develop valid comparisons across countries and cultures.

More than 400,000 students from 57 countries making up close to 90% of the world economy took part in PISA 2006. The focus was on science but the assessment also included reading and mathematics and collected data on student, family and institutional factors that could help to explain differences in performance. This report summarises the main findings.

Source: OECD PISA 2006 database, Figure 6.20b, PISA 2006: Science Competencies for Tomorrow’s World. StatLink  http://dx.doi.org/10.1787/142046885031
Comparing Mathematics Instruction between the USA and High Performing Countries
The experience of these top school systems suggests that three things matter most:

1) getting the right people to become teachers

2) developing them into effective instructors

3) ensuring that the system is able to deliver the best possible instruction for every child.

How the World’s Best-performing School Systems Come Out on Top
The Economist findings from PISA

• Tracking hurts weak performing students without benefiting the rest
• Rising tides lift all boats - countries do well either by children of all abilities or by none
• Top performing Finland - the differences between schools are nearly trivial
• Poland is the posterchild for improvement by untracking: not increased spending but 1999 reforms
• Local/site control - budget, incentives, hiring, pay - improves a country's position internationally
• Teacher quality most important
Are we really doing as poor as everyone is saying?

No, as a nation we are actually improving, just not as fast as some other nations.
How do we compare nationally, state by state?
National Perspective
Mathematics Performance Discrepancies in 2005: State Test Performances Versus NAEP Performances

- There were only three states in which the NAEP\(^1\) performance percentage was higher than the state performance percentage: Hawaii (1 percent); Massachusetts (9 percent); and Wyoming (4 percent).

- For the remaining 42 states, the discrepancies in the two percentages, with the state percentages being equal to or greater than the NAEP percentages, ranged from 0 percent (Maine) to 60 percent (Colorado and Mississippi). The grade 4 performance discrepancy gaps were grouped as follows.
  - 0 to 10 percent: 2 states (ME, SC)
  - 11 to 20 percent: 7 states (AR, KY, MO, MT, NM, RI, WA)
  - 21 to 30 percent: 5 states (CA, FL, NV, OH, PA)
  - 31 to 40 percent: 10 states (AK, CT, IN, KS, LA, MD, MI, MN, NJ, WI)
  - 41 to 50 percent: 14 states (AZ, DE, GA, ID, IL, IA, NE, NY, OK, OR, SD, TX, VA, WV)
  - 51 to 60 percent: 4 states (AL, CO, MS, NC)

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Primary Progress, Secondary Challenge: A State-by-State Look at Student Achievement Patterns
The Education Trust American Association for Higher Education, 2006

\(^{1}\) NAEP 2005 4th Grade
Is our students’ math education making a difference in their lives and future opportunities?
The longer we teach them, the worse they perform.
ONE CHILD LEFT BEHIND

USA

NCLB

CONGRESS

STOP
What Happens in High School?
"I see trouble with algebra."

Courtesy of Cheryl Anderson
“As part of a series of studies on effective urban middle schools, we asked district researchers to track free and reduced lunch-eligible students from the middle schools we identified into high school. The findings were truly depressing. We estimated that three years in an exemplary middle school added about twenty-five percentage points to kids scores on state tests—which is quite meaningful. As much as 80% of that effect was erased on one year of comprehensive high school. While 80% was the worst case, the erosion was high in all the schools we studied from the six urban districts.”

Uri Triesman, Phd., Dana Center, University of Texas
The Drop-Out Disaster

1. Nationally, about one-third of all high school students fail to graduate with their class.

2. For whites and Asian students, the graduation rate is about 75 percent; for minority students (African-American, Hispanic, Native American), the rate is about 50 percent.

3. In 2003, there were 3.5 million Americans aged 16 to 25 who had not graduated from high school and who were not enrolled in school.
Sorry, Bob. We need someone who thinks outside the box.
Where do misconceptions come from?
7th Grade Geometry Task

This problem gives you the chance to:
• reason about similar figures and scale factor

Here are some right triangles.

1. Which of the triangles on the opposite page are congruent to triangle A?

Explain your reasons.

2. Which of the triangles on the opposite page are similar to triangle A?

Explain how you decided.

3. If triangle A is enlarged by a scale factor of 3, what will the area of the new triangle be?

Show your work.
Score Distribution for 7th Grade Similar Triangles

![Score Distribution Chart]

The chart shows the percent of students per score for similar triangles. The x-axis represents points awarded, ranging from 0 to 8, and the y-axis shows the percent of students per score, ranging from 0% to 35%. The chart includes data for 7th grade scores, with the highest percentage of students scoring between 2 and 4 points.
Misconception students illustrated in their work on Similar Triangles

- Students thought the orientation of the figure mattered in whether figures were similar (they both face the same way).
- Students believe that all triangles are similar or all rectangles are similar.
- Students misinterpreted how to measure length of figures on graph paper.
- Students added the scale factor, instead of multiplying to find proportional enlargements of the lengths.
- Students seldom identified that a similar figure could be smaller in size. (go from large triangle to small triangle)
**Similarity**

**Goal: Using Properties of Similar Figures**

If the corresponding angles of two figures are congruent and the ratios of the lengths of their corresponding sides are equal, the figures are similar. Similar figures are the same shape, but are not necessarily the same size. So, two congruent figures are always similar, but two similar figures are not necessarily congruent. In the diagram below, quadrilateral $ABCD$ is similar to quadrilateral $EFGH$. You can write this statement as $ABCD \sim EFGH$.

**Example: Properties of Similarity**

$\triangle ABC \sim \triangle DEF$: Describe the relationships among the angles and sides of the triangle.

**Solution**

Corresponding angles are congruent. That is, $\angle A = \angle D$, $\angle B = \angle E$, and $\angle C = \angle F$.

The ratios of the lengths of corresponding sides are equal. The lengths of corresponding sides $BC$ and $EF$ are given, so this ratio is $3:5$.

- $\frac{BC}{EF} = \frac{AB}{DE} = \frac{AC}{DF} = \frac{3}{5}$

Find the length of $RS$.

**Solution**

Because two angles of $\triangle RST$ are congruent to two angles of $\triangle UVW$, $\triangle RST \sim \triangle UVW$ by the AA similarity postulate. Write and solve a proportion to find the length of $RS$.

$$\frac{RS}{UV} = \frac{ST}{VW}$$

Write proportion.

$$\frac{8}{5} = \frac{5}{x}$$

Substitute.

$$8x = 30$$

Cross product property.

$$x = 3.75$$

Divide each side by 8.

**Answer:** The length of $RS$ is 3.75 units.

If two polygons are similar, the ratio of the lengths of two corresponding side lengths is called the scale factor. In the triangles above, the scale factor of $\triangle RST$ to $\triangle UVW$ is $\frac{5}{8}$ or $\frac{3}{4}$.

**Example 2: Using a Scale Factor**

You are designing a poster to advertise the next meeting of the Space Club. You begin by sketching the design shown at the right. The scale factor of the actual poster to your sketch is 4:1. Find the height and the width of the actual poster.

**Solution**

Use the scale factor to find the height $h$ and the width $w$ of the poster.

- Poster height $= \frac{4}{1}$ (Sketch height)
- Poster width $= \frac{4}{1}$ (Sketch width)

$$\frac{h}{3 \text{ inches}} = \frac{4}{1}$$

$$h = 4(3)$$

$$h = 28$$

$$\frac{w}{5 \text{ inches}} = \frac{4}{1}$$

$$w = 4(5)$$

$$w = 20$$

**Answer:** The poster has a height of 28 inches and a width of 20 inches.
Sheer imitation, dictation of steps to be taken, mechanical drills may give results most quickly and yet strengthen traits likely to be fatal to reflective power.

John Dewey, 1910
Teaching Matters

To Really Improve Student Learning - Invest in Teachers
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*
Teacher Knowledge

“Teaching mathematics requires an appreciation of mathematical reasoning, understanding the meaning of mathematical ideas and procedures, and knowing how ideas and procedures connect.”

Ball, 1990
“There is more variability in teachers within a school than there is teaching between schools.”

Phil Daro
“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
Documenting Pockets of Success

2007 CST Math Scores - Proficient and Advanced
Activities of Successful PLCs
Article about the need for professional learning communities

THOUGHT LEADER

Michael Fullan

Change the terms for teacher learning
Professional development as a term and as a strategy has run its course. The future of improvement….depends on a radical shift in how we conceive learning and the conditions under which teachers and students work.

Five key ideas:

1. Professional development as a term is a major obstacle to progress in teacher learning;

2. Improvement above all entails ‘learning to do the right things in the setting where you work’ [Richard Elmore 2004, p 73]

3. Student learning depends on every teacher learning all the time;

4. The first three components depend on deprivatizing teaching as teachers work together to continuously improve instruction;

5. Teachers’ working conditions are inimical to the four previous points.

Understand these five ideas and their interrelationships and you will understand the future of teacher learning over the next decade.

Michael Fullan, University of Toronto, Thought Leader; Change the terms for teacher learning
Position on Professional Learning

Key elements of intensive and sustained high quality, content-based professional learning must:

• reflect a well-defined vision of quality mathematics and effective classroom practices.
• provide opportunities for teachers to enhance their mathematical knowledge and skills.
• To improve teachers’ classroom practice and lesson planning.
• Be situated in the context of the teachers’ work environment.
• Provide time and resources for teachers to work in collaborative teams.
• Be sustained and focused on student learning.
• Promote high-quality, content-based teaching and address equitable outcomes for all students.
• Allow time for mathematics teacher to practice and reflect on various methods for teaching and representing mathematics content.
PROFESSIONAL LEARNING COMMUNITIES

Focus on Learning
Culture of Collaboration
Focus on Results
Professional Learning Communities

The First Big Idea

Dufour, et. al
In a learning community . . .

- the people in the organization have a clear sense of the mission they are to accomplish and a shared vision of the conditions they must create to achieve their missions
- work together in collaborative teams that engage in collective inquiry into both best practices for accomplishing their aims and the current reality of the conditions in their organization
- team engages in a cycle of continuous improvement – gathering and analyzing data and information, identifying weaknesses and areas of concern, working together to develop strategies to address specific weaknesses and concerns
- team members support each other as they implement strategies, gather new data to assess the impact, and then start process all over again
- not an annual event, but ongoing process that drives the daily work of people in the team
- effectiveness is assessed on the basis of results, rather than intentions or activities

Defining a Learning Community, Rebecca Burnett DuFour
Content for PLC’s Work
Lesson Study

- Lesson is taught and observed by team and occasionally “others”
- Team reflects, revises, sometimes reteaches
- Teams share findings with entire staff and through school network
- Focus for the next year’s work evolves from the learning that is shared among teams in alignment with district strategic plan
Lesson Study Group at Mills College

How Many Seats?
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?
Can patterns help us find an easy way to answer the question:

How many seats fit around any number of triangles, arranged in a row as shown?
<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Triangle Tables</td>
<td>Number of Seats</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
What we value about lesson study

- Teachers feel like professionals
- Valuable opportunity to collaborate to solve common problems
- Deeper understanding of mathematics and student learning and how they play out across the grade levels
- Collaboration opportunity to create lessons and activities that can be used immediately in class
- Important insights about instructional practices that extend well beyond the specific lesson designed
“One thing is to study whom you are teaching, the other thing is to study the knowledge you are teaching. If you can interweave the two things together nicely, you will succeed...Believe me, it seems to be simple when I talk about it, but when you really do it, it is very complicated, subtle, and takes a lot of time. It is easy to be an elementary school teacher, but it is difficult to be a good elementary school teacher.”

Quote from Tr. Wang, Ma 1999
Examining Student Work:
To Inform Instruction
Try the Task

A fourth-grade class needs 5 leaves each day to feed its 2 caterpillars. How many leaves would they need each day for 12 caterpillars?

Answer: ________________

Use drawings, words, or numbers to show how you got your answer.
MARS Task Anticipation Sheet

<table>
<thead>
<tr>
<th>Task Name: ____________________</th>
<th>Grade: _____</th>
<th>Year: _____</th>
<th>Tot Pts. _____</th>
<th>Core Pts. _____</th>
</tr>
</thead>
</table>

**In anticipating the student work where will students show success?**

<table>
<thead>
<tr>
<th>What parts of the task will students be successful?</th>
<th>In terms of knowing and doing mathematics what does this indicate?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**In anticipating the student work where will students struggle?**

<table>
<thead>
<tr>
<th>What parts of the task will students be unsuccessful?</th>
<th>In terms of knowing and doing mathematics what does this indicate? What understandings or skills do the students need to learn?</th>
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<tbody>
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</table>

**Considering strengths and weaknesses from students, what are plans for future teaching?**

<table>
<thead>
<tr>
<th>What are the implications for future instruction?</th>
<th>What specific instruction or lesson experiences will you design students?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examine the students work to determine:

- Mathematically valid solutions.
- How students approached and solved the problem.
- How one approach/solution relates to another.
- Characterize different approaches/solutions
Teaching Proportional Reasoning

As a function approach:

\[ y = m \cdot x \]

vs

As equivalent fractions will an unknown (cross-multiplication):

\[ \frac{a}{b} = \frac{c}{d} \]
Students’ Approaches to Caterpillar Problem

1. Students made a t-table (function table) comparing caterpillar to leaves eaten. Students counted by 2s to find the leaves eaten for 12 caterpillars.

2. Students used drawings - associating two caterpillars to five leaves. Students counted all leaves to find total for 12 caterpillars.

3. Students discovered a common scale factor of 6 to connect caterpillars and leaves. (2 x 6 = 12 and 5 x 6 = 30).

4. Students found the unit rate eaten by a single caterpillar then multiplied by 12 caterpillars to find total number of leaves. (5÷2=2 1/2 leave/caterpillar then 12 x 2 1/2 = 30 leaves).

5. Students multiplied 5 x 12 = 60 (leaves times caterpillars) and then divided by 2 to compensate for double counting since two caterpillars eat 5 leaves.
Watch Caterpillar Lesson
**MARS Task Analysis Sheet**

Task Name: ______________ Grade: _____ Year: _____ Tot Pts. _____ Core Pts. _____

**In analyzing the student work where did students show success?**

<table>
<thead>
<tr>
<th>What parts of the task did students demonstrate success?</th>
<th>In terms of knowing and doing mathematics what does this indicate?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**In analyzing the student work where did students struggle?**

<table>
<thead>
<tr>
<th>What parts of the task were students being unsuccessful?</th>
<th>In terms of knowing and doing mathematics what does this indicate? What understandings or skills do the students need to learn?</th>
</tr>
</thead>
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<td></td>
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**Considering strengths and weaknesses from students, what are plans for future teaching?**

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</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tom uses toothpicks to make the shapes in the diagram below.

**Shape 1**
- 6 toothpicks

**Shape 2**
- 9 toothpicks

**Shape 3**

1. How many toothpicks make shape 3? __________

2. Draw shape 4 next to shape 3 in the diagram above.

3. Tom says, “I need 36 toothpicks to make shape 12.” Tom is not correct. Explain why he is not correct. How many toothpicks are needed to make shape 12?

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**Cycle of Formative Assessment to Inform and Improve Learning**

- **Administer quality assessment tasks**
- **Collectively score and analyze student work**
- **Document student thinking to inform instruction.**
- **Leads to improved teaching and learning in the classroom.**
- **Drives the professional learning communities of the teachers.**

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**Leads to improved teaching and learning in the classroom**

**Cycle of Formative Assessment to Inform and Improve Learning**

**Administer quality assessment tasks**

**Collectively score and analyze student work**

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**Drives the professional learning communities of the teachers.**
ACTION RESEARCH CYCLE

Enacting a Lesson

- Sample Lesson: Teachers view model lesson during P.D.
- Classroom Instruction: Teachers teach model lesson to their own classes.
- Administer Assessment: Teachers administer assessment to their classes.
- Analyze Student Work: Using Tools for Teachers, math departments score and analyze student understanding revealed in the assessments.

Re-engaging with a Lesson

- Redesign Lesson: Teachers work together to redesign lesson.
- Re-teaching: Teachers teach redesigned lesson on their own classrooms.
- Assess Again: Teachers administer second assessment of same key ideas.
- Reflection Sharing 2nd Analysis: Design Lesson: Teachers work together.

During FiMC PD

- In individual teachers’ classrooms

In FiMC PD and Math Dept Meeting

- In Math Dept Meeting and FiMC PD.

Work with Math Coaches on building a PLC through Re-Engagement
Action Research Cycle

1. How this will work in your school around math?
2. Who will plan the sessions?
3. Who will lead the sessions?
4. How will you plan to engage the teachers who aren’t attending the PD?
Case Studies of Successful PLCs
Grant High School - Portland, Oregon

- The Math Department provided an intensive math program for struggling students by providing double period over two years. In two years the students completed 3 years of math - Pre Algebra, Algebra 1 and Geometry.
- The target students were predominantly ethnic minorities, disproportionate in numbers of below grade level achievement.
- The goal was to help students who entered high school behind in math to catch up, so they could enroll in higher-level math courses.
It is not just more time or different schedules that made the difference!

• The teachers looped with students for consistency over the two years.
• Four very experienced teachers taught the courses.
• They were all trained and used complex instruction.
• Used innovative and integrated curriculum modifying to provide access and enhance student interest.
• The principal supported the program by scheduling common planning periods for the four teacher.
• The teachers actively participate as a professional learning community maintain optimistic perspectives.
• The teacher sought out parents and communicated regularly.
## Grant High School Findings

### Percent of Students Enrolled in Algebra II

<table>
<thead>
<tr>
<th>Demographics</th>
<th>‘02–’03</th>
<th>‘03–’04</th>
<th>‘04–’05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>5.6</td>
<td>6.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Black</td>
<td>8.9</td>
<td>12.3</td>
<td>17.9</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2.3</td>
<td>2.4</td>
<td>4.3</td>
</tr>
<tr>
<td>White</td>
<td>83.2</td>
<td>80.6</td>
<td>72.7</td>
</tr>
<tr>
<td>NSLP</td>
<td>3.3</td>
<td>Na</td>
<td>20.9</td>
</tr>
</tbody>
</table>
Grant High School continued

Percentage At and Above the Proficient Level Oregan Statewide Math Assessment

<table>
<thead>
<tr>
<th>Demographics</th>
<th>‘02-’03</th>
<th>‘05 -’06</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>66</td>
<td>68</td>
</tr>
<tr>
<td>Asian</td>
<td>65</td>
<td>90</td>
</tr>
<tr>
<td>Black</td>
<td>25</td>
<td>31</td>
</tr>
<tr>
<td>Hispanic</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>White</td>
<td>75</td>
<td>81</td>
</tr>
<tr>
<td>NSLP</td>
<td>29</td>
<td>37</td>
</tr>
</tbody>
</table>
Railside High School Study

Dr. Jo Boaler
formally of Stanford University
Currently Marie Curie Professor at the University of Sussex, England
The Research Study

- The five year study involved 3 high schools, one urban and two suburban.

  **At the Urban District**
  - The study followed Students over 4 years
  - 700 students were studied
  - 600 hours of classroom observations, assessment, questionnaires.
  - 160 interviews with students.
Railside an Urban High School

Enrollment 1500

Ethnic Demographics

17% Asian
22% AfricanAmerican
49% Latino/Hispanic
11% White

English Learners 17%

Free & Reduced Lunch 41%

Parent Education
College Grads 11%
Findings from Student Achievement

• Results from the five year study of three high schools, Railside and two more affluent suburban high schools.
• Entering high school, the means scores of students at Railside were significantly behind compared to the two other schools (mean score 16 vs. 22).
• By the end of the first year (Algebra) the Railside students were outperforming the students in the other two schools.
• By the end of the second year the mean scores of Railside students was significantly higher than the other students (mean score 26 vs. 18).
• By their senior year 41% of Railside students were taking either pre-calculus or calculus versus 27% at the other two schools.
What is Unique

- The guiding theme is **equity for all!** It is a lot more than a slogan, it permeates all instructional decisions.
- The math department has worked together as a team for years and developed a common vision and culture, even though there has been significant turnover throughout the years.
- There is an intense hiring and induction process for new teachers.
- All classes are taught with the principles of Complex Instruction (*E. Cohen*) to address status issues.
- The curriculum is designed by the math dept. and pulls from reform math programs, CPM, IMP, etc.
Railside High School

Teaching for Meaning in an Equitable Classroom.

“No One is as Smart as All of Us Together”
Determine the perimeter of the arrangement of these algebra tiles.
Formative Assessment During Instruction

Discuss acts of assessment versus instruction.

How did the teacher assess the group?

How did she focus on student thinking?

Which student(s) benefited from the assessment? How?

What was learned during this portion of class time?

How does the teacher know, what was learned?
“Where is the Ten?”
Video Clip

Railside High School Study

Dr. Jo Boaler
Stanford University
Complex Instruction
No one of us alone is as smart as all of us together

Designing Groupwork: Strategies for the Heterogeneous Classroom
Elizabeth G. Cohen
Teacher College Press
Copyright 1994
ISBN 0-8077-3331-8
Comparison of Pass Rates

- A look at five neighboring high schools in an urban setting in California with similar demographics.
- Only one school, Railside, offers one type of double block Algebra 1 course.
- Other 4 high schools offer Algebra 1 and a two year Algebra 1a and 1b
- The percent of students getting into Algebra 2 by their junior year is significantly higher without a 2 year algebra sequence (see table)
<table>
<thead>
<tr>
<th>School</th>
<th>% NSLP</th>
<th>9th Graders in Algebra 1 or Algebra 1A or Algebra 1B 2004</th>
<th>10th Graders in Algebra 1 or Algebra 1A or Algebra 1B 2005</th>
<th>10th Graders in Geometry 2005</th>
<th>11th Graders in Algebra 1 or Algebra 1A or Algebra 1B 2006</th>
<th>11th Graders in Geometry 2006</th>
<th>11th Graders in Algebra II 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School with no 2 year algebra sequence</td>
<td>41%</td>
<td>52% (only Algebra 1)</td>
<td>38% (only Algebra 1)</td>
<td>38%</td>
<td>9% (only Algebra 1)</td>
<td>15%</td>
<td>33%</td>
</tr>
<tr>
<td>Other HS in District with 2 year Algebra sequence</td>
<td>12%</td>
<td>43%</td>
<td>33%</td>
<td>31%</td>
<td>13%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Neighbor HS 1 with 2 year Algebra sequence</td>
<td>31%</td>
<td>44%</td>
<td>49%</td>
<td>20%</td>
<td>13%</td>
<td>8%</td>
<td>21%</td>
</tr>
<tr>
<td>Neighbor HS 2 with 2 year Algebra sequence</td>
<td>31%</td>
<td>48%</td>
<td>35%</td>
<td>21%</td>
<td>32%</td>
<td>18%</td>
<td>12%</td>
</tr>
<tr>
<td>Neighbor HS 3 with 2 year Algebra sequence</td>
<td>49%</td>
<td>31%</td>
<td>51%</td>
<td>23%</td>
<td>23%</td>
<td>21%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Data Source: http://star.cde.ca.gov/star2006/Viewreport.asp
Railside Data from 2007 CST

- Railside’s 9th graders are above state averages for % of the class scoring proficient or above on WHATEVER math test taken. (state nslp 15% while Railside is 41%)
- Railside high school Algebra CST scores rank 7th of 50+ high schools in their county. (Only 3 comprehensive HS poorer than Railside in county)
- The number of African-American and Latino students from Railside HS scoring Proficient or Advanced on the Algebra exam is greater than that of any other high school in the county.
Focusing on Intervention Practices for Struggling Students

- Double periods/block, full year course
- Best teachers working with struggling students
- Teach for conceptual understanding
- Teachers attend to students’ self-image, productive disposition and status
- Pre-teach instead of remediate
- Arithmetic through the lens of algebra
Building Citizenship

“What makes the class good is that everybody’s at different levels so everybody’s constantly teaching each other and helping each other out.”

(Zane, Railside school)
Civil Rights

Thus, the work of students and teachers at Railside was equitable partly because they achieved more equitable outcomes on tests, with few achievement differences aligned with cultural differences, but also because they learned to act in more equitable ways in their classrooms. Students learned to appreciate the contributions of different students, from many different cultural groups and with many different characteristics and perspectives. It seemed to me that the students learned something extremely important, that would serve them and others well in their future interactions in society, which is not captured in conceptions of equity that deal only with test scores or treatment in schools.  

Dr. Jo Boaler
Democracy

It is commonly believed that students will learn respect for different people and cultures if they have discussions about such issues or read diverse forms of literature in English or social studies classes. I propose that all subjects have something to contribute in the promotion of equity and that mathematics, often regarded as the most abstract subject removed from responsibilities of cultural or social awareness, has an important contribution to make. For the respectful relationships that Railside students developed across cultures and genders that they took into their lives were only made possible by a mathematics approach that valued different insights, methods and perspectives in the collective solving of particular problems.

Dr. Jo Boaler
Problem vs. Dilemma

Problems can be solved

But

Dilemmas can only be managed

Larry Cuban
Stanford University
Where to Start? Beliefs about Teaching & Learning

• “Some students will always choose to fail, regardless of what we do in our schools and classrooms. It is impossible to help all students learn if students refuse to learn.”

• “We could help more of our students be successful if we were willing to work together to implement more effective practices.”

The Power of PLC at Work, 2007, Solution Tree
Why Students Struggle in Math Class?
Understanding the Challenge

• ‘low achievers’ are not slow learners they are learning a different mathematics

• The mathematics they are learning is ‘a more difficult form of mathematics’

Gray & Tall
Compression

“low achievers”

“high achievers”

Dr. Jo Boaler
Mathematics is amazingly compressible: you may struggle a long time, step by step, to work through the same process or idea from several approaches. But once you really understand it and have the mental perspective to see it as a whole, there is often a tremendous mental compression. You can file it away, recall it quickly and completely when you need it, and use it as just one step in some other mental process. The insight that goes with this compression is one of the real joys of mathematics.

W. T. Thurston
They become further apart from the flexible thinkers

“Their persistence in emphasizing procedures leads many children inexorably into a cul-de-sac from which there is little hope of future development.”
In one California district, student achievement was tracked from 5th grade to 8th grade over 4 years. The data is bleak.

If a student was proficient or advanced on the 5th grade CST math test, the chances of that student being proficient or advanced in 8th grade was 50%.

And if a student was far below basic on the 5th grade CST math test, the chances of that student being proficient or advanced in 8th grade was 0%.
What should be considered in an intervention plan?
System or Sieve?

- A system of interventions that catch students that need a little help and gives it
- Then catches those that need a little more and gives it
- Then those who need even more and gives it
- By layering interventions, minimize the number who fall through to most expensive

Phil Daro, UC Berkeley
<table>
<thead>
<tr>
<th>Situation of S</th>
<th>Needed by S</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeps up</td>
<td>Regular Instruction</td>
<td>None</td>
</tr>
<tr>
<td>Struggles some assignments</td>
<td>Extra feedback on work, thinking</td>
<td>Classroom Q&amp;A, partner, teacher’s ear</td>
</tr>
<tr>
<td>Not bringing enough from earlier lessons each day</td>
<td>Extra support with regular program</td>
<td>Homework clinic, tutoring, attention beyond regular class</td>
</tr>
<tr>
<td>Misconceptions disrupt participation</td>
<td>In depth concentration on troublesome concepts</td>
<td>Sustained instruction with special materials beyond regular class</td>
</tr>
<tr>
<td>More than a year behind, misconceptions from many years</td>
<td>Intensive ramp-up course</td>
<td>Designed double period ramp-up course, Summer schools</td>
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Copyright Phil Daro 2007
## Intervention Chart

<table>
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<tr>
<th>Situation of S</th>
<th>Needed by S</th>
<th>Intervention</th>
<th>Current Interventions</th>
<th>Capacity of current intervention</th>
<th>Actual numbers needed for S</th>
<th>Proposed interventions needed</th>
<th>Resources needed to either add or improve intervention</th>
</tr>
</thead>
<tbody>
<tr>
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Addressing Conceptual Understanding

America’s Choice - Navigator Program Program that focuses on conceptual understanding

Author: Malcom Swan formerly from Balanced Assessment, Nottingham, England
Problem: Number line

Where are $a+b$, $b-a$ and $a-b$?

What can you say about where $a/b$ is?
Always, Sometimes, or Never True

F.

To add one-half to a fraction you add 1 to the numerator and 2 to the denominator.

\[
\frac{a}{b} + \frac{1}{2} \rightarrow \frac{a + 1}{b + 2}
\]
Bell and Swan study
35^2 \times 469 y^3 = \\
17^3 \div 17 x^2 \\
\sqrt[15]{402} \\
\sqrt{x^2 + y^3} \\
472 \div 2^3 + y \\
I \heartsuit x^2 + 7.12

"I HAD MY DOCTOR DO A D.N.A. BLOOD ANALYSIS. AS I SUSPECTED, I'M MISSING THE MATH GENE."
Addressing Productive Disposition

\textit{Academic Youth Development}

Summer intervention program that focuses on students’ productive disposition and mathematics

Developed by Charles Dana Center, University of Texas and published on-line by Agile Mind
Overview

Are there people you think of as naturally smart? It may seem to you that everything comes easily to them or that they always get good grades without even trying. Have you ever wondered whether or not you were smart? Perhaps you've really struggled with something in school and felt you just weren't smart enough to learn it.

Not Smart  | Somewhat Smart  | Smart
Your brain changes when you learn

In the Overview you learned that you can get smarter. Now you will deepen your understanding of how that happens in your brain.

But first, you need to know some basic brain anatomy.
Overview

Just as an athlete develops her muscles to become a stronger and better player by working hard, you develop your brain to become smarter when you concentrate.
“A professional learning community is an ethos that influences every single aspect of a schools’ operation. When a school becomes a professional learning community, everything in the school looks different than it did before.”

– Andy Hargreaves
The Power of PLC at Work, 2007, Solution Tree
Planning for Site Level Work

### Math Coach’s Role

<table>
<thead>
<tr>
<th>Convener</th>
<th>Facilitator</th>
<th>Mediator</th>
<th>Planner</th>
<th>Observer</th>
<th>Technical Asst.</th>
<th>May not be present</th>
</tr>
</thead>
</table>

### Teacher’s Role

<table>
<thead>
<tr>
<th>Reluctant participant with limited engagement</th>
<th>Committed participants and leaders who take responsibility for contributing to group</th>
</tr>
</thead>
</table>

### Principal’s Role

<table>
<thead>
<tr>
<th>Sets expectations</th>
<th>May assist with plans</th>
<th>Observes frequently</th>
<th>Provides time</th>
<th>Occasional observer</th>
<th>cheerleader and encourager</th>
<th>Routinely looks at results w/ dpt</th>
</tr>
</thead>
</table>

### Time

| Special time has to be identified to do the work | The work is ongoing and becomes part of the ongoing routine of doing business. |
Think about who should fill these roles in your school:

Planner(s):

Facilitator(s):

Leader of Technical Processes (scoring work, for example):

Time (frequency and time of meetings, including specific dates):

Meeting Convener (person who notifies teachers of meeting):

Agenda: Following are some suggested items that you may wish to address during the first meeting –

- Setting expectations for the work (the principal should do this)
- Setting norms for meeting behavior
- Sharing the Action Planning Cycle
- Establishing time and dates for meetings
When is a School a Professional Learning Community?

1) When the teachers take ownership of all aspects of learning.
2) When professional learning is the culture of the school.
3) When the major focus is on student thinking and learning.
4) When the teachers embrace the work of managing a major dilemma or change.
5) When there is a cultural shifts that occurs as a school decides to take action to ensure all kids learn by becoming a PLC.
"The process of change is inherently constructivist. Any reform that is merely implemented will eventually recede rather than taking root. Each school community must struggle with new ideas for itself if it is to develop the deep understanding and commitment needed to engage in the continual problem solving demanded by major changes in practice."

Linda Darling-Hammond 1997
"Don't be encumbered by history-- go off and do something wonderful."

Dr. Robert N. Noyce
Inventor of the Silicon Chip
Co-founder of Intel
For a copy of the PowerPoint, download from:

www.noycefdn.org/math/resources.htm