Practices Worthy of Attention

Mathematics Coaching

Silicon Valley Mathematics Initiative

San Francisco Bay Area

Summary of the Practice. The Silicon Valley Mathematics Initiative (SVMI) has a project focused on mathematics content coaches, developed on the idea that improvements in students' mathematical achievement are based on improved teacher mathematical and pedagogical content knowledge. Coaches are experienced teachers working individually with less-seasoned teachers on improving their mathematical teaching and learning. Coaches provide hands-on and individually tailored professional development for the teachers at least 20 times per year, while also engaging at least monthly with other coaches to improve their own teaching and coaching methods.

Need. Previous mathematics professional development in the Bay Area did not focus on individual teacher needs, given that training was usually provided in large groups. As a result, teachers sometimes did not readily adopt the strategies or techniques due to a lack of full understanding and/or follow-up guidance for how to do so. SVMI decided that teachers needed coaching with a mathematics emphasis to help improve their pedagogy and the ways they can engage more students into mathematics learning.

Goal. The goal of SVMI's content coaching is to develop mathematics leaders and teachers with strong mathematical and pedagogical content knowledge that translates into improved instructional practice and better student learning.

Description of the Practice

Silicon Valley Mathematics Initiative's (SVMI's) theory of academic coaching is based on their belief that the key to improving student achievement is improving instruction through intensive hands-on professional development for teachers. SVMI has developed a set of tools for training mathematics coaches to model the behaviors they hope their teachers will employ in their classrooms throughout the San Francisco Bay Area, which encompasses a demographically diverse set of at-risk youth.

Coaches are usually experienced teachers with strong content knowledge, released from their regular teaching responsibilities. Their role includes the use of a variety of strategies to engage teachers in revising their practice, including modeling and team-teaching. The main job of the coach is to get teachers to focus on student thinking and mathematical pedagogy. The coach works with teachers in and out of the classroom on analyzing student work, reviewing and exploring mathematical concepts, reviewing and revising lesson plans, and reflecting on a lesson after the coach's observation.

Coaches do not target brand new teachers; rather, they focus on teachers who have been in the field a few years and are interested in improving their mathematics pedagogy. Since the teachers have some experience, the coaches can work on deepening the teachers' mathematics

knowledge and teaching skills, rather than getting sidetracked with more basic skill development.

Coaches meet as a group at least monthly throughout the academic year. These meetings are co-led by SVMI staff and one of the more experienced coaches. These meetings provide professional development for the coaches so they are continually expanding their own repertoire of skills. Coaches use these meetings to share ideas about mathematics content, teaching strategies, and learning theory. They can also focus on administration and analyses of performance exams, address issues with administrative policies, or analyze specific mathematics lessons.

Coaches also participate in a five-day coaching institute led by SVMI staff. Each coach chooses five teachers with whom he or she will work most intensively during the academic year. This institute helps coaches and teachers build a relationship before the beginning of the academic year. Each team of six examines mathematics across strands and grade levels in California's standards, aiming to build their understanding of what content their students will have learned in previous grades and what they will be expected to learn in later grades.

Building teacher capacity is key in SVMI's vision of coaching. SVMI wants the coaches to encourage teachers to adopt new frameworks for thinking about their students' mathematics learning; this, they hope, will help teachers learn to assess their own instructional practices and make changes where needed. To accomplish this, coaches encourage teachers to reflect on their practices and ask the teachers open-ended questions to keep them focused on specific goals. This type of questioning models for teachers how to assess their own practices. If a teacher has a misconception about aspects of the content, the coach can help the teacher reflect upon this in their meetings by having the teacher use logical arguments to derive correct mathematical understanding of different ideas. Teachers can then use this same technique with their students who are struggling with competing rationales for understanding math concepts.

The mathematics coaches tend to relate to their teachers in one of three ways—as a collaborator, a model, or a leader. In the collaborator role, coaches are a resource to the teacher, providing materials, information, and encouragement and working collaboratively in planning lessons. In this role, coaches do not give direct feedback about the teacher's pedagogy, but focus more on student work, which makes the teacher feel less defensive about being evaluated or criticized. In the model role, coaches model instruction of deep problem-solving tasks for students. Teachers can use this model lesson as a guide for how they might develop their future lesson plans. As a leader, the coach guides the teacher in nonevaluative ways. For instance, the coach's comments are grounded in what was just observed—what the teacher understood about how well the lesson went and what students seemed to learn. The coach then helps the teacher problem-solve how to address the content the students did not seem to understand well.

Coaches tend to meet with each of their teachers at least 20 times per year; the majority of that time is spent supporting in-classroom teaching. The general structure of each of the 20 visits includes a pre-conference, observation of a lesson, and a post-conference. In pre-conferences, the purpose is to focus the lesson both for the teacher and the coach. This time

can be used to clarify the lesson plan and the key ideas to be taught, which provides the coach with the teacher's understanding of the mathematics content. This time can also be used to strategize ways to address students' misconceptions and to help students who are having difficulty with mathematics thus far. The coach then observes the lesson discussed in the pre-conference, focusing on what was discussed in that meeting. After the lesson, the teacher and coach meet so that the coach can provide feedback. Coaches encourage teachers to reflect on the lesson, examining student thinking and work as evidence, to help inform and adjust future instruction. By focusing on student work, teachers can get a better sense of what students understand or what skills still need to be developed.

Results

Coaching shows promise for improving teachers' pedagogy and students' mathematical learning, whether the focus of the coaching is on teacher change or student change. Through this coaching model, teachers are still focusing on the mathematics content they are asked to teach. They are better equipped at understanding what their students know, and how to shape and reshape their instruction based on student understanding. Teachers spend time talking with their coach about student work, and find evidence of what students have learned rather than use anecdotal information to gauge students' understanding.

Not only do there appear to be changes in teachers' practices, but these changes also appear related to improvements in student learning. Table 1 shows the pass rates on California's large-scale assessment test in mathematics, the California Standards Test (CST). In the table, the treatment group includes 33 teachers who had intensive SVMI coaching, and a control group includes 51 teachers who did not. Teachers who engaged in professional development through SVMI coaching had a higher percentage of students passing the CST than those who did not. Although the difference between the two groups for grade 6 is minimal, the results for grades 7 and 8 and for Algebra I are significant.

Table 1. Pass Rates on the Mathematics Portion of the California Standards Test (CST)

Grade/Course	Percentage of the Non-SVMI Coached Group's Students Passing	Percentage of the SVMI Coached Group's Students Passing
6	42	44
7	29	49
8	15	25
Algebra I	52	70

In addition, the longer students were involved in classrooms with teachers who had SVMI coaches, the more likely they were to meet the standards on the Mathematics Assessment Resources Service (MARS) exam. The MARS exam is a performance assessment at each grade level, made up of five tasks. These five tasks assess concepts and skills at each grade level in addition to problem solving, reasoning, and communication skills. Teachers are involved in scoring these performance assessments and talking about the depth of student learning as part of their professional development.

Figure 1 shows the performance of a cohort of 152 students in grades 4–7 on MARS taught by SVMI teachers. Before coaching began, only 30% of students met the standards, compared with almost 100% of students who were in classrooms with SVMI teachers for three years.

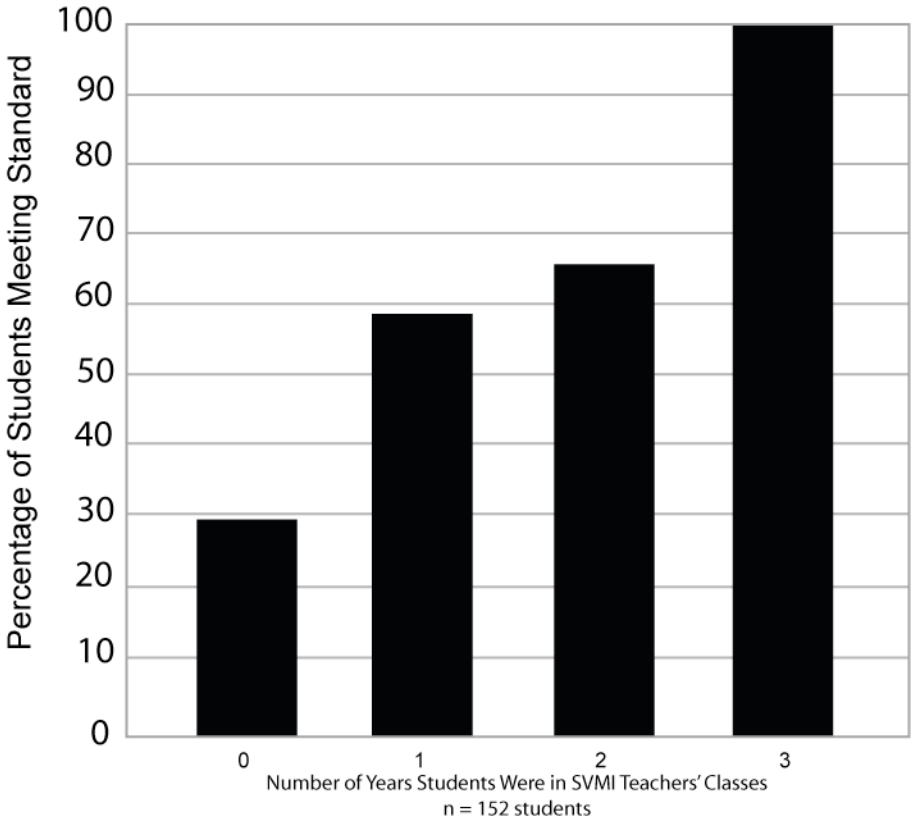

Figure 1. Percentage of Students Passing MARS Based on Length of Time in SVMI Classrooms

Conclusions

SVMI's mathematical content coaching appears to show improvement in student learning, both on standardized tests like the CST, which measure more computational skills, and performance assessments like MARS, which measure higher-order problem-solving techniques. Students in SVMI districts are showing improved performance over students in districts outside of SVMI. Although there are no direct measures of teachers in these results, it appears that teachers' practices are changing and are related to growth in student learning. A future study may include an evaluation of the coaches and teachers, to get an understanding of the level of implementation across coaches as well as across teachers and conduct a more fine-grained analysis of what is working.

About *Practices Worthy of Attention: Local Innovations in Strengthening Secondary Mathematics*

Practices Worthy of Attention is a joint initiative of Achieve, Inc. (www.achieve.org), and the Charles A. Dana Center at The University of Texas at Austin (www.utdanacenter.org). The initiative is led by Pamela L. Paek, a research associate at the Dana Center, who, in 2006, examined 22 program, school, and district practices that showed promise—based on early evidence and observation—of strengthening secondary mathematics teaching and learning.

Our goal was to document practitioners' descriptions of *what is really happening* in the field to strengthen secondary mathematics education around the country. Thus, while the practice highlighted may be common, the specific structures and strategies used to implement the practice are worthy of attention. These initial investigations set out to mark these practices for future rigorous scientific inquiry by Dana Center and other researchers.

Ultimately, we hope to create a community of inquiry made up of university researchers working with administrators and teachers from featured schools and districts to more rigorously research how effectively these practices improve secondary mathematics learning for all students.

Reports and practice profiles. An executive summary details the methods for this initiative and analyzes themes. Two cross-case analyses discuss specific strategies for raising student achievement and building teacher capacity. Brief profiles describe each practice. All of these publications are available on our website at www.utdanacenter.org.

Data. In all cases, data about the practice were provided by the program, school, or district studied as part of a description of their practice. We did not independently analyze data gathered through a consistent assessment tool, and we did not evaluate their uses of data for measuring effectiveness. Thus, the data in the practice profiles are intended not to prove the practice's effectiveness from a research perspective, but to paint a detailed picture of the practice and what data were used by the program, school, or district to gauge how well it was working.

Theoretical frameworks. In some cases, district staff mentioned specific literature on theory or practice that they used when they developed the practice we highlight. In those cases, we cite that literature in our discussion of the practice.

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