

Mathematics Professional Development Models for K-12 Mathematics Teachers in California

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This paper discusses three of the professional development programs that are currently implemented by the Central California Mathematics Project housed at California State University, Stanislaus. The first program supports the classroom teachers' needs by focusing on two types of activities: (i) supporting teachers with mathematics academic content knowledge and content specific pedagogical needs; and (ii) assisting teachers to meet licensing requirements in the State of California. The second program is an experimental and innovative professional development model that provides mathematics content knowledge and pedagogy that focus on the California Mathematics Content Standards for fifth and sixth grade teachers. The third – M is for Math Literacy – takes support and assistance to teachers when and where they need it. Several of the schools in the service area are located in rural settings, far away from the university location. Instead of requiring the teachers to commute to the campus for short frequent workshops and seminars on issues in classroom instruction and education, the presenter – teacher leader(s) and/or the university faculty - commutes to the school site insuring optimal participation.

Key words: *Mathematics professional development, Central California Mathematics Project, math literacy, Stanislaus County Mathematics Partnership*

The following is an overview of some of the approaches in providing in-service education to the K-12 mathematics teachers in California. All the models described below stem from my personal involvement as the Director of the Central California Mathematics Project and/or as a Professor of Mathematics at California State University Stanislaus. As part of my teaching assignment I teach mathematics content courses to pre-service teachers – students who are desirous of teaching mathematics at the elementary (K-6) or secondary (7-12) level. The elementary pre-service teachers are required to take nine units of mathematics courses in the mathematics department. The secondary pre-service mathematics teachers are required to obtain a bachelor's degree in mathematics, which include seven units of courses in mathematics pedagogy. For the preservice teachers, these are the courses that serve as a bridge from knowing the content to teaching the content in multiple

ways while providing greater insight into the mathematics principles and conceptual understanding. An in depth discussion of topics in these courses are the building blocks for ongoing professional development of the in-service education for all mathematics teachers.

This article discusses three of the professional development programs under implementation at the Mathematics Grants and Sponsored Programs Office directed by the author. They are: (i) the Central California Mathematics Project; (ii) the Stanislaus County Mathematics Partnership and (iii) M is for Math Literacy.

The Central California Mathematics Project

The Central California Mathematics Project (CCMP), funded by **the** California Department of Education, supports the classroom teachers' needs by focusing on two types of activities: (i) supporting teachers with mathematics academic content knowledge and content specific pedagogical needs; and (ii) assisting teachers to meet licensing requirements in the State of California. The CCMP programs are intended to offer ongoing support and technical assistance to schools to enable them to modify their teaching by designing mathematics lessons and delivery of concepts and skills to raise student understanding and eventually student achievement.

The CCMP is one of the 19 regional sites of the California Mathematics Project (<http://www.cmpso.org>). The California Mathematics Project is part of the California Subject Matter Projects (<http://csmp.ucop.edu/cmp/>), which is a network of K-16 educators who work with teachers, administrators, parents, and students to improve instruction for ALL students in the State of California classrooms. The State of California is divided into 9 regions for the administrative set up of the California Subject Matter Projects. This helps the regional project directors to conduct professional development that is responsive and tailor made to fit the needs of the region. The CCMP, housed at California State University Stanislaus, serves Region 6 – an area of 26,000 square kilometres or about 10,000 square miles, which include Stanislaus, San Joaquin, Amador, Calaveras and Tuolumne counties. The project delivers a variety of professional development courses and intensive leadership institutes for teachers. It offers conferences, symposiums, courses, workshops, and academic camps for teachers, parents, and students. In addition to conducting their own programs, all regional sites also enter into staff development partnerships with schools. The vision of CCMP in-service education programs is to solidify the “mathematics professional development” resources for Region 6. We are recognized as ‘the place’ in Region 6 where school districts turn to for programs on Teacher Leadership Development, Mathematics Content Knowledge/Pedagogy and Mathematics English Language Development.

The CCMP accomplishes the above goals through the following programs/activities:

- Offers courses to develop teachers' content knowledge and pedagogy
- Offers Saturday seminar series to improve teacher knowledge using research-based strategies
- Offers Summer Institutes for subject matter mastery and instructional strategies
- Conducts annual mathematics conference organized by teacher leaders
- Conducts a week-long writers' workshop for teachers in the summer to facilitate mathematical writing of their best lessons for publication
- Conduct short courses to affect teachers in their ability to teach for understanding
- Provide coaching sessions for teachers to pass State mandated tests
- Provides 'tailor-made' technical assistance to schools
- Offers assistance to improve student performance on State mandated assessments
- Conducts 'Dine & Dialogue' sessions at off campus eateries for teacher support
- Facilitates 'Chat & Chew' sessions to increase teacher collaboration and sustain communities of practice at school sites
- Meets with CCMP Advisory Board to engage teacher leaders and administrators in recruitment, retention, and program development and to build and sustain partnerships.

The CCMP's professional development model is intertwined with its goal to develop teachers as learners, as classroom teachers, and as teacher leaders. To quote Denis Waitley, "All the top achievers I know are life-long learners looking for new skills, insights, and ideas. If they're not learning, they are not growing not moving towards excellence" (Waitley, n.d.). One of the reasons many choose the teaching profession is that they are excited about learning and growing. They were good students who learned well in their student days and enjoyed the process of learning new facts, ideas, and concepts. Teaching solidifies the understanding, and the process of dissecting the content and unwrapping the material gives one a sense of euphoria and ownership. Any program to develop teachers as learners has to incorporate a sense of intellectual growth. CCMP activities are planned with this in mind. In order to develop teachers as learners CCMP offers programs and activities. For teachers who are yet to meet certification and licensing requirements, CCMP offers mathematics courses in content, and coaching classes to learn the material for mandated licensing tests. For new teachers CCMP offers one day, and/or half-day workshops to learn a hard to teach concept, skill or lesson. A team consisting of a teacher leader and a faculty advisor teach these workshops. For all teachers CCMP offers a series of Saturday sessions in the academic year. These all-day sessions create an opportunity to learn about current issues in mathematics education from presenters, as well as from each other.

It is important that a classroom teacher is competent in the subject matter and feels confident in imparting that knowledge to the pupils. In order to facilitate this, CCMP provides workshops on strategies in teaching Mathematics English Language Development (LoMonico & Saldutti, 2007). It also provides assistance to low performing schools by empowering teachers with strategies on how to address the need of multi-grade level students in the classroom, strategies to teach, review and re-teach number sense and algebraic thinking. Two of the Saturdays are devoted to topics on classroom management, which include all aspects of a teacher's day in the classroom. This is led by a panel discussion with 4-5 teachers covering a variety of topics.

The impact and effectiveness of the CCMP's professional development will be evaluated by collecting evidence from the attendees of CCMP courses, workshops, and colloquium series) to the three Research Questions. (1) Are teachers prepared to teach according to the California Common Core State Standards? (2) Have the teachers' teaching strategies changed? (3) Have the students' assignments changed?

The project personnel will collect as evidence: (1) teachers' self-reports (portfolios, diaries, questionnaires, catching a moment of change), (2) interviews with teachers, (3) pre-post tests for teachers, (4) in class – observations, (5) questionnaires and tests for students and (5) samples of student work.

The Stanislaus County Mathematics Partnership

This is a comprehensive and intensive professional development model designed to provide Mathematics content knowledge and mathematical pedagogy that focus on the California Mathematics Content Standards for fifth- and sixth-grade teachers with an emphasis on research based pedagogical strategies. This is a three-way partnership between California State University Stanislaus (Higher Education Institution), Ceres Unified School District (consist of 7 secondary and 11 elementary schools) and Stanislaus County Office of Education (Lead Educational Agency). This is a three million dollar three-year program (September 2010 through May 2013) funded by the Department of Education through the Mathematics and Science Partnership Initiative. The SCMP project has three goals: (i) improve student academic achievement and grade level proficiencies in mathematics by improving teacher subject matter knowledge and instructional strategies; (ii) promote systemic change for improving mathematics professional development among schools, districts, county office of education and university partners; (iii) improve student attitudes toward mathematics. The project includes 158 fifth- and sixth-grade mathematics teachers separated into a treatment (102) group and control (56) group and their 3,000 students. The longitudinal study of this project, which calls for a three-year

commitment by teachers, is a significant addition to mathematics educational research.

This model has three components: (i) 40 hours of a week-long professional development in mathematics content and pedagogy offered during a one-week summer institute; (ii) 32 hours of lesson study in two cycles of collaborative lesson planning, implementation, observation and reflection; and (iii) 12 hours of individualized support (peer coaching) to create and work toward professional goals. The result is the creation of a comprehensive program that includes professional development training through the following elements: 1) improved content knowledge; 2) pedagogical knowledge focusing on mathematical discourse and multiple representations; 3) the use of student assessment data to guide instruction; 4) lesson study implementation and practice; and 5) instructional coaching.

Each of these strategies, individually and collectively, is based on documented research and proven to be effective in improving student achievement. By combining these strategies into a comprehensive, well-designed and sequenced program, we are able to create an environment for teaching and learning that fosters a continual increase in student achievement gains. The design and strength of this professional development model is drawn from research, which show that coaching “can be applied with good promise to professional development in which the objective is substantial improvement in knowledge, skill, and transfer of training into the classroom,” (Joyce & Showers, 2002). Teachers ability to “analyze student work and to make inferences about students’ thinking can lead to significant changes in teachers’ practices,” (Hiebert & Stigler, 2004). “Adding a component of training that increases content knowledge among teachers has been documented as one of the most critical aspects of why students’ understanding of mathematics concepts varies from teacher to teacher among the same grade levels.” (Desimone, 2009). Furthermore, adding training in the area of pedagogical knowledge, which focuses on mathematical discourse that includes questioning strategies, student-to-student conversations, and speaking and writing, are critical to how teachers can effectively deliver instruction that builds students’ conceptual understanding of mathematics. Mathematical discourse also includes the use of multiple representations – as representation is central to the study of mathematics. “Students can develop and deepen their understanding of mathematical concepts and relationships as they create, compare, and use various representations,” (National Council of Teachers of Mathematics, 2000). Lastly adding Lesson Study training and implementation gives each teacher the opportunity to develop practices that become “second nature” in their instructional style and delivery. Lesson Study “creates a culture of examining and learning from practice...and encourages life long professional learning” (Chokshi & Fernandez, 2005).

Based on the results of the three-year evaluation, the researcher found that the SCMP made excellent progress on Goals 1 and 2. The students and

teachers developed more content knowledge, and teachers displayed more understanding and use of the pedagogy supported. The data shows that teachers are using what they have learned and the student achievement has shown some improvement, especially in the area of Algebraic Ideas. The higher education faculty revealed clear use of grant content and pedagogy.

There were a few inconsistent patterns of change in the CST (California Standards Test) scores, which may be attributed to several possible reasons. First, while, the students were observed by many groups of teachers and coaches in lesson study, their responses to the CST items were not as strong as might have been expected. This may be due to the nature of the CST items (the test is several years old and reflects differing views of mathematics instruction, reasoning and problem solving). In addition, most of the test questions addressed content that was not the focus of the grant.

While, students generally seemed clear about the usefulness and importance of mathematics, they were much less positive about their own confidence in “doing math.” Work on this issue was initiated with teachers at the 2011 Summer Intensive and continued in the 2012 Spring. In addition, during Year 3, the teachers worked with coaches in the lesson study sessions to explore ways to help students to raise their levels of confidence in “doing math.” Finally, the evaluator worked with the grant statistician, who was a Mathematics Department faculty member, to increase the responses obtained from students and faculty.

M is for Mathematics Literacy

The program, ‘M is for Mathematics Literacy’ is one of our newly conceived mathematics education program for classroom teachers in our service area. Another way of looking at this would be as a ‘CCMP Professional Development on Wheels.’ In a nutshell this program offers classroom teachers the support and assistance they need when they need it and where they need it by taking the university to the school site than have the teachers come to the university site. It came out of the need for the low performing schools desire to get the entire school community involved in raising the standards of the school performance. Since several of the schools in the 10,000 square miles area we service are located in rural settings and far away from the university location, we were forced to come up with a model that will insure optimal participation. Rather than require the teachers to commute to the campus for short frequent workshops and seminars on issues in classroom instruction and education, the presenter – teacher leader(s) and/or the university faculty - commutes to the school site.

Presently CCMP is servicing three schools under this model. As we increase the capacity and available resources, and fine-tune the mechanics of offering the right mix of content, pedagogy, and support to the participating schools, we will be adding more. What makes this model unique is its three-

pronged approach, which integrates several of the building blocks of creating a community of learners. The program has (i) monthly/biweekly (based on need) mathematics content and pedagogy session for teachers (tailored to grade level and/or individual teachers); (ii) university students tutoring pupils at the school site and (iii) monthly parent sessions where parents learn how to help their children do well in schools.

One of the goals of the Math Literacy Project is to empower the parents of low performing pupils in primary grades with skills and strategies to help their children in mathematics and academics. Many of the parents in low performing schools that CCMP services are first generation immigrants who are not aware of the rights and responsibilities of parents in American schools. They come from a culture where teachers are revered and schools authority is seldom questioned by parents and guardians. In the United States, democracy is at work in every facet of life and schools are no exception. We inform parents that they are active participants and partners in their child's education and are welcomed by the teachers and school administrators to discuss the performance - or the lack thereof - of their children. The teachers, school counselors and principals work in tandem to help the child rise to its highest potential.

I conclude this section with an answer to two questions. The first is, 'who is a classroom teacher?' For the purpose of this article, a classroom teacher is a person in the classroom with a teaching credential and an employment contract with a job title as 'teacher.' The second question is, 'What is a classroom teacher's job?' The enormity of the teachers' responsibility is not well understood by the public at large. The following quote from Donald Quinn on teachers and teaching sheds some light in answering this. "If a doctor, lawyer, or dentist had 30 people in his office at one time, all of whom had different needs, and some of whom didn't want to be there and were causing trouble, and the doctor, lawyer, or dentist, without assistance, had to treat them all with professional excellence for nine months, then he might have some conception of the classroom teacher's job" (Quinn, n.d.).

Conclusion

The three professional development models evolved over the past 26 years of CCMP's involvement with area teachers. During the first fifteen years of CCMP we had a model that was aimed to train Teacher Leaders. The Project received State funds to conduct a four-week Summer Institute for 32 teachers who received a generous stipend to attend the program. The model required the teachers to come together during the academic year for four follow-up sessions. The plan was for these summer participants to be leaders at their school sites. It soon became apparent that all teachers needed professional development and the model did not meet the need of the majority

of the schools. The need for greater professional development for all teachers became a reality in the mid nineties as the number of students who came to post secondary institutions without adequate mathematical skills showed a marked increase. This also forced the educators to come up with models that met the regional needs.

I conclude this brief paper with a few words on some of the strengths and weaknesses of the three models discussed above. The programs and activities of CCMP are exactly what teachers from our region need and want. Implementing these models for optimal effect requires time, commitment and money from the project, university, and the schools. Consequently no school or district has been able to continue it long enough to reap the full benefits. The advantage is that as these activities are conducted at the University and frequently - as there is at least one professional development program each week (sometimes there will be three) – each teacher can always find something to choose from that fits the individual’s need. Teachers can also earn professional growth units for attending the sessions. The disadvantage is that these sessions are held after school hours, which require the teachers to give up their weekends or evenings to attend them.

The Stanislaus County Mathematics Project is well focused and targets teachers who are in 5th and 6th grade. The duration of the project, its rigor, and the support – both academic and financial – that teachers receive are excellent. The teachers have to commit to be involved in SCMP for three years, which allows for significant growth in teachers’ understanding of mathematics. Since there is no funding to continue the program at the end of three years, there is no guarantee that the majority of teachers and students will retain much after five years.

M for Math Literacy has a lot of potential to impact the mathematical achievement of all students. The disadvantage is that the university students are not always paid for their tutoring time and commute to the site, which is a hardship in sustaining this component, as most university students have to support themselves. The benefit is that the university students who tutor at school sites use their academic skills and knowledge to meet school and community needs (Wade, 2011) and learn to serve their community. On the whole this is a very powerful model as it brings together all the stakeholders – educators, parents and students – in educating a child and holds each one valuable and responsible.

Author’s Note:

The author would like to thank the agencies below for providing funds and express her gratitude to the individuals listed below:

- California State Department of Education Grant for providing the major funds to support the Central California Mathematics Project.

- U.S. Department of Education grant through the California Mathematics and Science Projects to support the Stanislaus County Mathematics Project.
- Dr. Millie Murray-Ward, Professor, California State University, Stanislaus, Project Evaluator of Stanislaus County Mathematics Project.
- Dr. Bjorg Johanisdottir, Assistant Professor of Mathematics for providing the Research Questions for the Central California Mathematics Project.
- Dr. Shuhua An, Director, Graduate Program in Mathematics Education California State University for making this publication possible.

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