Successful Long-Term Professional Development

Experience and research suggest that effective professional development models have some common characteristics. Effective, professional development

- Begins prior to curriculum implementation and continues through several years of implementation.
- Is centered on the particular curriculum that will be/has been adopted, in this case, CMP.
- Develops teachers’ knowledge of mathematics and pedagogy.
- Models and reflects good mathematical pedagogy.
- Addresses teacher concerns about change.
- Involves teachers in reflecting and planning for improvement.
- Creates strong leadership.
- Includes a plan for training new teachers as they join the district.
- Reflects strong support from administration and parents.
- Establishes an expectation among teachers of working together to learn from and with each other during and after the formal professional development has ceased.

Change in itself can be problematic and the changes for some teachers associated with using any standards-based curricula are significant. The Concerns-Based Adoption Model (CBAM) (Hall & Hord, 1987, Hord, et al. 1987, Loucks-Horsley, 1989, Friel and Gann, 1993) offers help in addressing these issues. Teachers may need help moving through levels of concern, from non-awareness to ownership of new ideas, from a focus on themselves and their own needs to a focus on their students’ learning needs. The stages of concern can be described as

- Self-concerns—What is this new change and how will it affect me?

  - Task-oriented concerns—How do I implement this change? What do I need to do to make this change happen with my students?

  - Impact-oriented concerns—How are my students learning? Are they learning more and are they learning better? How do I work with others who are also implementing these new ideas?

Progressing through these stages of concern while one is implementing CMP takes time—two to three years is a good target.

The change process is ongoing with different needs surfacing during the period of professional development and implementation. Early in the professional development component, time is needed to address teachers’ concerns about implementing CMP. In the beginning these concerns may tend to focus on management, grading issues, special needs students, tracking, skills, transitions to high school, etc. While these issues are important and should be addressed, they can divert attention from content and instruction. These concerns can be addressed gradually during the first phase of professional development. Let teachers have time to get their concerns on the table early in the process and be assured that these concerns will be addressed. Many of the concerns become less urgent as the teachers engage in studying the mathematics and sharing their knowledge with colleagues. These experiences help teachers integrate previous teaching practice with new expectations.

Good professional development to support a standards-based curricula like CMP weaves mathematics, pedagogy, and assessment together. To make significant changes, professional development must address teachers’ stages of concerns and concurrently provide opportunities for growth. Growth should focus on

- Developing a deeper understanding and broader view of mathematics (mathematical knowledge).
- Strengthening teachers’ pedagogical knowledge (teaching & learning).
Professional development must be based on sound criteria and principles that have evolved from research and been verified in experience. The research discussed above as well as other research described by Loucks-Horsley et. al (1996), the extensive experiences of the CMP authors and staff, and the Professional Standards for Teaching Mathematics (NCTM 1991) serve as important references for our professional development design. Examples of professional development plans are available on the CMP Web site. See www.math.msu.edu/CMP: Professional Development.

Three components—content, teaching and learning, and assessment—are core areas of the professional development model and each comes to the foreground at critical times during the professional development. Below is a rationale for the components that need to be included, and an order of inclusion that has been successful.

**Mathematical Knowledge**
An effective professional development model associated with preparing for and implementing CMP begins with an emphasis on mathematical content, with supporting pedagogy being modeled by the professional development leader. Teachers need to be comfortable with the mathematics embedded in the problems in order to begin to examine how the materials can be taught to reach their full potential.

Teachers benefit from examining the complete picture of how mathematical ideas build on previous ideas and how those ideas in turn provide the foundation for the mathematics in later units and in subsequent grades. Even teachers who have taught mathematics for some time will find that ideas that they have accepted without questioning are presented in a new light, one that illuminates both meaning and connections to other mathematics and to other uses of the mathematics. There is value in trying to see mathematical ideas as they are first encountered by a student, rather than reproducing what has been stored in memory. Asking, “*How do I know this? Why does it make sense?*” are not questions that teachers typically take the time to ask about familiar mathematics, yet they are at the core of understanding how students learn new material.

Good instructional decisions and practice rely on deep understanding of the mathematics that is embedded in the problems. We suggest that developing the mathematics of the units in early professional development be given primary focus, with any pedagogical discussions focusing only on how to help students learn the mathematics. Discussions of management and assessment are more effective if they occur toward the end of the early professional development. First developing mathematical and pedagogical content knowledge keeps the professional development from becoming mired in discussions of issues that as yet have no real basis for a substantive conversation.

**Teaching and Learning**
Having developed a better understanding of the mathematics within CMP, the focus of professional development can shift teaching and learning to the foreground. Teachers need to experience inquiry-based pedagogy in their professional development so that it will serve as a model for their own teaching. They also need to be involved in sufficient conversations about teaching problem-centered materials to feel comfortable during implementation.

More in-depth work on instruction after teachers have experience in teaching units is needed and is very effective in improving teacher practice. The idea that teachers should be encouraged to reflect upon, revise, and refine their initial understandings of the mathematics in a unit, and of ways to teach, after practical experience parallels the learning process that is expected of students. It is worth noting that when the focus shifts to pedagogy, teachers continue to develop their own understanding of the mathematics through conversations that analyze student work and assess student understanding.

While the teacher and student books serve an important role in helping the teacher implement the curriculum within their classroom, teachers also need time away from their classroom to talk with peers and to fully investigate the potential of the curriculum.

**Assessment**
Once teachers have begun using inquiry-based instruction in CMP, it becomes clear that traditional forms of assessment that focus only on skills may be insufficient to gauge the depth and breadth of student learning. CMP offers a variety
of forms of assessment to support teachers, including embedded assessment, which may be unfamiliar to teachers.

Orchestrating different types of assessment requires new skills for teachers and should be included in the professional development program. Figuring out how to assess and how to grade assessments is a concern of teachers that tends to arise as implementation progresses. Therefore the time for assessment to be an emphasis in professional development is after teachers have experienced some of the curriculum. Equally important is the influence of assessment as evidence to promote teacher reflection and decision making. For example, with support and experience, teachers begin to see assessment as data to drive instructional decisions.

**Contexts for Professional Growth**

The activities of a strong professional development program for teachers implementing CMP emphasize four areas.

- experiencing
- planning
- teaching
- reflecting

**Experiencing**

First and foremost, to implement a problem-centered curriculum like CMP, teachers need deep understandings of the key mathematical ideas and ways of reasoning that are embedded in solving the problems within a unit. In addition, they need to see how understanding of these ideas develops over time and connects to content in other units. Thus, during the workshops (or whenever teachers are being introduced to a new unit), teachers should experience the curriculum in a way that is similar to what their students will experience. This does not mean they need as much time for each problem, nor that they must do every problem. Problems for the workshops should be chosen to highlight the development of key mathematical ideas. The supporting problems can be more quickly examined so that the flow of development is clear, but the main focus is on the key idea.

Professional development leaders should model good teaching; they should set a context for teacher learning, encourage teachers to investigate, and help teachers make their conclusions explicit. This allows teachers to focus on making sense of the mathematics needed to solve the problems posed. By setting the context as, “*How do you think your students might solve this problem?*”, the workshop leader can shift the focus to students’ understanding. Teachers should be encouraged to make a good faith effort not to superimpose their own store of remembered knowledge on to each problem. The goal is not so much to find answers to the problem as it is to ask, “*What would my students bring to this problem? What solution strategies might they try? Which seem productive and rich in mathematical ideas? What are some of the misunderstandings that students might evince, and how can I best use discussions around these misunderstandings to help everyone learn more?*”

Some teachers may think that the problems, or the mathematical ideas, are too hard. A powerful strategy for helping teachers with the mathematics and showing what students can learn is to use examples of student work. This alleviates the anxiety of teachers who have never learned or understood the mathematics in the problem, or have no confidence in their ability to do the mathematics. It allows teachers to ask questions they might be reluctant to ask. In such an environment teachers can and do learn the mathematics of a unit. Positioning the mathematics and the teaching through the lens of the student helps provide a comfortable environment for discussions of teaching and learning of the mathematics.

Through follow-up discussions of the problems, the mathematical potential of the problems, the reasoning that students employ, and the connections that can be made become more explicit. Through such interactions teachers begin to value such questions as, “*What is the mathematics? At what stage are we in the development of understanding of the key idea? What do students need to bring to the problem? To what do these ideas connect in a student’s future study of mathematics?*”

While effective teaching strategies are modeled and occasionally discussed during the study of a unit by the participants, it is most effective if attention to teaching becomes explicit in the professional development. Teachers will need help with the teaching model. Knowing how to launch a problem, how to assist and guide all students during the exploration, and how to summarize student understandings and strategies are very
crucial to the development of the mathematics. A good stimulus for discussions on teaching is observation of good teaching, either live in a classroom or on video. Analyzing students’ strategies can lead to conversations on how the classroom environment/discussion may have affected learning. This is also a time for teachers to experience collaborating to make sense of what evidence there is of good teaching. Developing the habit of asking, “What aspects of the launch were effective? What aspects of the summary were effective? How would I address that student question?” prepares teachers to make of themselves the same demands.

Planning
Planning is key to success with any problem-centered curriculum such as CMP. Professional development activities should include opportunities to plan collaboratively. Occasionally teachers should be asked to plan together to teach a problem, asking, “What is the mathematics? What difficulties will students encounter? What mathematical discoveries might they make? How will I launch this?” (See page 12.) It is crucial that administrators recognize that, while the planning load reduces somewhat after the initial implementation stage, there will always be a need for teachers to plan lessons and reflect on what students learned from the lessons, and for administrators to help find time for these planning and reflecting activities. This is a way to optimize and continue professional development.

For each class session it is important for teachers to identify the mathematical concepts or strategies, their stages of development, and the time needed to develop these understandings. The power of CMP does not lie in any one activity or any one unit. Important ideas are studied in depth within a unit and further developed and used in subsequent units. It is both the depth of understanding within units and the careful building and connecting of the units that allow students to develop to their fullest mathematical potential.

Initial planning can occur in the first summer, prior to the implementation of the CMP. However, teachers also need time during the year to plan, particularly with their colleagues. Planning sessions allow teachers to share problems they have experienced, learn new ideas from their colleagues, probe the mathematics more deeply, look for connections, and plan upcoming class sessions.

Once teachers are comfortable with the mathematics and inquiry-based instructional model, they are ready to look more closely at assessment and how to use assessment to evaluate students’ knowledge and to inform their teaching. Fuller discussions on assessment are appropriate during the second year of teaching CMP and continued professional development. However, examining student work with a colleague is valuable. Asking questions about what the students’ work shows not only deepens teachers’ knowledge, but it can also serve as a guide to planning effective teaching strategies. Planning also allows teachers time to discuss and share management and grading strategies as well as ways to address the needs of diverse student populations.

Teaching
Teachers need to think critically about creating a classroom environment that fosters students’ expectation that they will work together to solve problems, reason about possibilities, justify their ideas, and solutions, and look for connections. Posing problems that provide a challenge for the students, allowing students to explore the problem and guiding class discussion on the solution of the problems requires the teacher to play many roles at the same time.

Teachers need help in learning how to ask effective questions that can guide and probe students’ understanding, and at the same time they need to learn to listen carefully to their students. These are not skills that teachers, even those with many years of experience, have traditionally practiced. District administrators who take the time to become knowledgeable about inquiry-based learning are better able to support teachers directly. They can help set the expectation that teachers will collaborate and learn from and with each other as the curriculum is enacted.

Setting and achieving high expectations for understanding, problem solving, representing, and communicating for all students is a task that confronts teachers on a daily basis. Reflecting on one’s practice with a lens on student understanding is important for teachers to make progress. Establishing the kind of environment in a school where administrators support and expect teachers to collaborate with each other can change the whole school’s daily focus to such teacher questions as, “What evidence do I have that my students learned something? What did they learn?”
Reflecting on Lessons
Professional development activities should model reflective practices. It is through reflection on their teaching and their students’ understanding that teachers continue to grow in their capacity to build powerful mathematical experiences for all students. Planning with a colleague, peer coaching, observing a peer, or sharing with colleagues are some ways to encourage reflection.

Videotapes of lessons can serve as a catalyst for reflections. Caution must be exercised if videos are used. If a teacher within a building agrees to be video taped, then the focus should be students’ learning rather than critique of the teacher. Centering conversations on student learning is a way to help the teacher think about his or her practice. “What is there about my students’ ways of approaching the problem that I like?” Why do I think this is effective? What should I do to encourage more of this? What aspects of my students’ actions are not productive? Why is this? What can I do to redirect my students?” Finding the fine line between trying to help the students be successful with the problem and allowing the students freedom to explore a more open problem will take reflection and growth over time.

Similarly, using rich collections of student work in professional development activities can focus teachers’ attention on the role and importance of the summary phase of the lesson. When teachers study a collection of student work, some say that all of the solutions are acceptable, or they correct those that are not, and go on to the next lesson. But it is the analysis and comparison of the collection of student work that can bring the important mathematics to the forefront. Student work can also be the way to center discussions and reflections on students’ understandings.

A variety of assessment tools can be used including mathematical reflections, quizzes, unit tests, projects, and district wide instruments. To be effective, discussions on student learning should go hand in hand with discussions on teaching. A focus on student learning leads naturally to looking at the development of ideas over time. Talking and planning with colleagues in different grade levels provides the opportunity for teachers to build and share a coherent curriculum vision. Collaboration and reflection are key elements in creating a community of teachers and administrators within the school that can support improvement in teaching and learning over time.

Teacher’s Guides and Professional Development
The teacher materials that accompany each unit of CMP offer help with the same components that are included in a good professional development program. Part of the professional development should be to model how these materials might be used. But these materials should not be considered a replacement for the professional development necessary to get teachers started and for the district’s support in keeping teachers enthused and learning after the initial implementation phase.

Each unit contains:
- Help with the mathematics—an in-depth look at the mathematical ideas and how these are developed.
- Suggestions for planning effective launches, asking good questions, and leading powerful summaries.
- Suggestions for good assessments and how to manage them.
- Help in working with diverse or special needs populations.
- Connections to prior and future units and assistance in tracking where students should be in their development of key ideas.

If we believe it is a worthy goal to establish a safe and healthy environment in each classroom to enable students to learn together, then it becomes equally important that we acknowledge that teachers need time and opportunities to work with each other. No matter how informative the teacher support materials are, teachers will get more from them if they can plan or reflect with a colleague.