Mathematics Instruction in One School

Impact of RMMSSMP

The Rocky Mountain Middle School Science and Mathematics Partnership (RM MSMSP) is providing mathematics and science content courses as well as 'structured follow-up" courses (SFU). (The purpose of the structured follow-up courses is to support teachers as they implement their learning through changes in instruction in their own classrooms.) These courses are taught collaboratively by university faculty and district science or mathematics instructional experts. Early information about the positive impact of this aspect of the NSF-funded project is beginning to emerge.

Math Focus

Jefferson County, the largest school district in Colorado, is one of the partner school districts included in the RM MSMSP. Everitt Middle School is located in Wheat Ridge, an established area of Jefferson County, where younger families of more diverse ethnicities, languages, and socio-economic backgrounds are taking the places of older, more homogeneous families. The student progress in mathematics has been variable over the past several years. The focus for Everitt Middle School and the Wheat Ridge Articulation Area (which includes Everitt) is to enhance achievement in mathematics. This focus area was based on an analysis of student achievement data for the Wheat Ridge Articulation Area. To enhance achievement in mathematics, this articulation area adopted *Connected Mathematics 2 (CMP2)* for the middle school mathematics program because it is intended to encourage the development of problem-solving skills. Since *CMP2* is a challenging curriculum to successfully implement, the district and the school principal encouraged teachers assigned to teach mathematics to access professional learning in both content and pedagogy.

Teachers Participate in First Content Course(s)

Since *Algebraic Patterns and Functions* was being offered through the RM MSSMP at Everitt Middle School and with a participating teacher stipend, fourteen members of the staff including the principal completed the course. This group of staff included three mathematics teachers, a special education teacher, the media specialist, a music teacher, a technical arts teacher, and a language arts teacher. The participating teachers reported that "content areas are interconnected and that the experience of learning together would move them closer to working as teams" in the *Autonomous Learner Model* that they will be implementing during the 2006-2007 school year. The content course *Algebraic Patterns and Functions* was completed during the fall of 2005, and the SFU was offered during the fall of 2005. The Everitt teachers were offered the opportunity to complete the SFU in the spring, 2006. About six members of the teaching staff are currently completing *Mathematics of Change* during the spring semester of 2006.

Experience of the Participants

The teacher learners from Everitt Middle School were generally positive about their learning experience although they were generally in agreement that the course was rigorous and required many hours outside of the classroom to master the content knowledge. Two non-math teachers expressed the range of feeling: "I was extremely frustrated by the course and won't take another one." "The *Algebraic Patterns* content

course was very difficult for me since I haven't had a math course since 1971 when I was in high school, but I am now taking *Mathematics of Change*." Two math teachers related the following experiences: "The content was not difficult for me because I have worked as an engineer, but I had never tried to use graphing calculators for applications with seventh-graders. I liked learning about the applications that crossed curricular areas." "I was familiar with the mathematics but not with presenting it in a way that showed the real-world application. Having three instructors for the course also helped honor the varying backgrounds of the teacher learners."

Increased Content/Pedagogical Knowledge

All teachers felt that their own content and/or pedagogical knowledge had been enhanced through their participation in *Algebraic Patterns and Functions.* The non-math teachers indicated that it helped them to gain insight into how they approach learning and therefore how some of their students learn. "I think I can understand where students are not making connections because I was not making some of the same connections. I realized how frustrating that can be." Another non-math teacher said, "It [the course] helped me think about the different ways that people learn. I learned that I have to do the work by myself and not in a group." The math teachers gained different insights through the course. "I didn't extend my actual mathematics content that much, but I got better ideas about how to help students access the content." Another math teacher reported, "I was rusty on some of the content so it helped to refresh the knowledge. Using the graphing calculator to start with a big algebraic idea first and then go backwards to the specifics was the way that I improved my pedagogy."

Impact on Instruction

The principal and each participating teacher reported changes in instruction that seem to be impacting students. The Principal noted that "we are noticing that critical thinking skills in mathematics are beginning to transfer to other subjects." "CSAP [Colorado Student Assessment Program] is not a sensitive measurement so we aren't sure that the mathematics achievement levels in CSAP will begin to show up for a year or two." "We are seeing stronger student engagement. Fewer students are saying, 'I hate mathematics.'" The principal was told by one of the Everitt students that "class went so fast that I hardly had time to collect the calculators."

The mathematics teachers reported the following as impacts on their instruction and/or relationships with students: "I am more willing to take risks in using the graphing calculator and help my students take the "error" out of computation. I have more confidence in allowing kids to try richer problems. This is a stretch to get beyond the drill and practice." "I tutor better because I have a better idea of the students' frustration. When the students do 'get it,' it is exciting."

Not all non-math teachers felt that the impact on their instruction justified the commitment of time to complete additional courses. "I think people have a math maturation level. I understand my students' frustration in learning mathematics because I experienced it. I don't think the higher level mathematics serves much purpose for middle school teachers who are not assigned math or science courses. The math and science people loved the class."

The Principal observes that teachers are all feeling more capable so they feel more comfortable assisting students. The staff have "worked miracles" in sending the message to students that they are capable of learning high level mathematics skills. She is also

observing that teachers have learned through teaching the *Connected Math* curriculum and the *RM MSMSP courses* to make mathematics lessons more relevant. Examples of meaningful lessons included *Building Ruffy a Dog Pen*. The pens were designed based on the type of dog and that dog's characteristics. Students are also using the graphing calculators. Lessons using the graphing calculators have been rigorous, relevant, meaningful, and engaging.

Indirect or Unintended Positive Impact on Students

"Because several of us (teachers) are taking the courses together, it becomes a topic of conversation. Students are intrigued by the fact that the adults in our school are taking a class 'for fun' and doing homework. The students have a hard time understanding why a language arts or music teacher is taking a math course. The modeling of life-long learning has made an impression on the relationship of being an adult and learning. Some students also note that teacher learners may not be proficient at everything but that they still work to understand concepts that are more difficult."

Impact on Relationships among Teachers

Teachers expressed in various ways that their relationships with each other had been enhanced through completing a mathematics course together. Examples of their comments follow:

- "Because we took the course together, helped each other with homework, and had dinner together, we got to know each other better. We also added another dimension of knowing each other professionally."
- "It was very positive in building collegial relationships. I learned about others' strengths and non-strengths which gives us a whole new focus for conversation."
- "Although three of the four of us [math teachers] took the course, I would like for all of us to have taken it. The non-math teachers showed me how different their approaches are to teaching and their strengths and loves."
- "Our camaraderie was enhanced from facing the challenge of the mathematics course and crying about it together."
- "Although we didn't develop lessons together, we helped each other with homework and positively impacted our communication and personal relationships."

Impact of Team Approach

The participating staff members were unanimous in concluding that their participation had been enhanced by taking the initial course with colleagues.

- "We were able to see that teachers approach problem-solving in multiple ways. I think mathematic teachers have only one vision, maybe more linear than others. It helps mathematics teachers understand the approach of more of our students. As teachers, we were doing what we hope the kids will do which is talk, argue, discuss, and eat while doing our homework. The band teacher gave me a graphing problem; he had information on two different fund raisers. The students could compare the results in terms of money-making. Also, we rarely talk about mathematics to others. It gave us a chance to have the appreciation of our expertise and to appreciate that of other teachers in the building."
- "I was able to see how others approach problems. Language Arts teachers don't approach problem-solving in the same way I do. I don't always have the range of

approaches needed by students with a similar approach as that of the Language Arts teacher. The disadvantage [to taking the class as a team] is the level of frustration among some of the non-math and science teachers who had never heard of such common knowledge mathematics memory cues as FOIL (first, outer, inner, last) for multiplying polynomials."

- "It was good to learn that some people who don't teach in math and science do have strengths in those areas."
- "Three of the four mathematics teachers are completing *Mathematics of Change* (calculus) which gives us more common ground and more reason to have conversations about applying the math. We have more common ground across grade levels in mathematics. The advantage to me in having other teachers (outside of math) take the course together was that I got to see different ways of approaching problem-solving and how hard the non-math teachers struggled with mathematics."

Sustaining Professional Learning

The teachers varied in their plans to continue taking the courses offered through the grant.

- "I am going to take *History of Mathematics* because I love history and the fascinating characters of mathematics. Maybe I will be a stronger student in this course."
- "I am planning to take *History of Math* next. I may not have time for the Structured Follow-up. I want to continue to make mathematics more relevant/real to kids. The human interest [of topics in *History of Mathematics*] could make mathematics more interesting."
- "I am not taking any more courses because I need to focus on my Master's Program in ELL which is directly tied to my teaching assignment. I would like to take other classes but can't right now."
- "I want to take *Discrete Mathematics* and *History of Mathematics* to learn new teaching techniques, to learn how the subjects can be meshed together, and to increase the connectivity for my students."

The principal highlighted three factors that she predicts will encourage a continuation of professional learning. (1) The interdisciplinary teams truly collaborate and team effectively. The staff members also have a lot of communication among teachers of the same subject. (2) Monthly late starts allow professional learning time. The elective teachers self-select which core area each will join for training. The literacy teacher and the art teacher chose social studies; the physical education and computer science teachers chose science; and the technical arts chose mathematics. (3) In an annual survey of students at Everitt Middle School, the following question is always posed. *What is the best thing about Everitt?* The student responses always indicate that teachers are "kind", "care about me", "make time for me", and "explain things to me."